Revised Final

Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

December 21, 2016

Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Prepared for:

National Guard Bureau
NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
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14. ABSTRACT

The TEC-Weston Joint Venture (JV) is submitting this Remedial Investigation Work Plan (RIWP) in accordance with the Performance Work Statement (PWS), Contract Number W9133L-14-D-0008 Task Order Number 0003 to provide Groundwater and Environmental Investigation Services for the RVAAP-66 Facility-Wide Groundwater Area of Concern (AOC) at the Former Ravenna Army Ammunition Plant (RVAAP); now known as Camp Ravenna Joint Military Training Center (Camp Ravenna) in Portage and Trumbull Counties, Ohio.

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RVAAP-66, Remedial Investigation Plan, RIWP, Sampling and Analysis Plan, Field Sampling Plan, QAPP, Health and Safety Plan, HASP

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Ohio Environmental Protection Agency

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

March 2, 2017

Mr. Mark Leeper, Acting Chief
ARNGD-ILE Clean Up
Army National Guard Directorate
111 South George Mason Street
Arlington, VA 22204

Re: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage
267000859036

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Approval of the "Revised Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater," Dated December 21, 2016. Ohio EPA ID # 267-000859-036

Dear Mr. Leeper:

The Ohio Environmental Protection Agency (Ohio EPA) has received the replacement and insertion pages for the "Revised Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater" at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This revised information was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) on January 27, 2017. The report was prepared for the Army National Guard Directorate by TEC-Weston Joint Venture under Contract Number W9133L-14-D-0008.

This document was reviewed by personnel from Ohio EPA's DERR, pursuant to the Director's Findings and Orders paragraph 39 (b), Ohio EPA considers the document final and approved.

If you have any questions, please call me at (330) 963-1292.

Sincerely,

Kevin M. Palombo, Environmental Specialist
Division of Environmental Response and Revitalization

KP/nvr

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-Weston Joint Venture (JV) has completed the Final Remedial Investigation Work Plan, including the Field Sampling Plan, Quality Assurance Project Plan, and Health and Safety Plan. 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 data quality objectives; technical assumption; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing National Guard Bureau policy.

12/20/2016

E. Michael Chapa, P.G., TEC-Weston JV — Date
Study/Design Team Leader

12/20/2016

Jim Brackett, PA PMP, TEC-Weston JV — Date
Independent Technical Review Team Leader

Significant concerns and the explanation of the resolutions are as follows:

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Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio

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ARNG = Army National Guard

NGB = National Guard Bureau

OHARNG = Ohio Army National Guard

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LIST OF ACRONYMS/ABBREVIATIONS

3D	three-dimensional
amsl	above mean sea level
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
ARNG	Army National Guard
ASP	ammunition supply point
AST	aboveground storage tank
AWQC	Ambient Water Quality Criteria
BERA	baseline ecological risk assessment
bgs	below ground surface
BRA	baseline risk assessment
BRAC	Base Realignment and Closure
BUSTR	Bureau of Underground Storage Tank Regulations
Camp Ravenna	Camp Ravenna Joint Military Training Center
CD-ROM	compact disc-read only memory
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	constituent of potential concern
COPEC	chemicals of potential ecological concern
CRJMTC	Camp Ravenna Joint Military Training Center (aka Camp Ravenna)
CRM	Cultural Resources Manager
CRS	Compliance Restoration Site
CSM	Conceptual Site Model
dbh	diameter at breast height
DD	Decision Document
DEHP	bis(2-ethylhexyl) phthatlate
DEM	Digital elevation models
DFFO	Director's Final Findings and Orders
DGA	data gap area
DMM	Discarded military munitions
DOT	Department of Transportation
DQO	Data Quality Objective
EBG	Erie Burning Grounds
ECM	earth covered magazines
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESI	Environmental Simulation, Inc.

ESL	Ecological Screening Level
ESV	Ecological Screening Value
FS	Feasibility Study
FSP	Field Sampling Plan
ft	feet
ft^2	square feet
ft/day	feet per day
FWCUG	Facility-Wide Cleanup Goal
FWGW	Facility-Wide Ground Water
FWGMP	FWGW Monitoring Program
FWGWMPP	Facility-Wide Groundwater Monitoring Program Plan
FWHHRAM	Facility-Wide Human Health Risk Assessor Manual
FWSAP	Facility-Wide Sampling and Analysis Plan
GIS	geographic information system
GSA	General Services Administration
GSI	groundwater/surface water interface
GWV6	Groundwater Vistas 6
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
HRR	Historical Records Review
HUC	Hydrologic Unit Codes
IDW	investigation derived waste
IMZM	inside mixing zone maximum
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
JV	Joint Venture
KM	Kaplan-Meier
MC	munitions constituents
MCL	maximum contaminant level
MDL	maximum detection limit
MEC	munitions and explosives of concern
MEK	2-butanone
MMRP	Military Munitions Response Program
MRS	munitions response site
MSR	Monthly Status Report

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	non-detect
NGB	National Guard Bureau
NHD	National Hydrography Dataset
NRHP	National Register of Historic Places
NTU	nephelometric turbidity unit
ODNR	Ohio Department of Natural Resources
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
OMZA	outside mixing zone average
OMZM	outside mixing zone maximum
OSHA	Occupational Safety and Health Administration
OSW	Outstanding State Waters
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PFC	perfluorinated compound
PQL	practical quantitation limit
PRG	preliminary remediation goals
PVC	polyvinyl chloride
PWS	Performance Work Statement
QA	quality assurance
QC	quality control
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-trazine
RGWMP	Routine Groundwater Monitoring Program
RIWP	Remedial Investigation Work Plan
ROD	Record of Decision
ROS	Robust Regression on Order Statistics
RQL	Ramsdell Quarry Landfill
RSL	Regional Screening Level
RTLS	Ravenna Training and Logistics Site
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation

SAP	Sampling and Analysis Plan
SHQW	Superior High Quality Waters
SLERA	screening level ecological risk assessment
SRC	site-related compounds
SRW	State Resource Waters
SSHO	Site Safety and Health Officer
S-W	Shapiro-Wilk
SVOC	semi-volatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
TEC-Weston JV	TEC-Weston Joint Venture
TGMs	Technical Guidance Manuals
TNM	The National Map
TNT	trinitrotoluene
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USP&FO	United States Property and Fiscal Officer for Ohio
USGS	United States Geological Survey
UXO	unexploded ordnance
VOC	volatile organic compound
WAU	Water Assessment Units
WAWP	Well Abandonment Work Plan
WQS	Water Quality Standards

EXECUTIVE SUMMARY

The TEC-Weston Joint Venture (JV) is submitting this Remedial Investigation Work Plan (RIWP) in accordance with the Performance Work Statement (PWS), Contract Number W9133L-14-D-0008 Task Order Number 0003 to provide Groundwater and Environmental Investigation Services for the RVAAP-66 Facility-Wide Groundwater Area of Concern (AOC) at the Former Ravenna Army Ammunition Plant (RVAAP); now known as Camp Ravenna Joint Military Training Center (Camp Ravenna) in Portage and Trumbull Counties, Ohio. The Task Order Notice to Proceed was issued by the National Guard Bureau (NGB) on August 18, 2015. A kick-off meeting was held on September 22, 2015 at Camp Ravenna. An initial scoping meeting was held on October 14, 2015 at the Ohio Environmental Protection Agency (Ohio EPA) Northeast Ohio office.

The primary goal of the RVAAP-66 Facility-Wide Ground Water (FWGW) RI is to adequately characterize pertinent physical and chemical groundwater conditions in the multi-aquifer hydrostratigraphic units variably present across Camp Ravenna, so that potential risks (current and future) to potential human and environmental receptors can be ascertained, effectively managed, and mitigated as needed. The 284 existing monitoring wells installed beneath known and suspected contaminant source areas and at locations upgradient, sidegradient, and downgradient of those source areas, have generally enabled ARNG/OHARNG, the Ohio EPA, and other stakeholders to gain a good understanding of the nature and extent of groundwater contamination at Camp Ravenna. Implementation of this FWGW RI is expected to bolster that understanding and address those uncertainties that may pose the greatest potential risk to potential receptors, and that may inhibit the successful completion of an adequate Feasibility Study (FS). The RI contaminant nature and extent determination and related risk assessment processes will employ the use of “Plume Groups” (collocated restoration sites with overlapping contaminant plumes) to support a holistic, facility-wide determination of residual risk in order to determine if a remedial response is required.

This RIWP has been structured to facilitate Ohio EPA early concurrence on component tasks that will require near-term execution in order to maintain regulatory compliance. Specifically, this RIWP will serve as the 2016 Semiannual Facility-Wide Groundwater Monitoring Addendum required by the June 2004 Ohio EPA Director’s Final Findings and Orders (DFFO). Additionally, it serves to support the overall requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) RI process and goals and objectives of this project including, but not limited to, the delineation of groundwater contaminants potentially migrating off-post and execution of a background study to determine naturally occurring levels of inorganic constituents in the various impacted aquifers at Camp Ravenna.

Planning and performance of all elements of the RI will be in accordance with the requirements of the Ohio EPA DFFO for Camp Ravenna dated June 10, 2004 (Ohio EPA, 2004), applicable Ohio EPA Technical Guidance Manuals (TGMs), and applicable United States Environmental Protection Agency (USEPA) statutes and guidance including Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

An evaluation of the existing monitoring well network was conducted as part of this RIWP to preliminarily determine the usefulness of the well network and identify data gaps that exist. The evaluation was also conducted to support eventual modifications to the well network, which will be comprised of existing wells deemed still useful, and new wells (to be installed as part of the FWGW RI) necessary to fill the identified data gaps. The evaluation also assessed turbidity conditions at all of the existing monitoring wells, with correlations made to inorganic chemistry sample results, to identify which wells merit redevelopment, abandonment, and/or replacement.

The Camp Ravenna monitoring well network is comprised of 284 wells at locations and depths selected based on both location-specific and facility-wide hydrogeologic conditions, contaminant conditions, and potential receptor conditions. Monitoring wells have been installed as part of numerous environmental investigations conducted at those AOCs, CRSs, and MRSs with the potential to impact groundwater quality, and at facility-wide locations deemed crucial for upgradient and downgradient groundwater monitoring purposes. Each of the historical investigations systematically increased the overall understanding of groundwater conditions both locally and facility-wide, with many of the individual wells confirming groundwater contaminants are not present at levels posing unacceptable risks to human health and the environment. A subset of the 284 monitoring wells exhibit constituent of potential concern (COPC) concentrations above regulatory and/or risk-based levels.

As part of this RIWP effort, field measurements of all monitoring well turbidity levels, measured while purging the wells as part of recent quarterly and semi-annual sampling events, were assimilated and assessed. A total of 65 wells may require redevelopment. Decisions on individual well redevelopment needs will be made based on measured turbidity readings obtained during the pending RI.

The identification of monitoring well data gaps required gathering a comprehensive amount of physical, chemical, historical operations, waste handling, remediation, and potential receptor information. Much of this data gathering task focused on the AOC-specific evaluations. In addition, the numerical groundwater flow model developed as part of this RIWP for use throughout the pending RI process was used to bolster the understanding of groundwater contaminant fate and transport conditions.

A total of 191 wells (170 existing and 21 new) will be sampled to support the FWGW RI (and background groundwater study). The background study is being conducted as part of the FWGW RI to determine the background level of metals (and other inorganic/indicator parameters as needed) for all pertinent water bearing units at Camp Ravenna. The revised background well network will be comprised of 10 pre-existing wells and four newly installed wells.

A Conceptual Site Model (CSM) was developed as part of this RIWP to describe Camp Ravenna and its environmental setting (with a focus on FWGW), and to present hypotheses regarding the suspected sources and types of contaminants present, contaminant releases and transport mechanisms, rates of contaminant releases and transport, affected media, known and potential routes of migration, groundwater/surface water interface (GSI) interactions, and known and potential human and environmental receptors.

A matrix was prepared as part of the scoping effort for this RIWP for the AOCs, Compliance Restoration Sites (CRSs), and Munition Response Sites (MRSs). It briefly describes each of these locations, summarizes the environmental assessments conducted to date, cites the current regulatory status, references the most recent environmental report/planning document approved by the Ohio EPA, and highlights the primary conclusions and/or Ohio EPA review comment(s) pertaining to the most recent document.

The FWGW RI fieldwork is comprised of the First Half of 2016 FWGW sampling event scheduled to occur in April-May 2016 (pending Ohio EPA approval of work plan components associated with the FWGW monitoring program). The first (of several) monitoring well installation task is scheduled to occur in August 2016. Production well abandonments are scheduled to begin in August 2017. The monitoring well abandonments are scheduled to begin in 2018, following regulatory approval of the Final RI Report. Ohio EPA approval of the FWGW RI Report is anticipated in March 2018.

This RIWP organization follows the Camp Ravenna Submission Format Guidelines, Version 21 (Vista, 2015). **Section 1.0** summarizes the site history, site setting, and environmental investigations conducted to date, describes the current monitoring well network including background wells, and presents the Conceptual Site Model for RVAAP-66. **Section 2.0** provides an overview of the RIWP approach, including the goals, objectives, and data quality objectives (DQOs) for the RI. **Section 3.0** summarizes the planned project activities. **Section 4.0** presents the Environmental Protection Plan applicable to the RI. **Section 5.0** describes the project documentation and sample quality assurance and quality control (QA/QC) protocols. **Section 6.0** describes the planned disposition of investigation derived waste (IDW). **Section 7.0** summarizes the screening levels for use during the RI for groundwater samples. **Section 8.0** contains the FWGW project schedule.

This RIWP includes six appendices:

Appendix A	Sampling and Analysis Plan
A.1	Field Sampling Plan
A.2	Quality Assurance Project Plan
Appendix B	Health and Safety Plan
Appendix C	AOC-Specific Evaluations
Appendix D	Munitions and Explosives of Concern (MEC) Anomaly Avoidance Plan
Appendix E	Signed Documentation and Correspondence
Appendix F	Comment Response Table

1.0 BACKGROUND

1.1 PROJECT BACKGROUND AND SUMMARY

The TEC-Weston Joint Venture (JV) is submitting this Remedial Investigation Work Plan (RIWP) in accordance with the Performance Work Statement (PWS), Contract Number W9133L-14-D-0008 Task Order Number 0003 to provide Groundwater and Environmental Investigation Services for the RVAAP-66 Facility-Wide Groundwater Area of Concern (AOC) at the Former Ravenna Army Ammunition Plant (RVAAP); now known as Camp Ravenna Joint Military Training Center (Camp Ravenna) in Ravenna, Ohio (**Figure 1-1**). The Task Order Notice to Proceed was issued by the National Guard Bureau (NGB) on August 18, 2015. An initial scoping meeting was held on October 14, 2015 at the Ohio EPA Northeast Ohio office.

Appendix A of this RIWP contains a Sampling and Analysis Plan (SAP) as an addendum to the Facility-Wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations (SAIC, 2011a). The FWSAP also contains the Facility-Wide Quality Assurance Project Plan (QAPP). The JV's SAP is comprised of a Field Sampling Plan (FSP) and a QAPP. The FSP is an addendum to the FWFSP and is presented in **Appendix A.1** of this RIWP. The QAPP is an addendum to the FWQAPP and is presented in **Appendix A.2** of this RIWP. This RIWP also includes a Health and Safety Plan (HASP) in **Appendix B** as an addendum to the Facility-Wide Safety and Health Plan (SAIC, 2011b).

This RIWP has been structured to facilitate Ohio EPA early concurrence on component tasks that will require near-term execution in order to maintain regulatory compliance. Specifically, this RIWP will serve as the 2016 Semiannual Facility-Wide Groundwater Addendum required by the June 2004 Ohio EPA DFFO. Additionally, it serves to support the overall requirements of the CERCLA RI process and goals and objectives for this project including, but not limited to, delineation of groundwater contaminants potentially migrating off-post and execution of a background study to determine naturally occurring levels of inorganic constituents in the various impacted aquifers at Camp Ravenna.

Planning and performance of all elements of the RI will be in accordance with the requirements of the Ohio EPA DFFO for Camp Ravenna dated June 10, 2004 (Ohio EPA, 2004), applicable Ohio

EPA Technical Guidance Manuals (TGMs), and applicable USEPA statutes and guidance including Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

1.2 WORK PLAN ORGANIZATION

This RIWP organization follows the Camp Ravenna Submission Format Guidelines, Version 21 (Vista, 2015). The remainder of **Section 1.0** summarizes the site history, site setting, and environmental investigations conducted to date, describes the current monitoring well network including background wells, and presents the Conceptual Site Model for RVAAP-66. **Section 2.0** provides an overview of the RIWP approach, including the goals and objectives for the RI. **Section 3.0** summarizes the planned project activities. **Section 4.0** presents the Environmental Protection Plan applicable to the RI. **Section 5.0** describes the project documentation and sample QA/QC protocols. **Section 6.0** describes the planned disposition of investigation derived waste (IDW). **Section 7.0** summarizes the screening levels for use during the RI for groundwater samples. **Section 8.0** contains the FWGW RI project schedule.

Data evaluation statistical methods and the proposed monitoring well network (i.e., existing groundwater monitoring wells and proposed new well locations) to be utilized for the metals background study are presented in Section 1.7. Work plan elements covering the installation of new groundwater monitoring wells on the Camp Ravenna southeastern boundary (i.e., to evaluate the potential for off-post migration of site-related compounds in groundwater at concentrations above method detection limits) are included in Section 3.5. Groundwater monitoring and sampling tasks satisfying requirements of the 2016 FWGW Semiannual Groundwater Monitoring Addendum are described in Section 3.7. Supporting details and Standard Operating Procedures (SOPs) for all fieldwork are provided in **Appendices A and B**.

This RIWP includes six appendices for the RI activities to be conducted at the FWGW Area of Concern (AOC):

- **Appendix A** Sampling and Analysis Plan
  - **A.1** Field Sampling Plan
  - **A.2** Quality Assurance Project Plan
- **Appendix B** Health and Safety Plan

- **Appendix C** AOC-Specific Evaluations
- **Appendix D** Munitions and Explosives of Concern (MEC) Anomaly Avoidance Plan
- **Appendix E** Signed Documentation and Correspondence
- **Appendix F** Comment Response Table

1.3 FACILITY HISTORY

The current layout of Camp Ravenna is illustrated on **Figure 1-2**. The property was purchased between 1939 and 1940. In 1942, construction was completed on the Ravenna Ordnance Plant and the Portage Ordnance Depot. In 1943, the facility was renamed the Ravenna Ordnance Center. In 1945, the facility was renamed the RVAAP. At the end of World War II, the RVAAP was placed on a "stand-by" status for munitions production and storage. Between 1946 and 1949, the facility produced ammonium nitrate for use as an agricultural fertilizer in the reconstruction of Europe.

The RVAAP was re-activated in 1950, and operations were contracted to Ravenna Arsenal, Inc., a subsidiary of the Firestone Tire and Rubber Company. RVAAP once again produced and stored a variety of munitions in support of U.S. troops.

In 1957, the RVAAP was again placed on "stand-by" status, at which time the focus shifted from munitions production to demilitarization. The RVAAP began production again for the Vietnam War, and then returned to standby status in 1971. The facility continued to demilitarize ammunition until 1991.

The RVAAP munitions storage mission ended in 2004 with the removal of all bulk explosives from earth covered magazines (ECM).

Currently a few ECMs are used by tenants who are authorized to use them via a lease agreement with the OHARNG. Several of the ECMs are being upgraded and renovated so that they may be used as an ammunition supply point (ASP) in the future to support range operations. ECMs are also used as tornado shelters. Several of the ECMs are up kept for use as a Conditionally Exempt Storage for munitions storage for restoration activities.

Operations at the former RVAAP consisted of 12 munitions-assembly facilities referred to as "load lines." Load lines 1 through 4 were used to melt and load 2,4,6- trinitrotoluene (TNT) and

Composition B into large-caliber shells and bombs. The operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. The resulting wastewater, containing TNT and Composition B, was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to earthen settling ponds. Load Lines 5 through 11 were used to manufacture fuses, primers, and boosters. Potential contaminants in these load lines include lead compounds, mercury compounds, and explosives. From 1946 to 1949, Load Line 12 was used to produce ammonium nitrate for explosives and fertilizers prior to use as a weapons demilitarization facility.

In addition to production missions during the Korean and Vietnam wars, various demilitarization activities were conducted at facilities constructed at Load Lines 1, 2, 3, and 12. Demilitarization activities included disassembly of munitions and explosives melt-out and recovery operations using hot water and steam processes.

In addition to production and demilitarization activities at the load lines, other facilities at the former RVAAP included sites that were used for the burning, demolition, and testing of munitions. These burning and demolition grounds consisted of large parcels of open space or abandoned quarries. Other types of sites at the former RVAAP included landfills, an aircraft fuel tank testing facility, material storage areas, and various general industrial support and maintenance facilities.

Previous ammunition plant industrial operation sites on the facility are undergoing environmental restoration due to contamination caused by past industrial activities. The restoration program began in 1989 with the first attempt to identify Solid Waste Management Units (SWMUs) and is expected to have remedies in place on most AOCs and munitions response sites (MRSs) by 2018. Long-term monitoring/management is expected to continue for another 30 years.

The OHARNG has used various portions of Camp Ravenna since the 1950s for military training. In the 1970s, the OHARNG was issued a license by the Army to use 2,494 acres of the RVAAP for training. The Air Force Reserve also has a license to use 338 acres as a Drop Zone. In 1999, 16,164 acres of the RVAAP (total facility acreage of 21,683 acres) were transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio (USP&FO, 1999). Included within the transferred acreage was the property licensed to the OHARNG, the property licensed to the Air Force Reserve, and munitions storage areas utilized by the RVAAP. The transferred area was then licensed to the OHARNG, to be managed and used as a training area. The OHARNG called this site the Ravenna Training and Logistics Site (RTLS). The Air Force Reserve Drop Zone license was left in place with the Air Force Reserve. Additional acreage was transferred between 2002 and 2010, and the remaining balance of the property was transferred in 2013. The facility is now identified as the Camp Ravenna Joint Military Training Center (Camp Ravenna) and is licensed to the OHARNG for use as a military training site.

Environmental remediation efforts to clean up and restore industrial sites on the property have been underway since the mid-1990s. The Base Realignment and Closure (BRAC) Division managed the Installation Restoration Program (IRP) and Military Munitions Response Program (MMRP) at Camp Ravenna up until 2013 when the ARNG and OHARNG took over program management. This transition was done to better integrate the remedial activities with the OHARNG training mission and to ensure remedies provide for the designated reuse of the property for OHARNG military training.

1.4 PHYSICAL SETTING

1.4.1 Physiographic Setting and Topography

Camp Ravenna is situated within the glaciated Allegheny Plateau section of the Appalachian Plateaus Province. The general terrain is gently rolling, which is characteristic of post-glacial moraine formations. The topography has an overall decrease in ground elevation from a topographic high of approximately 1,220 ft above mean sea level (amsl) in the far western portion of the facility to low areas at approximately 930 ft amsl in the far eastern portion of the facility (Leidos, 2014).

1.4.2 Site Geology

Surface geology at Camp Ravenna generally consists of glacial till deposits from the Wisconsinan glacial advance, with occasional outcrops of bedrock of the Pottsville formation. The surface of the eastern two-thirds of the Camp Ravenna property is composed of the clay-rich and relatively impermeable Hiram Till and associated outwash plain, while the western one-third is covered by the Lavery Till, a silty, sandy material with a few cobbles and sporadic boulders (Winslow and White, 1966).

Pre-glacial valleys were deepened by scouring and subsequently buried during two minor glacial advances and retreats. The first advance occurred over the entire installation, depositing the Lavery Till at a thickness of 20 to 40 feet. The second advance covered only the eastern two-thirds of Camp Ravenna depositing the Hiram Till (Kammer, 1982). The Hiram Till consists of 12 percent sand, 41 percent silt, and 47 percent illite and chlorite clay minerals, and ranges in depth from 1.5 to 4.6 m (5 to 15 feet) below ground surface (bgs). The Hiram Till overlies thin beds of sandy outwash material in the far northeastern corner of the facility. The till thickness throughout the property ranges from less than three feet in some locations to approximately 45 feet (from the INRMP; Author unknown, 1998).

The uppermost bedrock underlying Camp Ravenna (**Figure 1-3**) consists of several units of the Pottsville Formation of Pennsylvanian age. **Figure 1-4** is a line of section map constructed for this RIWP. **Figures 1-5** and **1-6** illustrate geologic cross sections trending east-west and north-south, respectively. The Pottsville Formation varies in composition from coarse, permeable sandstones to impermeable shales (Winslow and White, 1966). The Sharon Sandstone/Conglomerate Unit, the lowest unit of the Pottsville Formation, is a highly porous, loosely cemented, permeable, cross-bedded, frequently fractured, and weathered sandstone, which is locally conglomeratic. Thin shale lenses occur in the upper portion of the unit. The Sharon Shale is a gray to black sandy to micaceous shale, containing thin coal, underclay, and sandstone lenses. Above the shale is the Mercer Member of the Pottsville Formation, which consists of silty to carbonaceous shale with abundant thin, discontinuous sandstone lenses in the upper portion. Regionally, the Mercer Member also has 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 shade of color (Winslow and White, 1966).

The Pottsville Formation is underlain by Mississippian-age shale of the Cuyahoga Formation.

The FWGW RI Report will provide formation-specific lithology descriptions based on monitoring well and soil boring logs for historically characterized locations on post, with an emphasis on characteristics affecting contaminant fate and transport (e.g., texture/grain-size for unconsolidated materials, relative permeability, and porosity for bedrock).

1.4.3 Hydrogeology

The sandstone units of the Pottsville Formation are the major aquifers in the region. These aquifers can exist under artesian conditions and are typically confined above by glacial drift or shale. Within this formation, the Sharon Sandstone/Conglomerate is the most productive of these units and is the major bedrock aquifer in northeastern Ohio. A 1982 study reported that of the 71 groundwater wells that had been installed at the installation, 57 were completed in the Sharon Sandstone/Conglomerate. Data from that study indicated that the thickness of the Sharon Sandstone/Conglomerate ranges from 44 to 177 feet, while the average well depth at Camp Ravenna is approximately 155 feet, with a range between 83 and 261 feet (Kammer, 1982).

As shown on **Figures 1-7** through **1-10**, which are potentiometric surface maps developed using July 2015 depth to water measurements, groundwater flow at Camp Ravenna is generally from west to east. Note that these flow maps will be modified to provide higher resolution depictions as the FWGW RI progresses, to better illustrate the interaction of shallow groundwater with surface water (i.e., gaining and losing streams).

Review of local geology literature references (i.e., Winslow and White, 1966) with respect to upper contact bedrock formations at Camp Ravenna indicates that a number of wells identified in historically prepared Camp Ravenna assessment documents as being installed within the Homewood Sandstone aquifer may actually be screened within other stratigraphic units (e.g., the Mercer or Massillon Member of the Pottsville Group, see Figure 1-8). **Figure 1-11** presents a 3-dimensional view of critical hydrogeology characteristics in the area of the Fuze and Booster Quarry Landfill/Ponds site and Load Lines 5 through 10, where these monitored formation discrepancies are primarily suspected to have occurred. Lithologic units, in descending order, include the Homewood Sandstone Member, the Mercer Member, the Massillon Sandstone Member, the Sharon Member Shale, and the Sharon Member Sandstone/Conglomerate of the Pottsville Group. Generally, these lithologic units are not exposed at the ground surface but rather are overlain by thin soil horizons or by glacial till composed of sand, silt, clay, and gravel. Variations in the uppermost lithologic unit subcrop in this portion of Camp Ravenna are related to erosional processes, ostensibly allowing the bedrock units to transition in sequence laterally following the ground surface topography downslope. Groundwater is indicated to flow in the direction of ground surface topography through the basal unconsolidated material matrix and through the upper-reach weathered sandstones of the Homewood, Mercer, and Massillon members. Groundwater elevations determined from historical gauging measurements indicate semi-confined conditions associated with overlying, low-permeability till material may be present in some areas. Potential aquitards within and underlying the bedrock units include discontinuous shale lenses in the Mercer Member and shale layers of the Sharon Member. As a result of these lower confining unit conditions, groundwater may be discharged along the edge of the formations' topographic boundary as surface seeps or may flow downslope and migrate through the till/weather bedrock interface zone to enter a lower lithologic unit. In instances where the shales are discontinuous, vertical migration through different sandstone units may occur.

Historically prepared monitoring well logs for this portion of Camp Ravenna generally provide insufficient lithologic description details to make definitive delineations of the various bedrock upper contact areal extents (therefore, limiting confidence in identification of individual well monitored formations). However, the current understanding of the site hydrogeology characteristics discussed above indicates that, regardless of actual formation, groundwater within the upper contact bedrock reaches in this portion of Camp Ravenna may nevertheless be hydraulically connected as has been historically assumed in mapping of "Homewood Sandstone" potentiometric surface elevation contours. The RI will include installation of new groundwater monitoring wells in the Upper Sharon Sandstone and Basal Sharon Conglomerate that will support a more detailed evaluation of the overlying bedrock stratigraphy, the hydraulic relationships between these uppermost water bearing intervals, and the resulting effects on groundwater contaminant fate and transport. Spatial variation in stratigraphy within the study area and localized hydrogeology will be provided graphically in the RI through illustrations of "release scenarios" with supporting text for Camp Ravenna areas representing primary hydrogeologic regimes affected by historical releases of contaminants. The release scenario illustrations will be categorized by the following water bearing units/aquifers:

- Homewood Sandstone and other upper contact water bearing units in the area of the Fuze and Booster Quarry and LL5 through LL10.
- Unconsolidated Aquifer: NACA Test Area.
- Upper Sharon Sandstone and Basal Sharon Conglomerate: LL1 and LL2.

The release scenario illustrations will provide discussion of aquifer permeability and localized physical influences (e.g., surface water, ground surface, and upper geologic contact topography, wetlands) on contaminant fate and transport. Analysis will include review of seasonal variation in the hydrologic regime. Current data gaps in the characterization of the upper contact geology in the Fuze and Booster Quarry area will be re-evaluated through results of the pending RI well installations. The RI Report will provide an analysis of groundwater within the Mercer and Massillon formations as separate aquifers requiring additional investigation during the RI, or as a contiguous water bearing unit hydraulically connected to other formations also present in this portion of the post and adequately covered by the existing FWGWMP well network.

A tabulated summary of key hydrogeology parameters for each AOC currently monitored at Camp Ravenna will be provided in the RI report, to include:

- Thickness of water bearing units, lithologic composition, and presence/thickness of confining units (based on site-specific logs).
- Depth-to-water table aquifer/potentiometric surface elevations for each WBU monitored with seasonal variation.
- Hydraulic conductivities and transmissivities for each water bearing unit.
- Calculated gradients within and between formations, based on Ohio EPA's *Technical Guidance Manual (TGM) for Hydrogeologic Investigations and Groundwater Monitoring* (OEPA, 2015) and *TGM Assessment of an Aquitard during a Ground Water Contamination Investigation* (OEPA, 2009).
- Monitored interval depths/elevations/formation descriptions, with a correlation to current identification of monitored formation: emphasis on review of wells currently mapped in the Mercer that have been historically identified as Homewood wells.
- Determination of vertical gradients.

Throughout the facility, average depth to ground water is as deep as 50 feet below ground surface (bgs), with static water levels occurring between 958 and 1,184 feet amsl (Kammer, 1982).

However, groundwater has been encountered at much shallower depths in the upper unconsolidated aquifer across the property. Groundwater flows from bedrock highs in the western portion of the property toward stream valleys in the eastern portion; these latter areas act as discharge areas, as indicated by static water levels in monitoring wells across the installation (Kammer, 1982).

Groundwater occurs within the unconsolidated deposits in many areas of the facility. The thickness of the unconsolidated interval at the facility ranges from thin to absent in the eastern and northeastern portions of the facility to an estimated 150 feet (ft) (46 m) in the central portion of the facility. Because of the heterogeneous nature of the unconsolidated glacial material, groundwater flow patterns are difficult to determine.

Groundwater in the unconsolidated aquifer predominantly flows in an eastward direction; however, the unconsolidated zone shows numerous local flow variations influenced by topography and stream drainage patterns, with preferential flow along pathways (e.g., sand seams, channel deposits, or other stratigraphic discontinuities) having higher permeabilities than surrounding clay or silt-rich material. The local variations in flow direction suggest: (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, as inferred near the western facility boundary.

In the region of Camp Ravenna, groundwater recharge occurs via surface streams and surface infiltration of precipitation along root zones, desiccation cracks, and partings within the soil column through sand and gravel within buried valleys. Two large buried valleys occur southwest and northwest of the facility, and wells in the unconsolidated aquifers there can yield up to 1,600 gallons per minute.

However, the majority of the property itself is comprised of clay-rich glacial tills with low permeabilities and underlying bedrock formations with extremely variable, but relatively low, permeabilities. Typical yields from wells penetrating the Sharon Conglomerate range from 5 to 200 gallons per minute; yields from the overlying unconsolidated sediments are usually considerably lower. In addition, the thickness and permeability of the bedrock formation/units producing the water at Camp Ravenna vary considerably and have a strong effect on well yields, transmissivity, and hydraulic conductivity (Kammer, 1982). Records (well logs) on file at the Ohio Department of Natural Resources (ODNR), Division of Water indicate that over 3,000 water wells exist with the Mahoning River Basin.

1.4.4 Groundwater Use

Groundwater development and use is limited at Camp Ravenna due to potential contaminants identified and investigated as part of the environmental restoration program. During past munitions production operations, groundwater was obtained from on-site production wells. The majority of these wells and the residential wells in the vicinity of Camp Ravenna are screened in the Sharon Conglomerate as this is the major producing aquifer in the area. The potable water production wells have been permanently abandoned through previous activities at the post (historically in 1992 or recently in 2015) or are planned for abandonment during field activities associated with the FWGW RI project. **Figure 1-12** illustrates the locations of all historical production wells.

In 1993, two groundwater production wells were developed in Cantonment Area 1. The OHARNG developed two additional wells in Cantonment Area 1 in 2011. One well is west of the former Building 1039 and provides potable water to Buildings 1037, 1038, and the Post 1 Guard Shack. The second well is west of Building 1034 and east of George Road and provides potable water to Building 1034. The third well is just north of Cantonment Area 1 off the west side of George Road and services Building 1067. The fourth well is southeast of Building 1068, which it serves.

The well west of former Building 1039 was at one time a non-transient, non-community water system that required an on-site licensed operator with a Limited A certification to operate. Currently all of the wells service less than 25 people, are classified as private water systems, and do not require a licensed operator.

Several old construction era and pre-construction homestead wells scattered throughout Camp Ravenna are still open. Many of these were properly abandoned during 2015, and more of these will be properly abandoned as part of this RI.

1.4.5 Site Hydrology

Camp Ravenna is located within the Mahoning River Watershed, which is comprised of eight Water Assessment Units (WAU). Camp Ravenna is located within two of the eight WAUs, which include United States Geological Survey (USGS) Hydrologic Unit Codes (HUC) 05030103-030 and 05030103-040. Surface water features within Camp Ravenna include streams, lakes, ponds, floodplains, and wetlands.

Numerous streams drain Camp Ravenna, including approximately 19 miles of perennial streams. The total combined stream length at Camp Ravenna is approximately 212 linear miles, while average stream width is approximately 3 ft and average stream depth ranges from 1 to 2 ft (USGS, 2002; USAERDC–WES, 1999).

Three major streams (South Fork Eagle Creek, Sand Creek, and Hinkley Creek) drain approximately 65 percent of the facility. The northern and central portions of the property are drained by Sand Creek, with a total drainage area of 13.5 square miles (8,640 acres). Sand Creek subsequently drains to South Fork Eagle Creek, which has a drainage area of 30.7 square miles (19,648 acres) and runs into Eagle Creek and finally the Mahoning River. The western portions of Camp Ravenna drain to Hinkley Creek, a 7.2 square mile (4,608 acres) drainage basin, and subsequently to the West Branch of the Mahoning River. The eastern-most portion of the installation drains to the West Branch of the Mahoning River near its confluence with the main trunk of the Mahoning River. The southern areas drain directly into Michael J. Kirwin Reservoir. A number of smaller, unnamed creeks drain other areas of the facility (USGS, 2002).

Streams throughout Camp Ravenna are generally dominated by sand, fine gravel, and small cobble substrates. However, bedrock-bottomed pools and riffles and runs of bedrock rubble were also found in South Fork Eagle Creek, Sand Creek, and Hinkley Creek. South Fork Eagle Creek, Sand Creek, and Hinkley Creek are designated as warm-water habitats in the Ohio Water Quality Standards (WQS).

South Fork Eagle Creek and its tributaries, including Sand Creek, are also designated by the Ohio EPA as State Resource Waters (SRW). State Resource Waters include water bodies which lie within park systems, wetlands, wildlife areas, and wild, scenic and recreational rivers, and publicly owned lakes, and waters of exceptional recreational or ecological significance. In 1978, the State Resource Water designation was redefined to include four levels of high-quality water: (1) General High-Quality Water, (2) Superior High-Quality Water, (3) State Resource Water, and (4) Outstanding national Resource Water. In 2003, many SRWs were redesignated by the Ohio EPA as Superior High Quality Waters (SHQW) and Outstanding State Waters (OSW). South Fork Eagle Creek was redesignated as a SHQW because of the endangered mountain brook lamprey (*Ichthyomyzon greeleyi*) collected there in 1987, 1999, 2003, and 2010.

Ohio EPA antidegradation rules protect SHQW and OSW from lowering of existing water quality, and permitted pollutant loadings are less than what are permitted for other use designations in Ohio. These waters are protected from any action that would degrade the existing water quality.

Approximately 282 acres of ponds are found on the facility. Many of the ponds are shallow and in advanced eutrophic states, but approximately 22 are deep enough to support a warm water fishery. Most of the ponds were created by beaver (*Castor canadensis*) dams, or small man-made dams and embankments. A few of the ponds were originally used as settling ponds during load line production and are undergoing investigation and clean up when determined necessary.

In the recent past, the OHARNG constructed several sedimentation ponds to catch runoff from tank trails and protect surface water quality on the Gunnery Table IV Range. The OHARNG also built a sedimentation pond between the two target tracks on this range when the track beds where being built and have converted it into a permanent pond that supports a warm water fishery. The borrow site northwest of the target tracks has also filled with water and is being left as a pond. These ponds generally provide valuable wildlife habitat. Almost all the ponds contain fish, except for some of the shallow hatchery ponds and new shallow beaver ponds.

One-hundred-year floodplain areas are associated with Hinkley Creek and its tributaries, lower portions of Sand Creek and its tributaries, and South Fork Eagle Creek and its tributaries (including Sand Creek). An area of approximately 185 acres near the confluence of Sand Creek and South Fork Eagle Creek also is considered to be within the 100-year floodplain. Additional 100-year floodplain areas are mapped along the southern boundary of Camp Ravenna, within unnamed Mahoning River tributary drainages (FEMA, 1987; 1978).

1.5 SUMMARY OF INVESTIGATIONS TO DATE

Environmental investigations at the facility began under the IRP in 1989, at 32 AOCs. The United States Army Center for Health Promotion and Preventive Medicine (now the United States Army Public Health Command) collected samples at each of the AOCs and performed a Relative Risk Site Evaluation, which prioritized each AOC into three groups: low, medium, and high. Restoration work has proceeded primarily by addressing the highest priority sites first. In 1998, the number of AOCs was increased from 32 to 51 (AMEC, 2015). Since the start of the IRP, 53 AOCs, 17 MRSs, and 14 Compliance Restoration Sites (CRSs) have been identified. Some of these sites have been closed, some have received No Further Action decisions pertaining to MEC or certain environmental media (excluding groundwater). **Figures 1-13** through **1-15** are AOC Location Maps for the east, central, and west portions of Camp Ravenna.

Appendix C contains a matrix for the AOCs, CRSs, and MRSs prepared as part of the scoping effort for this RIWP. It briefly describes these locations, summarizing the environmental assessments conducted to date, citing the current regulatory status, referencing the most recent environmental report/planning document approved by the Ohio EPA, and highlighting the primary conclusions and/or Ohio EPA review comment(s) pertaining to the most recent document. This matrix will be more fully populated as the RI progresses.

1.6 EXISTING MONITORING WELL NETWORK EVALUATION

This subsection describes the evaluation of the existing monitoring well network conducted as part of this RIWP to preliminarily determine the usefulness of the well network and identify data gaps that exist. The evaluation was also conducted to support eventual modifications to the well network, which will be comprised of pre-existing wells deemed still useful, and new wells (to be installed as part of the FWGW RI) necessary to fill the identified data gaps. The evaluation also assessed turbidity conditions at all of the existing monitoring wells, with correlations made to inorganic chemistry sample results, to identify which wells merit redevelopment, abandonment, and/or replacement. The TEC-Weston JV utilized the following references as part of the monitoring well network evaluation:

- Proper location (Ohio EPA, TGM Chapter 5), found at: http://www.epa.state.oh.us/Portals/28/documents/TGM-05_final1107W.pdf.

- Appropriate construction/installation (Ohio EPA, TGM Chapter 7) found at http://www.epa.state.oh.us/Portals/28/documents/TGM-07_final0208W.pdf.
- Appropriate development to the extent practicable (Ohio EPA TGM Chapter 8) found at: http://www.epa.state.oh.us/Portals/28/documents/TGM-07_final0208W.pdf.
- Ground Water Sampling (Ohio EPA, TGM Chapter 10) found at: http://www.epa.state.oh.us/Portals/28/documents/TGM-10_final0512W.pdf.

1.6.1 Monitoring Well Network Overview

The Camp Ravenna monitoring well network is comprised of 284 wells located throughout the site (**Figures 1-16** through **1-18**), at locations and depths selected based on both location-specific and facility-wide hydrogeologic conditions, contaminant conditions, and potential receptor conditions. Monitoring wells have been installed as part of numerous environmental investigations conducted at those AOCs, CRSs, and MRSs with the potential to impact groundwater quality, and at facility-wide locations deemed crucial for upgradient and downgradient groundwater monitoring purposes. Each of the historical investigations systematically increased the overall understanding of groundwater conditions both locally and facility-wide, with many of the individual wells confirming groundwater contaminants are not present at levels posing unacceptable risks to human health and the environment. A subset of the 284 monitoring wells exhibit COPC concentrations above regulatory and/or risk-based levels.

Table 1-1 is the FWGW monitoring well network construction summary excerpted from the Draft FWGW Groundwater Report regarding the March 2015 sampling event (EQM, 2015). The table lists all 284 wells that are included in the annual FWGW elevation measurement event (most recently conducted in July 2015). This table presents top of casing and elevations, total depth measurements, and well screen lengths, and identifies the aquifer in which each well is screened.

A total of 150 monitoring wells are completed in the unconsolidated aquifer, 45 wells in the Homewood Sandstone, 7 wells in the Sharon Shale, 76 wells in the Upper Sharon Sandstone, and 6 monitoring wells in the Basal Sharon Conglomerate (i.e., Lower Sharon).

The total well depths within each aquifer vary, due largely to the topographic relief across the site. Unconsolidated aquifer well depths range from 11 to 130 ft. Homewood Sandstone well depths range from 16 to 50 ft. Sharon Shale well depths range from 18.5 to 115 ft. Upper Sharon

Sandstone well depths range from 18.3 to 71 ft. Basal Sharon Conglomerate well depths range from 90 to 230 ft.

All monitoring wells are constructed with 2-inch diameter screens and risers, with above-grade protective casings secured with padlocks. Wells proximal to vehicular traffic areas are additionally protected with bollards. Well materials consist mostly of polyvinyl chloride (PVC), with some wells constructed with stainless steel. In accordance with Ohio EPA guidelines, screen lengths are mostly 10 ft, although some wells were constructed with shorter screens.

1.6.2 Monitoring Well Turbidity

Elevated turbidity levels in groundwater samples have been observed during historical well sampling events from monitoring well locations across Camp Ravenna. The transition to low-flow well sampling methods from previous methods such as bailers/three well volume purging/etc. has reduced the number of wells with elevated turbidity levels. At many of the well locations where turbidity levels remain above optimal turbidity standards (ideally less than 10 nephelometric turbidity units [NTUs]), field measurements of turbidity are lower than prior results (but remain higher than optimal standards).

As part of this RIWP effort, field measurements of all monitoring well turbidity levels, as measured while purging the wells as part of recent quarterly and semi-annual sampling events, were assimilated and assessed based on current guidance (Ohio EPA Technical Guidance Manual for Ground Water Investigations, specifically Chapter 8, Monitoring Well Development, Maintenance, and Redevelopment, and Chapter 10, Ground Water Sampling).

In the most recent sampling events, 70 monitoring wells had measured turbidity levels less than the optimal standard of 10 NTUs. The remaining wells have turbidity readings greater than 10 NTUs. There are several potential reasons for high turbidity in these wells:

- Improper installation.
- Inadequate development of the well.
- Improper sampling techniques (i.e., excessive purge rates that exceed the well yield, use of portable pumps with a lack of settling time).

- Sediment accumulation at the bottom of the well over the course of time.
- Groundwater zones that naturally exhibit higher turbidity (i.e., formations that contain fine clay or silt particles).

Per Ohio EPA Chapter 10, Ground Water Sampling: *Generally, the turbidity of in-situ ground water is very low (Nightingale and Bianchi, 1977). When sampling for contaminants or parameters that may be biased by turbidity, Ohio EPA recommends stabilizing the turbidity readings at or below 10 NTUs (Yeskis and Zavala, 2002). It is recognized that some ground water zones may have natural turbidity higher than 10 NTUs. If turbidity is being used as a stabilization parameter, it may be necessary to evaluate the stabilization criteria on a site-by-site basis.*

At Camp Ravenna, the monitored zones within the unconsolidated, Sharon Shale, and possibly the upper portions of the Sharon Sandstone/Conglomerate water-bearing units have localized issues with fines that may have naturally high turbidities. Monitoring wells located within these zones may not be able to meet the turbidity standard of 10 NTUs. Per Ohio EPA guidance, those wells will likely need to be evaluated for stabilization criteria (specific to turbidity) on "a site-by-site basis".

To identify monitoring wells that may require redevelopment, the following question and subsequent steps were used:

What are the turbidity results from past sampling events?

< 10 NTU = No redevelopment required unless there is > 0.5 ft of sedimentation in the bottom of the well, and unless all previous rounds showed exceedingly high NTU.

10 NTU to 20 NTU = No redevelopment required unless there is > 0.5 ft of sedimentation in the bottom of the well, unless all previous rounds showed exceedingly high NTU, and unless the well is a non-producer (i.e., low yield).

> 20 NTU = Redevelopment is required unless turbidity was < 10 NTU in the three previous rounds and unless the well is located within a naturally high turbidity water-bearing zone/aquifer.

Table 1-2 shows the results of applying this general process to each of the wells currently planned for sampling during the RI with available historical turbidity readings. As listed, a total of 65 wells planned for sampling may require redevelopment. Decisions on individual well redevelopment needs will be made based on measured turbidity readings obtained during the pending RI sampling events regardless of a particular well's current inclusion or listed status in **Table 1-2**.

1.6.3 Monitoring Well Network Data Gaps

The identification of monitoring well data gaps requires gathering a comprehensive amount of physical, chemical, historical operations, waste handling, remediation, and potential receptor information. Much of this data gathering task was accomplished as part of the AOC-specific evaluations (in this context; "AOCs" includes AOCs/CRSs/MRSs) described in **Subsection 1.5**. Those evaluations considered all of the information listed above. In addition, the numerical groundwater flow model developed as part of this RIWP for use throughout the pending RI process was used to bolster the understanding of groundwater contaminant fate and transport conditions.

Monitoring well network data gaps can be categorized according to certain aspects of this FWGW RI:

- AOC-Specific:
  - Upgradient, Source Area, Sidegradient, and Downgradient Locations
    - Plume delineation data gaps horizontally and vertically.
    - Hydrogeology data gaps.
    - Residual source area data gaps.
    - Local upgradient/background data gaps.
    - Local potential receptor/risk assessment data gaps.
- FWGW
  - Upgradient/Background Locations
    - Groundwater chemistry statistics data gaps for one or more aquifers.
  - Downgradient Locations
    - On-site downgradient property boundary plume delineation confirmation, including vertically.
    - Off-site downgradient property boundary plume delineation confirmation, including vertically.

Several of the historical investigation reports prepared for individual AOCs/CRSs/MRSs specified that additional and/or conclusive groundwater characterizations would be conducted as part of the FWGW RI. Some of those sites had extensive groundwater evaluations completed, while others did not include any groundwater characterizations. The AOC-specific evaluations completed as part of this RIWP enabled the development of a hierarchy of preliminary RI tasks to prioritize potential investigative efforts, as listed below. Monitoring well network data gaps were subsequently assessed in part by utilizing this hierarchy.

Prioritization of Potential FWGW RI Tasks (*based on AOC-specific evaluations)*

AOC Condition	Potential FWGW RI Task
Acute Groundwater Risks are Confirmed:	Focused groundwater characterizations near contaminant source area required
Potential Acute Groundwater Risks are Identified:	Limited groundwater characterizations near contaminant source area likely required
Exposure Pathway to a Receptor is Potentially Complete:	Determination of the groundwater exposure magnitude may be required
Groundwater Quality Downgradient of Source Area is Undefined:	Limited groundwater characterizations may be required
Groundwater Quality Upgradient of Source Area is Undefined:	Limited groundwater characterizations may be required
Vertical Delineation of Groundwater Quality is Undefined:	Limited groundwater characterizations may be required
Localized Hydrogeological Uncertainties Remain:	Limited hydrogeology characterizations may be required
Soil Contaminant Leaching to Groundwater is Potentially Significant:	Groundwater characterization may be required
Soil Contaminant Leaching to Groundwater Potential has been determined as Insignificant or Absent:	Groundwater characterization not likely required

For the purposes of identifying monitoring network data gaps, each of the AOCs with historical groundwater monitoring wells were evaluated by executing data queries on the REIMS database to determine:

- Site-specific lists COPCs, defined as those constituents with any historical results exceeding current applicable USEPA screening levels (i.e., the lower of constituent-specific Maximum Contaminant Levels (MCLs) or risk-based residential tap water Regional Screening Levels (RSLs), excess lifetime cancer risks of 1 x 10^{-06}, or hazard quotients [HQ] of 0.1 for non-carcinogens; COPC screening included as consideration of constituents with analytical laboratory method detection limits [MDLs] above screening levels).
- Key sampling statistics (e.g., frequency of detection, range of detected concentrations, range of laboratory MDLs, total samples, total detections, total screening level exceedances) for each site and on an individual monitoring well basis.
- Individual monitoring wells representing maximum COPC concentration locations for each respective site, considered with respect to the comprehensive REIMS database and with respect to samples collected during the 2013-2015 timeframe.
- The dataset for wells located on the downgradient edge of the Camp Ravenna installation boundary was reviewed for detected constituent concentrations, regardless of whether those reported concentrations levels exceeded current EPA screening levels.

See the Site-Specific Summary of Groundwater COPCs with Results Statistics Tables in **Appendix C.** These COPC data were interpreted into geographic information system (GIS) based map annotations plotted onto individual well locations for each site with historical groundwater monitoring wells (see **Appendix C, Figures C-1** through **C-25**). Additional GIS layers (e.g., direction of flow contours for each monitored aquifer present, ground surface topography, historical soil sampling locations, and the extent of historically completed soil removal actions) supported the evaluation of the contaminant nature and extent for developing the FWGW Conceptual Site Model (CSM) and for identifying the areas representing potential gaps in the historical characterization efforts. Additional discussion regarding the current CSM and data gaps identified during the groundwater contaminant nature and extent evaluation are presented in Subsections 1.8.6 and 1.8.7.

Based on feedback obtained from Ohio EPA during the October 14, 2015 Initial Scoping Meeting, the evaluation of the current nature and extent of groundwater COPCs conducted to date (i.e., for this Final RIWP) and the identification of data gaps to be addressed during the pending RI were based on a site-specific review of historical monitoring and sampling data obtained from REIMS (evaluation of the current nature and extent of metals has been deferred pending Ohio EPA approval of the pending background study for those constituents [see Section 1.7.4 for details on submittal of the background study results for stakeholder review]). Results of the site-specific nature and extent review were used to further define and develop an RI groundwater sampling program that considers areas of Camp Ravenna with comingled contaminant plumes. Where practical, individual AOC monitoring well networks were combined to provide area-wide "Plume Groups" with primary groundwater COPC source area characterization and delineation points shared for multiple AOCs. Preliminary groupings of groundwater AOCs are provided in the depiction as **Attachment 1 –** Preliminary Plume Group Map. "Final" proposed plume group configurations will be based on data collected during the pending field investigation and provided for stakeholder review and concurrence prior to inclusion in the RI Report.

1.7 BACKGROUND WELL STUDY

A new background groundwater study is being conducted as part of the FWGW RI to determine the background level of metals (and other inorganic/indicator parameters as needed to support the preparation of Piper Diagrams to correlate groundwater quality between monitoring wells as previously requested by Ohio EPA) for all pertinent water bearing units at Camp Ravenna. The revised background well network, comprised of 10 pre-existing wells and four newly installed wells, will be sampled in accordance with the frequency and methods outlined in Ohio EPA Technical Guidance Manual For Hydrogeological Investigations and Groundwater Monitoring (TGM) Chapter 5, Ohio EPA's August 2009 Technical Decision Compendium titled "Use of Background for Remedial Response Sites", and appropriate USEPA guidance. **Figure 1-19** illustrates the current background well network.

Data from existing and new wells will be used to develop a database that is statistically valid for the methods employed and representative of each groundwater formation. While the proposed background well network is currently anticipated to be hydraulically upgradient of all AOCs and none of the wells are expected to be impacted by site-related activities, additional confirmations will be made early in the RI fieldwork through the acquisition and assessment of potentiometric surface elevations and ongoing groundwater chemistry evaluations. For the new background wells, quarterly samples will be collected to acquire a minimum data population of 12 sampling events (per aquifer) best suited for statistical methods, and conducive for seasonal variation assessments.

There is one existing/acceptable background well in the Homewood Sandstone, and one existing/acceptable background well in the Basal Sharon Conglomerate. Because background statistics are required, wells will be installed in both of these aquifers to allow the acquisition of 12 sampling data points within the first four sampling quarters.

1.7.1 Background Well Network Locations

A focused file review and GIS queries were conducted to ascertain the locations, screen depths, aquifer intervals, and historical groundwater chemistry results for all existing background wells at Camp Ravenna. Wells with obvious COPC impacts were immediately discarded from further consideration. Remaining background wells were then placed onto newly developed plan-view maps that illustrate both groundwater flow and chemistry conditions, differentiated by aquifer. In addition, hydrogeologic cross-sections were developed to depict these conditions in profile. Lastly, EarthVision® software was employed to create 3D depictions of Camp Ravenna, including the positioning of selected background wells. By applying these steps, a holistic determination of the location of the existing background wells within the FWGW AOC, with the important assimilation of highly variable vertical and horizontal groundwater flow patterns, contaminant plume positions and migration patterns, GSI conditions, and hydraulic communication between aquifers was made to ensure the most representative of the existing background wells were retained in the background well network.

The next step involved tallying how many existing background wells remained as reliable sample points for the background study, per aquifer. That tally was then assessed against the TGM, so that a recommendation could be made on the placement of new background wells, and the redevelopment of some existing background wells due to turbidity. In addition, the list of approved background wells documented by the Ohio EPA in 2015 was assessed. As a generalized approach with inherent conservative components, a minimum of three background wells per bedrock aquifer, plus at least one unconsolidated aquifer background well near each of the three Camp Ravenna portions (Eastern/Central/Western) are planned, as summarized in **Table 1-4** and illustrated on **Figure 1-19**.

1.7.2 Groundwater Sampling Procedures/Analysis

The use of dedicated bladder pumps for low-flow sampling is expected to improve the overall dataset quality and provide representative results. All 14 background wells will be sampled using the well purging and sampling procedures outlined in the FSP (**Appendix A.1**) and analyzed for the constituents in accordance with the QAPP (**Appendix A.2**).

1.7.3 Statistical Evaluation of Data

This section presents the statistical methods to be used to calculate the background level of metals (and other inorganic/indicator parameters as needed) for all pertinent water bearing units at Camp Ravenna. Data preparation and statistical analyses will be performed in accordance with applicable methods described in the following guidance:

- Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance. USEPA (2009).
- Use of Background for Remedial Response Sites (Ohio EPA Technical Decision Compendium, 21 August 2009).
- Groundwater Quality Data Organization and Interpretation (Ohio EPA, TGM, Chapter 12, February 1995 found at: http://epa.ohio.gov/Portals/28/documents/TGM-12.pdf).
- ProUCL Version 5.0.00 Technical Guide (USEPA, 2013).

The primary applications for statistical evaluation will be USEPA's ProUCL Version 5.0.00 (or newer) statistical software (USEPA, 2013) and the USEPA's Scout 2008 version 1.00.01 (or newer) (USEPA, 2009b). As appropriate, the background dataset will be updated following methods recommended in Chapter 5 of the U.S. EPA (2009) Unified Guidance. Updating would occur when four to eight new measurements are available. A test of means (or medians in the case of non-normal data) will be conducted to ensure that no statistical differences are detected between the new data and the current background data.

1.7.3.1 Data Preparation

The background monitoring wells for each water-bearing unit will be sampled for four sampling quarters to acquire at least 12 sampling data points for each aquifer. This is best suited for statistical methods and conducive for seasonal variation assessments. The data will be prepared for statistical analysis as follows:

1.7.3.1.1 Sample Size

A sample size of 12 data points per aquifer will be used to calculate background concentrations. If sampling error occurs, a sample size less than eight will not be used and additional samples may be collected. Instead of collecting additional samples, data from historic sampling of background wells will be considered for use in increasing size of the dataset. Historical data had problems with turbidity. Historic sample results will only be considered for inclusion if turbidity was less than 10 NTUs. In addition, two sample comparison testing will be performed to ensure that the historic and new datasets are from same population prior to using historic data.

1.7.3.1.2 Pooling Well Data

Several conditions may need to be satisfied when data from separate wells are pooled to ensure appropriate and representative background. USEPA Unified Guidance states that a background database should satisfy key statistical assumptions of statistical independence of background measurements, temporal and spatial stationarity, lack of statistical outliers, and correct distribution assumption. Prior to pooling data, the data from the proposed background wells will be assessed to determine whether they meet these key assumptions.

The similarity of groundwater chemistry at each of the wells in a water bearing zone will be checked to determine that they are similar prior to pooling data. Standard geochemical bar charts, pie charts, and Piper diagrams of the major constituent ground water cations and anions, as well as alkalinity, will be used as recommended by Ohio EPA. The most recent groundwater data from each of the proposed wells will be plotted on Piper diagrams to help demonstrate that it is appropriate to pool data. The results of the site-specific study on groundwater chemistry (USGS, January 2013, *Final Results of Groundwater Sampling for Major Cations and Anions, Trace Elements, Nutrients, Organic Chemicals, and Isotopes of Hydrogen and Oxygen at RVAAP-66 Facility-Wide Groundwater*, April 2011, Ravenna Army Ammunition Plant, Ravenna, Ohio) may also be considered in this demonstration.

1.7.3.1.3 Duplicates

Duplicate samples are collected to evaluate the effects of sample collection, handling, and analysis. These replicate analyses will be inspected to determine if they are comparable. For comparable samples, the lower of the duplicate and primary result will be used in the statistical analysis. If a pair of duplicate analyses is not comparable, they will be treated as possible outliers and subjected to data audits.

1.7.3.1.4 Outliers

Occasionally a dataset may contain a sample concentration that is far greater or less than any of the other concentrations. Outliers are not uncommon in environmental data because of the variety of natural processes as well as variables in sample collection and analysis that can affect a reported concentration. The background datasets will be screened for outliers by use of graphical analysis (e.g., Q-Q and box plots) and statistical analysis (e.g., Dixon's and Rosner's test).

If outlier testing indicates that a value is a possible outlier, the following actions will be taken:

- Field notes concerning the sample will be reviewed to determine if any irregularities in the sampling process may be responsible for the discordant concentration.
- Laboratory QA/QC documentation for the sample will be reviewed to determine if any irregularities in the sampling, packaging, transport, and analysis processes may be responsible for the discordant concentration.
- If field or laboratory information indicates that the sample is probably not representative of the area, the sample will be excluded from further analysis.
- If field and laboratory information indicate that the sample should be representative of the area, results for other parameters at the same location will be evaluated to determine if the sample geochemistry is consistent with the suspected outlier.
- If the geochemical profile for the suspect sample is consistent with results from other samples in same background dataset, the suspect result will be retained.
- If the geochemical profile for the suspect sample is not consistent with results from other samples in same background dataset, the suspect result will be excluded from further analysis.

1.7.3.2 Calculation of Background Values

The determination of background levels will follow the Ohio EPA (2009) recommendation for employing a method commonly associated with a graphical technique for the detection of outliers from a population (*i.e.*, box plot). This method will be used to select a reasonably-protective estimation of an upper-bound value of the dataset for each water bearing zone. Background concentration levels will be calculated using the following equation:

$$U = Q3 + k(Q3 - Q1)$$

Where, Q1 is the lower quartile, Q3 is the upper quartile, (Q3 - Q1) is the interquartile range, and the multiplicative constant k is one of two factors for determining the upper cutoff value. Following the Ohio EPA recommendation, a value of 1.5 will be used for k. The upper cutoff value will be used as the background concentration level and will be compared to samples taken on-site on a point by point basis.

1.7.3.3 Two Sample Comparisons

If concentrations exceed the upper cutoff value, additional statistical analysis may be performed. Single sample or two sample comparison of upgradient versus downgradient concentrations will be used to determine if the datasets are significantly different. Methods provided in the Unified Guidance and the ProUCL technical guidance will be used for the statistical analysis. Parametric or two sample hypothesis testing provided in ProUCL Version 5.0.00 will be used in comparing the upgradient/downgradient datasets. An alpha level of 0.05 will be used for testing. The data distribution and the percent censored (non-detect [ND]) data will be determined for each dataset to determine the appropriate statistical test to use prior to comparing the upgradient and downgradient datasets,

1.7.3.4 Data Distribution

The distribution of each dataset will be made by examining Q-Q plots and the use of distribution goodness-of-fit tests. The Shapiro-Wilk (S-W) test and the Lilliefors test will be used to determine whether data follow a normal distribution (using raw values) or lognormal distribution (using log-transformed values). An alpha level of 0.05 will be used for distribution goodness-of-fit testing. For datasets with non-detects, Robust Regression on Order Statistics (ROS) techniques will be used to estimate non-detect values in goodness of fit testing. If the distribution goodness-of-fit testing indicates that the data do not fit normal or lognormal distributions, the data will be assumed to have come from a population having an unknown distribution.

1.7.3.5 Censored Data

The laboratory will provide quantifiable results for parameter concentrations at or above the practical quantitation limits (PQLs). Any parameter detection below the PQL and at or above the MDL will be flagged accordingly as an estimated value in the laboratory data reports. Estimated results will be used in the statistical analysis at the reported estimated concentration. For concentrations flagged below the MDL, an imputed ND data value will be used in the statistical analysis. If the ND percentage is no more than 15 percent, each non-detect observation will be replaced with one half the PQL in the statistical evaluation. For higher ND percentages up to 50 percent, either the Kaplan-Meier (KM) or the ROS technique will be used to estimate values. The KM or ROS estimation method will be used for datasets with more than 15 to 50 percent NDs, though non-parametric methods will also be considered for datasets with more than 15 percent NDs. Non-parametric methods will be used to evaluate data sets that have more than 50 percent NDs.

1.7.4 Presentation of Results

The sample size, ND percentage, mean, standard deviation, skewness, median, minimum and maximum concentrations and the proposed background level will be tabulated for each water-bearing unit. The background report will also provide details concerning the methods used to calculate the background level, including the complete raw data background dataset, the working dataset used to calculate background levels, the output of all statistical analyses. The results of hypothesis testing will also be presented, if performed.

The background study report will be provided either as an appendix to an FWGW RI Work Plan Addendum or as an appendix to the FWGW RI report. A FWGW RI Work Plan Addendum will be prepared in the event the results of the background study indicate additional sampling of currently existing wells or installation of new monitoring wells is required to characterize the nature and extent of metals constituents in groundwater for the RI. The currently anticipated schedule for submittal of the RI Work Plan Addendum (if required) and of the RI Report is provided in **Figure 8-1**.

1.8 CONCEPTUAL SITE MODEL

1.8.1 Overview

A CSM was developed as part of this RIWP to describe Camp Ravenna and its environmental setting, and to present hypotheses regarding the suspected sources and types of contaminants present, contaminant releases and transport mechanisms, rates of contaminant releases and transport, affected media, known and potential routes of migration, groundwater/surface water interface (GSI) interactions, and known and potential human and environmental receptors. These descriptions are presented with a focus on FWGW. Qualitative and quantitative data have been incorporated and will continue to be incorporated throughout the FWGW RI. Hypotheses presented by the CSM will also be tested, refined, and modified throughout the FWGW RI. The key elements in the development of the CSM are identification of those aspects of the model that require more information, development of data quality objectives (DQOs), and facilitating decision-making capabilities regarding remediation.

Certain components of the CSM are presented elsewhere within this RIWP, especially **Subsections 1.3** and **1.4**; Facility History and Physical Setting, respectively.

1.8.2 Contaminant Source Areas

As described in **Subsection 1.5** and summarized in **Appendix C**, the 53 AOCs, 17 MRSs, and 14 CRSs represent the known or suspected contaminant source areas at Camp Ravenna. The types, origins, release mechanisms, past and current source area concentrations, leaching to groundwater potentials, and horizontal and vertical extents of the source areas have been generally well characterized through the completion of multiple environmental investigations.

Importantly, many of the COPC concentrations in groundwater only slightly exceed the very conservative RSLs, but do not exceed MCLs. The COPCs that have been identified at the source areas include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) (including polyaromatic hydrocarbons [PAHs]), other inorganics, pesticides, polychlorinated biphenyls (PCBs), explosives compounds, and propellants (evaluation of the current nature and extent of metals has been deferred pending Ohio EPA approval of the pending background study for those constituents).

The FWGW RI will prioritize addressing groundwater data gaps associated with those known or suspected contaminant source areas deemed as having the highest potential to threaten groundwater quality.

1.8.3 Groundwater Contaminant Nature and Extent

The primary goal of the FWGW RI is to adequately characterize pertinent physical and chemical groundwater conditions in the multi-aquifer hydrostratigraphic units variably present across Camp Ravenna, so that potential risks (current and future) to potential human and environmental receptors can be ascertained, effectively managed, and mitigated as needed. The 284 monitoring wells installed beneath known and suspected contaminant source areas, and at locations upgradient, sidegradient, and downgradient of those source areas, have generally enabled ARNG/OHARNG, the Ohio EPA, and other stakeholders to gain a good understanding of the nature and extent of groundwater contamination at Camp Ravenna. Implementation of this FWGW RI is expected to bolster that understanding and address those uncertainties that may pose the greatest potential risk to potential receptors, and that may inhibit the successful completion of an adequate Feasibility Study (FS).

Environmental impacts have been documented to varying degree in the unconsolidated aquifer, and in several underlying bedrock aquifers, including the Homewood Sandstone, the Upper Sharon Sandstone, and the Basal Sharon Conglomerate. These impacts occur near and downgradient of various contaminant source areas located within all three portions of Camp Ravenna (the West, Central, and East portions), with most occurring in the Central and East portions. For the purposes of this CSM, each of these groundwater impacts is referenced in terms of a groundwater plume. Some of these plumes exhibit very small, discrete footprints both laterally and vertically. Others are more extensive, and these can be comingled with plumes emanating from multiple source areas.

The lateral extents of the various groundwater plumes at Camp Ravenna are influenced by a variety of factors, including initial contaminant concentrations, initial contaminant release locations and source area footprints, rates and durations of those releases, horizontal hydraulic gradients, physical and chemical attenuation processes, and hydraulic boundary conditions, including GSI interactions and lithology changes.

Vertical hydraulic gradients across Camp Ravenna are generally upward from the bedrock aquifers and have limited the transport of groundwater contaminants from shallow water-bearing units to deeper aquifers. These gradients, coupled with variable contaminant release mechanisms (such as releases at formerly quarried/mined sites and within subgrade structures such as sewers and sumps), physical and chemical attributes of the COPCs (such as density and sorbing potential), aquifer matrix factors (such as organic carbon content affecting adsorption and contaminant migration retardation), and hydrostratigraphic conditions (such as vertical fracturing and discontinuous aquitards), can all affect the ultimate vertical extent of groundwater contamination at Camp Ravenna.

A summary of the preliminary evaluation of the groundwater contaminant data is presented below, separated by contaminant type.

Explosives

The primary areas where groundwater has been impacted with explosives at concentrations exceeding RSLs and/or MCLs are in the load lines (especially Load Lines 1, 3, and 12), former demolition and/or burning areas (e.g., Central Burn Pits, Demolition Area 2, NACA Test Area, Winklepeck Burning Grounds), and at former site landfills (e.g., Ramsdell Quarry Landfill, Fuze and Booster Quarry).

Pesticides

The primary areas where pesticides have been identified in two or more monitoring wells include Load Lines 1, 2, 3, 11, and 12, Demolition Area 2, and Ramsdell Quarry Landfill.

VOCs

Unlike explosives and pesticides, the nature and extent of VOCs in groundwater does not appear to correlate between the potential source areas. The VOC plumes are localized and generally are comprised of very low concentrations. They tend to contain either residual chlorinated solvents (such as monitor well locations LL3mw-240, LL5mw-005, and LL7mw-001), carbon tetrachloride and chloroform (LL3mw-239, LL10mw-001, and LL10mw-003), or petroleum constituents

(LL3mw-240, LL4mw-193, LL4mw-200, LL12mw-185, LL12mw-187, LL12mw-242, FWGmw-006, and NTAmw-113), and the other scattered VOCs, which are dominated by chloromethane, carbon disulfide, and 2-butanone (MEK).

Inorganics

Aluminum, arsenic, and manganese are the most prevalent inorganic constituents detected in groundwater across Camp Ravenna. Cobalt and thallium have also been monitored with particular scrutiny. The assessment of inorganics in groundwater will be further refined during the FWGW RI with the planned enhancements to the background well network and the placement of dedicated bladder pumps in both the background wells and the investigative wells.

1.8.4 Groundwater Potential Receptors and Exposure Pathways

Potential human receptors of impacted groundwater at Camp Ravenna are based on the land use. The defined land uses and receptors for Camp Ravenna defined in the *Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the Ravenna Army Ammunition Plant (RVAAP) Installation Restoration Program* (OHARNG, 2014) are:

- Unrestricted (Residential) Land Use, whose representative receptors are the Resident Receptor (adult and child). This land use is also considered to include off-site receptors.
- Military Training Land Use, whose representative receptor is the National Guard Trainee, This land use describes potential exposure for military and civilian personnel that would train or work (part-time) on any AOC or MRS within Camp Ravenna.
- Commercial/Industrial Land Use, whose representative receptor is an industrial receptor. This land use represents a full-time occupational receptor at Camp Ravenna at AOCs/MRSs. Activities can include work that would be conducted in office buildings, schools, maintenance buildings, as well as manufacturing facilities, and include outdoor work that will be conducted by full-time personnel to maintain military training lands.

The potential for groundwater discharge to impact surface water is another potential exposure pathway at Camp Ravenna. While a surface water and sediment investigation is being conducted separately (Leidos, 2015), aquatic organisms may be exposed to groundwater contaminants at GSI zones.

Ultimately, the FWGW RI will gather data necessary to determine whether the groundwater exposure pathway(s) to each of these potential receptors is complete.

1.8.4.1 Human Health Receptors and Exposure Routes

Figure 1-20 is a graphical CSM developed as part of this FWGW RIWP, to illustrate the potential complete exposure pathways and routes of exposure for human receptors to groundwater contaminants.

Camp Ravenna receives its potable water from nearby municipalities via pipelines and from groundwater production wells in Cantonment Area 1 (see Section 1.4.4 for a description of specific buildings at the post supplied by the on-site production wells); however, future land use scenarios may include the use of on-site wells. Off-site residents to the south and east use private wells completed in the Unconsolidated and Sharon Sandstone/Conglomerate units.

Workers and residents are assumed to be exposed to groundwater under future land use scenarios, based on the potential use of on-site groundwater as a potable water source. A receptor may be exposed to groundwater contaminants through ingestion of groundwater as potable supply, dermal contact with groundwater while washing/bathing, and inhalation of volatile chemicals released from potable use (e.g., showering). Workers and future on-site residents may also be exposed to volatile contaminants in groundwater through vapor intrusion into structures and inhalation of indoor air.

1.8.4.2 Ecological Receptors and Exposure Routes

Figure 1-20 is a graphical CSM developed as part of this FWGW RIWP, to illustrate the potential complete exposure pathways and routes of exposure for ecological receptors to groundwater contaminants. Previous investigations have indicated that groundwater in the unconsolidated deposits is generally in direct hydraulic communication with surface water, surface water drainage ways may also act as groundwater discharge locations, and the upper portion of the Sharon Formation has been found to be in direct communication with surface water at Sand Creek in the vicinity of Open Demolition Area #2. Surface water bodies at Camp Ravenna that may be affected by groundwater contaminants as a result of these mechanisms include lakes, ponds, and streams. Aquatic-dependent organisms, including fish, aquatic macroinvertebrates, crayfish and mollusks have been documented to inhabit the streams, ponds, wetlands, beaver swamps, and small beaver floodings on Camp Ravenna. These organisms may directly contact contaminants discharged to surface water. Sediment-dwelling organisms and terrestrial receptors that feed on the aquatic food web (e.g., water-dependent wildlife such as piscivorous birds and waterfowl) will be assessed in the surface water and sediment investigation (Leidos, 2015).

1.8.5 Preliminary Groundwater Modeling

A preliminary, steady state, groundwater flow model was constructed for Camp Ravenna to aid in the evaluation of facility-wide hydrogeology, contaminant fate, and potential receptors. The model was used to support evaluation of historically collected hydrogeologic information towards identification of data gaps in the current definition of groundwater contaminant nature and extent pertinent to this RIWP, and to allow the model's continued use and optimization as the RI progresses toward completion. The model was assembled using Environmental Simulation, Inc.'s (ESI) Groundwater Vistas 6 (GWV6) visual interface for several industry standard finite difference simulators authored by the USGS and their collaborators. MODFLOW-USG (Panday et.al. 2013) was used to construct the flow model, and it was subsequently calibrated using PEST (Doherty, 2010).

1.8.5.1 Model Design

The preliminary model was designed to simulate localized groundwater flow in the various bedrock strata and overlying glacial deposits beneath Camp Ravenna. The 215-square mile (100,000-ft by 60,000-ft) model domain depicted on **Figure 1-21** was established by expanding its edges beyond the Camp Ravenna boundary to incorporate the nearby surface water features that constitute natural boundary conditions for the site. This larger domain also allows for evaluating the potential for off-site contaminant migration. The model uses a "quadtree" grid design to balance model resolution with computational time. This design allows the model resolution (i.e., square grid cell dimension) to grade from 125 ft within AOCs containing numerous monitoring wells up to 500 ft along surface water boundaries and 1,000 ft elsewhere.

The flow model consists of seven layers imported from a digital CSM constructed using EarthVision (Dynamic Graphics, 2015). **Figure 1-22** depicts the current state of the three-dimensional (3D) CSM and the data upon which it is based. Publicly available geographic information system (GIS) content regarding the bedrock geology of Ohio were augmented with observations of drift thickness and bedrock strata elevations within site borings to produce a model that honors regional geologic interpretations by the USGS but is more refined within the Camp Ravenna footprint. Digital elevation models (DEM) of both the surface and bedrock topography and regional cross-sections constitute the USGS data visible on **Figure 1-22**. Site-specific data are comprised of approximately 300 site lithologic logs and interpreted structural contours for the Sharon Sandstone/Conglomerate unit established during a prior hydrogeologic study (Kammer, 1982). A minimum tension algorithm was employed within EarthVision for interpolation of all bedrock strata from the assemblage of spot elevations within boreholes, interpreted structural contours, and contacts digitized along both USGS and site-specific cross-sections. The two USGS DEMs were each incorporated in the model as unconformities to establish the few bedrock outcrops at ground surface and the intersection of bedrock strata with the overlying glacial drift.

The CSM layers were imported to MODFLOW-USG via MODFLOW style “matrix” files, which are text files that provide the upper and lower elevations for each layer. The shallowest layer in the resulting MODFLOW model represents the glacial till and the underlying layers represent the bedrock units of the Pottsville and Cuyahoga formations. The drift filled bedrock valleys are accommodated in the MODFLOW model using zonation that allows assignment of variable attributes within the same model layer. In essence, the properties from the shallowest layer are also applied to the portions of the underlying layers where the bedrock topography is lower than the vertical midpoint of the layer in question.

The surface water features depicted in **Figures 1-20** and **1-22** were imported to the flow model as river boundary conditions. Hydrography data from the National Hydrography Dataset (NHD) were originally obtained along with the 10-meter resolution DEM of topography from The National Map (TNM) Viewer 2.0 application (USGS, 2014) but it was evident that the stream channels were not entirely consistent between the two data sources. A new streams shape file (i.e., GIS layer) was consequently derived through slope analysis of the DEM using ESRI’s Spatial Analyst for consistency with the 3D CSM. The result was embedded with starting and ending elevations for each stream segment derived from the DEM as well as reach number assignments before import to MODFLOW-USG. Stream depth and width for flux calculations were each assumed to be three feet and streambed hydraulic conductivity was preliminarily assumed to be 10 feet per day (ft/day).

Boundary cell lengths and applicable model layers for flux calculations were determined by GWV upon import to the quadtree grid.

1.8.5.2 Model Calibration

The preliminary steady-state groundwater flow model was calibrated to currently available site-specific data using a powerful inverse modeling code called PEST (Doherty, 2010). The PEST procedure entails hundreds of individual model runs through which the sensitivity of the model to numerous parameters are automatically determined and those to which the model is sensitive are iteratively adjusted to produce the lowest possible model residuals based on user specified targets, constraints, and the weights assigned to each. For this model, uniformly weighted time-averaged water level data for each monitoring well for the entire period of record were used as calibration targets and upper and lower limits for horizontal and vertical hydraulic conductivity of each model layer were used as constraints.

PEST was allowed to vary both the horizontal (Kh) and vertical (Kz) hydraulic conductivity distributions in each model layer along with the recharge applied to the top of the model in order to optimize the fit of the simulated head distribution to the head targets. This was accomplished through the use of "pilot points," which are synthetic locations to which PEST assigns discrete values for interpolation over the model domain for each of the numerous model runs performed during the course of the PEST simulation. Preliminary Kh and Kz pilot point distributions were placed throughout each model layer using a 15,000 foot spacing for Kh and a 20,000 foot spacing for Kz. Both types of pilot points were also added at each of the 285 target locations to allow more heterogeneity where warranted by data. Layer dependent initial K values ranging from 5 to 50-ft/day were applied to Kx pilot points with an order of magnitude multiplier governing the upper and lower Kx limits and an industry rule of thumb anisotropy factor of 10 to derive corresponding values for Kz pilot points. A coarse (25,000-ft) grid of recharge pilot points was added to the uppermost model layer using an initial estimate of 11-inches per year, which is approximately 20 percent of annual precipitation, and a 4-inches per year possible range bounding this value. There were a total of ~700 pilot points for PEST to use during the optimization process.

1.8.5.3 Model Results

Figure 1-23 shows some of the results of the preliminary model calibration. This figure uses contours of the predicted water table to depict variability in the flow regime throughout the model. The shape of these equipotential lines and the magnitude of horizontal hydraulic gradients are generally consistent with prior manual interpretations of individual water level rounds. Flow is generally from west to east with significant local deviations due to surface water interaction. **Figure 1-24** shows that overall model bias and scaled absolute mean residual are relatively low, but **Figure 1-25** shows that the current model fit to individual AOCs requires further refinement. The model will continue to undergo significant enhancements throughout the remainder of the draft and final RIWP process, and the FWGW RI phases of work.

1.8.5.4 Anticipated Modifications

The preliminary groundwater flow model is being updated and enhanced with information identified via continued searches and with data collected as part of the pending RI. The goal is to significantly reduce the model residuals from current values while simultaneously honoring measured baseflow estimates using hydraulic conductivity and recharge distributions that are reasonable. The following is a list of the improvements that will support the model's finalization:

- Improving the fit of the bedrock topography to bedrock elevations from both site borings and historic borings with good horizontal and vertical accuracy, while preserving the current USGS interpretation of paleodrainage.
- Dividing the glacial drift into Lavery and Hiram till regions and incorporating the coarser bedrock valley fill using additional zones and/or sublayers within the MODFLOW-USG.
- Conditioning the calibrated hydraulic conductivity distributions within each zone and layer combination to historic aquifer test data.
- Changing river boundaries to stream boundaries, adding a constant head boundary at the reservoir, and incorporating surface water flux constraints based on USGS gaging data.
- Weighting the head targets to account for discrepancies within clustered data regions and biases in time-averaged values due to lack of historic information.
- Improving pilot point distributions to better account for data distribution and planned revisions to the zonation of glacial drift deposits.

- Improving the recharge distribution in the model based on USGS stream baseflow and watershed analysis.

1.8.6 CSM Summary

The preliminary CSM has been based on information obtained through review of the documented operational and investigation histories for AOC/CRS/MRS sites provided on the RVAAP Access website (http://www.rvaap.org/) (see **Appendix C – AOC Specific Evaluations**) and within other information provided by the ARNG. The current CSM has been developed with respect to the nature and extent of non-metals contaminants. Evaluation of the nature and extent metals in groundwater will be addressed in an addendum to this RIWP pending Ohio EPA approval of naturally occurring background concentrations for those constituents.

The comprehensive sampling dataset (obtained from REIMS) for each site with groundwater contaminants exceeding current USEPA screening levels was evaluated with respect to documented historical land uses with a potential to have resulted in groundwater contamination, contaminant trends over time, and the distribution of maximum contaminant concentrations to determine data gaps to be addressed during the pending RI. Review of the historical sampling data included a comparison of analytical laboratory MDLs to applicable screening levels to identify the potential need for resampling as a means to test for constituent concentrations with more sensitive current methods when applicable. In addition to historical groundwater contaminant analytical test results, aquifer-specific geochemical and hydrogeology data (e.g., major anions/cation concentrations, water level gauging measurements, turbidity readings), ground surface topography, and potential interactions with surface water features have been used in establishing primary contaminant fate and transport characteristics used in the preliminary CSM development. Considerations of current and potential future land use have been incorporated into development of the CSM to identify exposure pathways potentially complete at the Camp Ravenna.

Based on feedback from Ohio EPA during the October 14, 2015 Initial Scoping Meeting, the preliminary groundwater CSM development included a mapped-based comparison of historical soil sample results with respect to currently existing monitoring well locations and known groundwater COPCs (see **Appendix C, Figures C-1** through **C-25**). The mapped-based comparison was limited to providing the relative concentration (i.e., COPC concentrations below and above their respective arithmetic mean) and distribution of soil constituents identified to either:

> (A) Present a potential leaching risk to groundwater through the soil-to-groundwater contaminant migration pathway; or
>
> (B) To have been historically reported with groundwater concentrations above current USEPA screening levels (i.e., the lower of constituent-specific MCLs or risk-based Residential tap water RSLs, excess lifetime cancer risks of 1×10^{-06}, or HQs of 0.1 for non-carcinogens).

Continued development and refinement of the FWGW CSM will occur throughout the planning, assessment, and remedial action process. The preliminary CSM for this Final RIWP has been structured to provide a summary of key site-specific CSM aspects identified to date during evaluation of groundwater contaminants through the mapped-based nature and extent evaluation described in **Subsection 1.6.3**. **Table 1-3;** Key CSM Inputs for Camp Ravenna AOCs/MRSs/CRSs, provides a summary of currently identified CSM conditions and potential CSM data gaps to be addressed by the pending FWGW RI.

AOC-specific data gap areas (DGAs) discussed in **Table 1-3** are based on areal and temporal gaps in the facility-wide groundwater monitoring program that need to be resolved in order to: (1) complete a baseline risk assessment (BRA); (2) characterize potential vertical migration of COPCs between water bearing units at Camp Ravenna; and (3) ensure downgradient delineation of site related contaminants to below analytical laboratory MDLs. In general, DGAs that were not proposed to include installation of new monitoring wells were identified to require an assessment of current COPC conditions in historically characterized source areas to support development of exposure point concentrations (EPCs) for the BRA (e.g., historically impacted monitoring wells that have not been sampled within 3 to 5 years of the current date). In other cases, the need for additional characterization of groundwater through sampling of currently existing monitoring wells located within DGAs will be based on sampling results for other wells currently selected for sampling and listed in **Table 2-1** or new wells proposed for installation shown on **Table 3-1**.

Groundwater contaminant concentration trends have been evaluated at a limited subset of AOCs using the USEPA ProUCL software, Version 5.0.00, to support a determination of RI sampling requirements. Individual well concentration trends will be evaluated for the remaining Camp Ravenna AOCs utilizing the updated RI sampling dataset. Primary outputs of the ProUCL contaminant trend analysis are provided in **Appendix E**.

1.8.7 Data Gap Analysis

The evaluation and identification of data gaps to be addressed during the pending FWGW RI includes the following:

- Identification of Historical Data Usability Limitations.
- Delineation Issues (vertical and horizontal).
- Background Study.
- Risk Assessment Needs.

The AOC-specific contaminant nature and extent evaluations conducted to date for the purposes of this Final RIWP were primarily used to identify historical groundwater assessment data gaps that will require the installation of new monitoring wells to confirm adequate delineation of COPCs with respect to potential off-site exposures. Other key considerations for the currently proposed new monitoring well installations include vertical delineation aspects not covered by the current FWGW monitoring well network. Evaluation of the historical groundwater monitoring dataset with respect to COPC distribution and temporal trends, historical MDL exceedances of current USEPA screening levels, and statistical representativeness of the current dataset for use in the pending BRA was completed prior to submittal of this Final RI Work Plan, in order to develop the FWGW RI scope with respect to existing monitoring wells to be sampled, frequency of sampling, and new well installations. Per coordination with Ohio EPA during the October 14, 2015 Initial Scoping Meeting, evaluation of the nature and extent of metals contaminants is being deferred pending their approval of background concentrations for naturally occurring constituent levels (see **Subsection 1.7** for additional information on the currently identified scope for the pending metals background study).

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2.0 PROJECT DESCRIPTION

The primary objectives of the FWGW RI are to collect sufficient data to define the nature and extent of contaminants, to allow the completion of a BRA and to support the eventual execution of an FS. Groundwater characterization efforts will include sampling of existing groundwater monitoring wells and installation/sampling of new wells. Additionally, the RI will collect sufficient data to establish naturally occurring levels of metals constituents in groundwater and to determine the level of site-related groundwater COPCs that have migrated off-site. Activities conducted as part of the RI will include evaluation of individual well turbidity and implementation of a protocol for redevelopment or replacement of wells determined to be critical for determining groundwater contaminant nature and extent (see **Subsection 1.6.4**). Results of the RI will be documented in a FWGW RI Report submitted for Ohio EPA approval.

Additionally, the project will establish a long-term groundwater monitoring well network and provide for the proper sealing and abandonment of monitoring wells not required for use in the long-term network or as corrective action observation wells.

2.1 WORK PLAN APPROACH

Although this FWGW RIWP is used to establish the technical approach for overall project execution, stakeholder review and concurrence for certain work components will be addressed through submittal of stand-alone planning deliverables including an Archaeological Survey Work Plan, a Sampling and Analysis Plan (SAP, including a Field Sampling Plan/Quality Assurance Project Plan), a Health and Safety Plan (HASP), and a Well Abandonment Work Plan. The SAP and HASP are included as **Appendices A** and **B** of this RIWP.

Each of these stand-alone documents will be submitted in preliminary draft, draft, and final versions. Preliminary draft documents will only be provided for ARNG review. Based on stakeholder consensus during the October 14, 2015 Initial Scoping Meeting to defer review of metals constituents pending Ohio EPA approved background concentrations, a FWGW RIWP Addendum will be prepared to provide the nature and extent review and data gap analysis for those constituents. Note that "final" Plume Group combinations of individual sites to be carried forward under the Plume Group approach will be based on data collected during the pending field investigation and coordinated for OHARNG and Ohio EPA review and concurrence prior to submittal of the FWGW RI Report.

This RIWP has been structured to facilitate Ohio EPA early concurrence on component tasks that will require near-term execution in order to maintain regulatory compliance (the RIWP will serve as the Semiannual Groundwater Addendum required by the June 2004 Ohio EPA Director's Final Findings and Orders) and in order to support the overall requirements of the CERCLA RI process (e.g., delineation of groundwater contaminants potentially migrating off-post; execution of a background study to determine naturally occurring levels of inorganic constituents in the various impacted aquifers at Camp Ravenna).

Data evaluation statistical methods and the proposed monitoring well network (i.e., existing groundwater monitoring wells and proposed new well locations) to be utilized for the metals background study are presented in Section 1.7. Work plan elements covering the installation of new groundwater monitoring wells on the Camp Ravenna southeastern boundary (i.e., to evaluate the potential for off-post migration of site-related compounds [SRCs] in groundwater at concentrations above MDLs) are included in Section 3.5. Groundwater monitoring and sampling tasks satisfying requirements of the Semiannual Groundwater Addendum (i.e., to identify the proposed Routine Groundwater Monitoring Program [RGWMP] for 2016) are described in Section 3.7. Supporting details and Standard Operating Procedures for fieldwork are provided in **Appendices A and B**. Evaluation of historical soil data, identification of data gaps, and collection of soil samples is outside of the scope of the FWGW RI. The FWGW RI is limited to characterization of groundwater only.

2.2 DEFINITION OF GOALS AND OBJECTIVES, INCLUDING DATA QUALITY OBJECTIVES AND REMEDIAL ACTION ALTERNATIVES

2.2.1 Goals and Objectives

Selected AOCs, along with FWGW locations, have been identified for RI tasks as deemed necessary to attain a CERCLA decision for RVAAP-66 Facility-Wide Groundwater. RI-specific objectives have been developed using the DQO approach presented in the FWSAP. The following subsections present these objectives, summarize the FWGW RIWP development process, and list the primary tasks being performed to achieve the objectives:

- Obtain Ohio EPA approval of the 2016 RGWMP well network.
- Obtain Ohio EPA concurrence on methods and monitoring well network for the metals background study.
- Conduct the near-term installation of groundwater monitoring wells on the Camp Ravenna southeastern boundary to evaluate the potential for off-post migration of SRCs in groundwater at concentrations above laboratory MDLs.
- Complete a review of historical reports and data pertaining to contaminant source areas potentially posing risks to groundwater.
- Screen historical data.
- Identify locations needing additional data to define the nature and extent (horizontal and vertical) of FWGW contamination.
- Apply human health and ecological risk assessment methods to evaluate FWGW data.
- Utilize groundwater sampling procedures prescribed in the FSP to address data gaps.
- Adhere to the HASP to minimize the potential for personnel injury or illness.
- Comply with the QAPP regarding sample collection, documentation, and analysis during the FWGW RI.

Most of the AOCs/CRS/MRS have previously undergone investigations to characterize the nature and extent of source area contamination and assess human health and ecological risks. In addition, remedial activities were performed at some of these sites to address known contamination, primarily using source area excavations to reduce the potential for direct exposures, and impacts to groundwater and surface water bodies. Data pertinent to FWGW from the previous AOC-specific investigations and remedial activities, while systematically compiled as part of this RIWP scoping effort, will continue to be assessed as new data is acquired, to complete the FWGW RI.

Results of site-specific nature and extent evaluation will be used to further define and develop an RI groundwater contaminant delineation and risk assessment strategy that considers areas of Camp Ravenna with comingled contaminant plumes. The need for additional characterization of potential vertical migration of contaminants underlying AOC-specific source areas will be based on relative localized gradients determined between the aquifers and on sample results obtained from currently existing wells and new well installations during the RI. Where practical, individual AOC monitoring well networks will be combined to provide area-wide Plume Groups with primary groundwater COPC delineation points and primary source area characterization wells potentially shared for multiple AOCs.

2.2.2 Data Quality Objectives

The DQOs for the FWGW RI were developed based on guidance specified in the *Data Quality Objectives Process for Superfund* (USEPA, 1993b), the *Technical Project Planning Process* (USACE, 1998b), or the *Final Uniform Federal Policy QAPP Checklist* of 2008 as applicable. The FWGW FSP and QAPP in **Appendix A** define the project-specific scope and objectives, sampling rationale and approach, and data quality needs to support decisions to be made using the data collected during the FWGW RI. The DQOs for the FWGW RI were developed to supplement under the facility-wide DQOs, which serve two major purposes: (1) to present the facility-wide approach to sampling, and (2) to present the process that will be used to develop investigation-specific FSPs. The stages of the DQO development process are as follows:

- Develop the CSM;
- State the problem;
- Identify decisions to be made;
- Define the study boundaries;
- Develop the decision rule (if/then);
- Identify inputs to the decision (data uses and data needs);
- Specify limits on uncertainty; and
- Optimize the sample design.

A major goal of implementing the DQO process is to ensure that all data critical for decision making are collected. This includes data necessary for the eventual selection and implementation of cost-effective remedial actions for FWGW.

Measurement Performance Criteria are defined in Worksheet #12 (**Appendix A.2**) to provide a data set that will achieve DQOs, will be technically defensible, and will support project decisions. The criteria are related to the Data Quality Indicators of precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity. For the FWGW RI, three types of decision errors will be addressed using DQOs: sampling errors, measurement errors, and modeling errors. DQOs for the FWGW RI are:

- Assess hydrogeologic conditions, hydraulic communication between aquifers and between groundwater and surface water, and groundwater quality in unconsolidated, Homewood Sandstone, Sharon Shale, Upper Sharon Sandstone, and Basal Sharon Conglomerate water-bearing zones/aquifers.
- Characterize groundwater chemistry near selected AOCs and at FWGW locations to assess potential contaminant migration pathways.
- Establish background groundwater chemistry values.
- Conduct analysis of an adequate FWGW chemical dataset to facilitate subsequent remedial decision-making.

A list of FWGW RI goals and objectives related to currently identified AOC/MRS/CRS site-specific data gaps is provided in **Table 2-1**. AOC-specific RI activities outlined in **Table 2-1** have been structured to provide the following:

- Identification of specific constituents and individual wells to be sampled during the RI (based on historical data evaluations summarized by AOC maps and Data Tables provided in Appendix C).
- Summary of currently existing wells to be sampled and new wells to be installed broken down by DGA.
- Listing of FWGWMP wells that are associated with or collocated with AOCs, with an indication of which of these wells will also be sampled for the purposes of the RI.
- A description of site evaluation activities other than well sampling/new well installations that will be conducted as part of the RI.

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3.0 PROJECT ACTIVITIES

The following primary project activities associated with executing this RIWP will be completed as various RI field tasks, including: site reconnaissance, well inspections, well installations, well development, total depth and water level measurements, well surveying, well sampling, and well abandonment, and subsequent reporting. This RIWP addresses all project activities and includes addenda to the Final FWSAP, FWQAPP, and FWSHP (SAIC, 2011a). A Munitions and Explosives of Concern (MEC) Anomaly Avoidance Plan is included as **Appendix D**.

3.1 PREMOBILIZATION

Prior to the field efforts, a series of pre-mobilization activities will be undertaken to ensure that all applicable requirements are met. These will include obtaining any necessary notifications to the ARNG/OHARNG onsite restoration representatives, Ohio EPA, and other stakeholders. In addition, all necessary approvals as well as subcontracts and purchase orders for field services and other necessary services will be in place.

3.2 UTILITY CLEARANCE

Prior to the FWGW RI intrusive work (i.e., well installations and well abandonments), subsurface utilities identified during the pre-mobilization effort will be reviewed during a site walk. Work requiring clearance will be coordinated with the Camp Ravenna DPW office for utilities located inside the fence and Ohio Utilities Protection Service for utilities located outside the fence. Work around all marked utilities will be conducted with utmost precaution to ensure that no utility lines will be damaged. In case an unmarked utility line is exposed during drilling activities, the TEC-Weston JV will stop work and notify the ARNG/OHARNG onsite restoration representatives. Work will resume only after the TEC-Weston JV receives clearance from the representatives.

3.3 PRE-FIELD WORK MEETINGS

Pre-fieldwork meetings will be held prior to commencing the RI and monitoring well sampling fieldwork. These meetings will communicate project expectations and requirements to ensure that all stakeholders understand their roles, responsibilities, and interactions with others. These meetings will be conducted by the TEC-Weston JV Field Team Leader or designee.

3.4 MOBILIZATION AND SITE PREPARATION

Field personnel will be mobilized multiple times during the implementation of this project. All applicable requirements will be met prior to commencing work activities. Mobilization and site preparation will include, but will not be limited to, the following:

- Verify utility layout.
- Coordinate site security.
- Set up controlled access to the job site.
- Review the job safety analysis with field crews for the activities to be conducted.
- Establish environmental drilling, sampling, surveying, and monitoring operations in accordance with the HASP addendum to the FWSHP.
- Ensure that all necessary equipment is on site and ready for use.
- Set up an equipment staging area.

3.4.1 Temporary Facilities

Temporary facilities, including office space, sanitary facilities, and hand wash stations will be placed at locations designated by the ARNG/OHARNG onsite restoration representatives. Communications will include both cell phones and handheld radios. Signs and barricades will be used to identify sampling areas.

3.4.2 Site Security

Site security for the protection of the general public, site workers and equipment, and materials will be established in accordance with the HASP (**Appendix B** of the RIWP). Access rosters will be submitted to Vista Sciences a minimum of 48 hours in advance for coordination with Camp Ravenna Operations, restoration stakeholders, and Range Control. All personnel approved for entry will be required to provide government-issued identification (i.e., driver's license, or passport) to enter. Post 1 (Main Gate) is the main entrance to Camp Ravenna. In addition, the OHARNG will be notified a minimum of one week prior to the beginning of all field activities. Personnel working within any of the working areas will also be required to provide documentation of their 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste

Operations and Emergency Response (HAZWOPER) Training and their current 8-hour OSHA HAZWOPER Refresher Training.

3.4.3 Decontamination

A temporary decontamination area will be constructed to facilitate the decontamination of sampling equipment and other associated equipment and personnel. The location and layout of the field decontamination area will be determined by the TEC-Weston JV Field Team Leader and the Site Safety and Health Officer (SSHO). An additional decontamination area will be located in Building 1036 (or another location determined by the ARNG/OHARNG onsite restoration representatives) and will be used to decontaminate sampling equipment. All sampling equipment will be decontaminated in accordance with the procedures outlined in Subsection 4.8.4 of the FSP (**Appendix A.1**).

3.5 MONITORING WELL INSTALLATIONS AND REDEVELOPMENT

3.5.1 Monitoring Well Installations

New monitoring wells have been selected for installation based on needs for the pending metals background study and on AOC/MRS/CRS-specific RI goals and objectives described in **Table 2-1**. A summary of new wells with their intended monitored aquifer, purpose and general location is provided in **Table 3-1**. Proposed new well locations are provided on **Figures 3-1** through **3-3** and on AOC-specific maps provided in **Appendix C**.

All new bedrock wells installed where an unconsolidated aquifer overlies the bedrock, or where a shallower bedrock aquifer overlies the targeted deeper bedrock aquifer, will be installed using a sonic rig with the drill casing utilized to seal off the upper water-bearing zones from deeper screened zones. These will be installed using proper industry practice and applicable elements of Section 4.3 of the FSP (**Appendix A.1**). At no time will communication between two aquifers be allowed to occur. Additional details regarding the sonic drilling process are provided in Section 4.3 of the FSP. If sonic drilling methods are determined to be impractical, hollow stem auger, or air rotary drilling, methods will be used for monitoring well installations. These drilling methods are described in Section 5.5.2.1 of the FWSAP. Regardless of drilling method, at no time will communication between two aquifers be allowed to occur.

Prior to the field activities the Field Team Leader will submit the Granular Filter Pack Approval Form, Bentonite Approval Form, and Water Approval Form to the Camp Ravenna ARNG Project Manager. Specifications for the monitoring well construction materials (casing/screen, bentonite, filter pack, water source, etc.) are provided in Section 5.4.2.2 of the FWSAP. Evaluation of historical well construction and development details for the nearest currently present groundwater monitoring wells will be conducted to ensure best practices to limit turbidity levels are employed during the pending well installations. OHARNG will be notified prior to a departure from any well construction methods prescribed by the FWSAP are implemented. Specifications for monitoring well installation (screen, casing, filter pack, seal, and grout placement, etc.) are provided in Section 4.3.1.2 of the FSP (**Appendix A.1**). The Monitoring Well Construction Diagram Form contains the required information for development as defined in Section 4.3.2 of the FSP. Field personnel will fill out the form in its entirety to ensure all documentation requirements are met.

3.5.2 Monitoring Well Development/Redevelopment

Monitoring well development will be initiated no sooner than 48 hours after installation, and no longer than 7 days after internal mortar collar placement or the final grouting of the wells. The three approved development methods from the FSP are listed below. The Monitoring Well Development Form contains the required information for development as defined in Section 4.5.1 of the FSP.

1. Development using a bottom discharge/filling Teflon® or stainless steel bailer.
2. Development using a submersible pump.

Wells will be developed in accordance with the most recent version of relevant chapters of the Ohio EPA Technical Guidance Manual for Groundwater Investigations: Chapter 8, Monitoring Well Development, Maintenance, and Redevelopment; and Chapter 10, Groundwater Sampling (note that the current project PWS and Ohio EPA guidance indicates a turbidity threshold value goal of 10 NTUs). Development will be conducted until representative samples can be collected from the monitored aquifer, based upon stabilization of water quality parameters listed, turbidity levels, and minimum purge volume requirements described in the FSP, **Appendix A.1**. Review of well construction and development methods will be conducted with the Ravenna Restoration

Project Manager to determine if the well will be accepted if it cannot be developed to meet the turbidity threshold goal of 10 NTUs.

If existing monitoring wells must be redeveloped, then the integrity of each well will be checked prior to development. If the integrity of the well is questionable, the well will not be redeveloped. The integrity of the well will be checked by visual inspection of the surface casing and riser pipe and by performing an alignment test in accordance with Section 4.3.2 of the FSP.

3.6 DEDICATED BLADDER PUMP INSTALLATIONS

QED Well Wizard® bladder pumps will be installed at all monitoring well locations planned for multiple sampling events during the FWGW RI. These pumps will include a Teflon®-coated stainless steel safety cable/retrieval line, Teflon-lined polyethylene tubing or Teflon tubing and bladder, and 2-inch slip fit well caps with fittings, as detailed in the FSP (**Appendix A.1**). The pump assembly must be cleaned using a multi-stage washing and rinsing process utilizing phosphate-free laboratory-grade detergent and deionized and filtered water. The pump will be lowered slowly into the monitoring well until it contacts the groundwater surface, and then will continue to be lowered until the pump intake is at the desired level. The intake of the pump should be placed using two criteria: 1) if the water level is below the top of the screen the intake will be placed in the center of the water column; 2) if the static water level is above the screen then the intake will be placed in the center of the screen. The well caps include an access hole for water level measurement and include a dust protection cap to cover the entire cap to prevent the accidental introduction of contaminants to the fittings or well.

3.7 2016 FWGW MONITORING PROGRAM AND RI GROUNDWATER SAMPLING

Selected monitoring wells will be sampled to collect data that enable a synthesis with historical analytical results and minimizes data gaps pertinent to refining the CSM. Sampling will also allow for the characterization of current groundwater quality and the determination of COPC migration. Various quarterly and semi-annual sampling events will be conducted (along with their associated report submittals) based on data needs, new versus existing monitoring wells, well redevelopment factors, and FWGW Monitoring Program (FWGMP) requirements.

A total of 191 wells (170 existing and 21 new, including background wells) will be sampled to support the FWGMP, the RI, and the background study. The total of 170 existing wells includes 10 previously installed wells that will be utilized for metals background study. The 2016 FWGW Monitoring Program will include the same 46 wells sampled and monitored during 2015. A revised configuration of the final FWGMP network (for routine groundwater monitoring purposes) will be established after completion of the FWGW RI to support selection, implementation, and long-term monitoring of the selected FWGW remedy(s). **Table 3-2** summarizes existing and new monitoring wells to be sampled, including their monitored aquifers. A list of existing wells currently planned for sampling as part of the 2016 FWGW Monitoring Program or during the RI, including the monitored aquifers, well screen elevations, and analytical parameters, is provided as **Table 3-3**. **Figures 3-1** through **3-3** illustrate the FWGW monitoring well locations planned for 2016 FWGW Monitoring Program sampling and during this RI. The relative location with respect to groundwater direction of flow of the AOC-specific monitoring wells is provided in **Appendix C, Figures C-1** through **C-25**. New monitoring well locations are also illustrated on **Figures 3-1** and **3-3** and on AOC-specific maps provided in **Appendix C**. The rationale for each new well installation is provided in **Table 2-1**, new wells are summarized in **Table 3-1**. All new permanent monitoring wells will be sampled for the full suite of VOCs, SVOCS, PCBs, Pesticides, metals, explosives, and cyanide for four consecutive quarters. New well FWGmw-SS/C1 will also be characterized for alkalinity. Temporary wells to be installed for characterization of groundwater at the Sand Creek Landfill and at ODA1 will be sampled only for SVOCs and explosives, respectively.

All RI wells listed in Table 3-3 will be sampled at least once in association with the Fall 2016 FWGWMP monitoring event. Wells/constituents confirmed with stable or decreasing concentrations will generally only be sampled once for the purposes of the RI. Results of the initial sampling event and a list of wells planned for continued sampling will be provided in the 2017 Semi-annual Facility-Wide Groundwater Addendum.

Groundwater sampling activities will follow and achieve the requirements defined in the *Facility-Wide Groundwater Monitoring Program Plan* (FWGMPP), TGM Chapter 10, the FWSAP (SAIC, 2011a), and **Appendix A**. All monitoring wells will be purged and sampled using low-flow methods incorporating the dedicated bladder pumps and sample tubing (**Subsection 3.6**) to reduce turbidity in sampling, reduce the quantity of IDW generated, and eliminate the need for equipment blanks. Sample containers and preservation techniques will be in accordance with the approved FSP/QAPP in **Appendix A**. Field QA/QC samples will also be collected per **Appendix A**.

For sampling, the bladder pump will be activated and allowed to operate until a steady flow of groundwater is expelled from the return line at the ground surface. The pumping rate will be established once drawdown has been stabilized. Purging will continue until drawdown is stabilized, a minimum of two pump and tubing volumes have been withdrawn, 30 minutes of purging have occurred, and water quality parameters have stabilized for three consecutive readings per specifications in Section 4.8.1 of the FSP **Appendix A.1**. Water quality parameters will be recorded commencing with the first flush of water through stabilization completion.

Water Quality Parameter	Stabilization Requirement
pH	± 0.1
Conductivity	± 3%
Temperature	± 5°C
DO	± ±10% or 0.2 mg/L (whichever is greater)
Turbidity	10 NTUs (well purging goal)
Oxygen Reduction Potential	±20 millivolts

Note that turbidity is a particularly important water quality parameter measured during all well purging activities, based on historical issues associated with well development uncertainties and groundwater turbidity effects on inorganic parameter analytical results. See **Subsection 1.6.2** and the FSP (**Appendix A.1**) for a full description of historical turbidity conditions, the evaluation process employed as part of this RIWP development, and the turbidity metrics to be applied to well purging tasks.

Sampling of the monitoring well will begin immediately after purging. The pump will remain on between purging and sample collection, including filtration of samples. The sample will be collected and preserved in the manner described in Section 4.8 of the FSP (**Appendix A.1)**. Following completion of groundwater sampling, a final set of groundwater quality parameters will be measured and recorded.

Based on feedback obtained from Ohio EPA during the October 14, 2015 Initial Scoping Meeting, the evaluation of the current nature and extent of groundwater COPCs conducted to date, and the identification of data gaps to be addressed during the pending RI, were based in part on a site-specific review of historical monitoring and sampling data obtained from REIMS. Results of the site-specific nature and extent review will be used to further define and develop the RI groundwater sampling program that considers areas of Camp Ravenna with comingled contaminant plumes. Where practical, individual AOC monitoring well networks will be combined to provide area-wide “Plume Groups” with primary groundwater COPC delineation points shared for multiple AOCs. Similarly, EPCs to be used for the BRA will be based on monitoring wells within contiguous plume extents for comingled COPCs associated with multiple individual source areas.

3.8 MONITORING WELL NETWORK REVIEW

During the course of the FWGW RI, as a follow-up to the monitoring well network evaluation completed as part of the RIWP, the monitoring well network will be assessed for both physical competency and technical adequacy. During each comprehensive water level measurement event conducted annually, the physical condition of all wells will be inspected. Per the FSP in **Appendix A.1**, this inspection will include components such as protective casing conditions, locking effectiveness, bollard placements and conditions, labelling, and total well depths.

Newly acquired laboratory data will be compared to historical groundwater chemistry results to identify potential monitoring well issues (such as changed/impaired well screen or filter pack conditions) and those possible effects on groundwater chemistry (such as inorganic concentrations increasing due to the decreased effectiveness of the filter pack). Groundwater chemistry results will also be scrutinized following each sampling event to assess the overall delineation of FWGW impacts, both horizontally and vertically across Camp Ravenna. Data gaps in the monitoring well network (pertaining to both groundwater chemistry objectives and hydrogeological purposes) will be re-assessed as the FWGW RI progresses. All newly installed wells will be sampled for four consecutive quarters.

3.9 RISK ASSESSMENT

A Baseline Risk Assessment (BRA) will be conducted in accordance with EM 200-1-4 and U.S. EPA Risk Assessment Guidance for Superfund (RAGS). It will be based on groundwater data collected during this RI, and based as allowed on historical groundwater data. The BRA will include both a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA), and will be consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

3.9.1 Human Health Risk Assessment

The HHRA will be prepared in compliance with applicable facility-wide risk documents, specifically, the February 2014 Risk "Tech Memo" FINAL TECHNICAL MEMORANDUM: *Land Uses and Revised Risk Assessment Process for the Ravenna Army Ammunition Plant Installation Restoration Program*, Portage/Trumbull Counties, Ohio (ARNG, 2014). As noted in the Risk "Tech Memo," the RA will also follow the basic risk assessment techniques and general risk assessment methods for Camp Ravenna restoration risk assessments in the following current risk assessment guidance documents; however, the methods in the Risk "Tech Memo" will take precedence. These current guidance documents are:

- United States Army Corps of Engineers (USACE). 2005. *Ravenna Army Ammunition Plant Facility-Wide Human Health Risk Assessor Manual* (FWHHRAM), Amendment 1. Prepared by the USACE, Louisville District. November 2005.
- Science Applications International Corporation (SAIC)/USACE. 2010. *Facility-wide Human Health Cleanup Goals*, Ravenna Army Ammunition Plant, Ravenna, Ohio (FWCUG Report). March 2010.
- USACE. 2012. Ravenna Army Ammunition Plant (RVAAP) *Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals* (FWCUG Position Paper). Revised January 2012.
- USEPA. *Risk Assessment Guidance for Superfund (RAGS)* Parts A, B, C, D, E, and F. 1989 through 2009.

The baseline HHRA procedures, including data groupings by Plume Group, exposure scenarios, exposure parameters, and toxicity information, will be approved by ARNG and the regulators prior to executing the HHRA. The Risk "Tech Memo" will be the primary source for these procedures. Risk scenarios for current and future land uses will be assessed consistent with other studies conducted at Camp Ravenna. Baseline risks (expressed non-carcinogenic hazard indexes and incremental cancer risks) for the FWGW RI will allow informed remedial decisions during subsequent phases of work in the CERCLA process.

The three exposure scenarios that will be evaluated are:

- Unrestricted (Residential) Land Use – Resident Receptor (Adult and Child)
- Military Training Land Use – National Guard Trainee.
- Commercial/Industrial Land Use – Industrial Receptor (USEPA's Composite Worker).

COPCs will be determined using the lower of constituent-specific USEPA MCLs or the most recent RSLs based on the carcinogenic risk level of $1x10^{-6}$ and the target hazard quotient of 0.1. Chemicals less than background will be excluded as COPCs. The USEPA Industrial RSLs will be used for the Commercial/Industrial Land Use. If the maximum concentration of a chemical exceeds these levels, the chemical will be considered to be a COPC for further evaluation. If a chemical without a USEPA residential RSL for tap water is detected in groundwater, this chemical will be retained as a COPC. A surrogate Facility-Wide Cleanup Goal (FWCUG) will be developed for such constituents or another approach (i.e., use of an RSL from a surrogate chemical – a chemical with similar chemical characteristics) will be used with concurrence from Ohio EPA, as discussed in the FWCUG Position Paper.

The exposure factors used for the residential receptor and the National Guard trainee will be obtained from the FWCUG Report or the FWHHRAM. The exposure parameters for the Industrial Receptor will be current industrial values at the time the risk assessment is completed and will be obtained from the USEPA’s Industrial RSL User’s Guide. FWCUGs based on the toxicity values available in the USEPA's Integrated Risk Information System (IRIS) at the time the risk assessment is completed will be used.

If multiple carcinogenic COPCs and multiple non-carcinogenic COPCs are identified in a discrete groundwater plume, then a multiple chemical evaluation (Sum of Ratios approach described in the FWCUG Position Paper) will be used to assess risk from groundwater exposure. The FWCUGs for the Resident Receptor will be used when assessing the Unrestricted (Residential) Land Use. The National Guard Trainee's FWCUGs will be used when assessing the Military Training Land Use. The USEPA's Industrial RSLs will be used for the Commercial/Industrial Land Use.

Cumulative risk and the noncancer hazards for multiple chemical evaluations will be performed using a representative EPC for each distinct water-bearing interval. A complex groundwater sampling program has been designed to ensure regulatory concurrence on representativeness of current conditions. EPCs for the various discrete contaminant plumes (within distinct water-bearing intervals) that are used in the risk assessment will be based on the data collected from this sampling program. The EPCs for groundwater will be developed in accordance with the most recent U.S. EPA guidance for EPC determination (USEPA, 2014). COC results from groundwater samples collected within the past year are preferred for use in the source term concentration statistical analyses (e.g., in relatively mobile plume environments). The wells will be sampled at a frequency to meet the USEPA's minimum dataset requirements for developing EPC statistics. The 95 percent upper confidence limit on the mean will be used as the EPC for each constituent present above screening levels. In some cases, contaminant type and relative permeability of the aquifer matrix material (e.g., organic contaminants in unconsolidated glacial till material), the maximum concentrations will be used as the EPC in the risk assessment.

If the cumulative groundwater carcinogenic risk exceeds $1x10^{-5}$, remedial action is warranted. If the cumulative non-carcinogenic hazard index (HI) exceeds 1, HI will be segregated by target endpoints. If the HI based on a segregated endpoint exceeds 1, remedial action is warranted for that chemical.

3.9.2 Screening Level Ecological Risk Assessment

As stated in the March 2015 FWGMP report (EQM, 2015), "the local variations in flow direction suggest: (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, the upper portion of the Sharon Sandstone is in direct communication with surface water at Sand Creek in the vicinity of Demolition Area #2 (EQM, 2015). Therefore, as part of the RI, a screening level ecological risk assessment (SLERA) will be prepared to address the potential for groundwater discharge to impact surface water. A surface water and sediment investigation is being conducted separately for Camp Ravenna. Although groundwater discharge to the surface water pathway is typically evaluated through surface water exposure, an ecological assessment specifically of groundwater will be performed to ensure that groundwater remedial measures will adequately protect ecological receptors in the future.

The technical approach for the ERA will follow the eight-step iterative process for an ERA. A SLERA (i.e., Steps 1 and 2) will be executed for the FWGW AOC, including Step 3a, Refinement of COPECs, as needed, to examine the conservative assumptions used in Steps 1 and 2. The more comprehensive baseline ecological risk assessment (BERA) steps (Steps 3 through 8) will be conducted if the scientific management decision point at completion of the SLERA indicates that a BERA is necessary. If the scientific management decision point indicates that the ERA process should proceed, a data gap analysis will be performed to determine if additional data are necessary to prepare a BERA.

Screening levels for surface water will be used to initially assess potential for groundwater discharge of contaminants as part of Steps 1 and 2 of the SLERA. The surface water screening levels will be ambient water quality criteria. The proposed facility-wide cleanup level for fish and fish-eating receptors are the general receptor of aquatic life related to the Ambient Water Quality Criteria (AWQC) (SAIC, 2008). Statewide water quality criteria for the protection of aquatic life are provided in OAC Rule 3745-1, and include numeric values for inside mixing zone maximum (IMZM), outside mixing zone maximum (OMZM), and outside mixing zone average (OMZA). Groundwater will be compared to chemical-specific OMZA criteria and OMZM to determine whether groundwater poses a potential risk to ecological receptors. If state criteria are not available for a chemical, other literature sources of surface water screening levels will be used including (but not limited to) USEPA Region 5 Ecological Screening Levels (ESLs), LANL Eco Risk Database 3.2 ESLs, USEPA Region 4 Ecological Screening Values (ESVs) for freshwater, and Final Facility-Wide Biological and Water Quality Study 2003 Ravenna Army Ammunition Plant (November 2005) (USACE, 2005).

If groundwater concentrations exceed screening levels, refinement of COPCs will be performed under Step 3a of the ERA process. The refinement will include:

- Use of a representative average exposure concentration in order to evaluate a more realistic exposure of receptors to the range of media concentrations.

- Comparison to background values, especially for metals that are naturally occurring.
- Use of low effect toxicity values (e.g., acute criteria) to assess the range of potential hazards.
- Fate and transport modeling to predict whether groundwater will discharge to surface water at concentrations exceeding criteria.

The BIOCHLOR model will be used to predict whether the maximum detected concentration of each COC in groundwater will discharge to surface water at a concentration that will pose a potential risk to aquatic organisms. The BIOCHLOR model, developed by Groundwater Services, Inc. of Houston, Texas for the Air Force Center for Environmental Excellence, will be used to predict the contaminant concentration along the centerline of a groundwater plume and potentially discharging to surface water at concentrations above surface water criteria. BIOCHLOR is available for download at http://www2.epa.gov/water-research/biochlor-natural-attenuation-decision-support-system. BIOCHLOR, programmed in the Microsoft Excel spreadsheet environment, is based on the Domenico analytical solute transport model and has the ability to simulate 1-D advection, 3-D dispersion, linear adsorption, and biotransformation via reductive dechlorination (the dominant biotransformation process at most chlorinated solvent sites). Dissolved solvent degradation is assumed to follow a sequential first order decay process (Aziz et al., 2000; 2002). Site-specific modeling inputs will be used, as well as common modeling inputs recommended in the Ohio EPA Technical Guidance Manual for Groundwater Investigations and the Ohio Bureau of Underground Storage Tank Regulations (BUSTR) guidance (2009; 2014).

3.10 WELL ABANDONMENT

During the course of the FWGW RI, a total of 10 ARNG-selected historical groundwater production wells and selected monitoring wells (to be determined) will be abandoned. The Well Abandonment Work Plan (WAWP) (TEC-Weston JV, 2016) describes in detail the activities associated with performing these well abandonments. The Ohio EPA will be notified in writing prior to beginning any abandonment activities. Submittal of the letter will be coordinated with OHARNG.

Abandonment of the 10 ARNG-prescribed production wells will eliminate a potential chemical hazard pathway by preventing a conduit for potential groundwater contamination migration between aquifers. Physical hazards will also be eliminated by the removal of a direct physical exposure pathway to the groundwater via the production wells.

Abandonment of selected monitoring wells will prevent contamination of the groundwater; prevent physical hazards; eliminate unnecessary, inadequate, and/or improperly installed monitoring wells; and minimize threats to the various aquifers and related groundwater receptors. Monitoring wells will be selected for abandonment based on Ohio EPA concurrence with the final monitoring network, which will be determined later in the FWGW RI process.

Abandonment of the wells will be performed as described in the State of Ohio *Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes* (Technical Guidance) (OWRC, 2015), documented in accordance with Ohio Revised Code 1521.05(B), performed per the TGM Chapter 9, *Sealing Abandoned Monitoring Wells and Boreholes*, per relevant portions of FWSAP (SAIC, 2011), and per the WAWP (TEC-Weston JV, 2015).

Well Abandonment Report(s) will be submitted to ARNG/OHARNG (and ultimately to the regulators) following the completion of all well abandonment activities. The report(s) will summarize the well abandonment processes and procedures used during all field activities conducted. It will describe pre-mobilization, mobilization, site preparation, depth to water and total depth measurements, casing diameters, decontamination, waste management, the chronology of events. It will include associated figures and tables. The report will also include the ODNR well sealing reports for all of the abandoned wells.

4.0 ENVIRONMENTAL PROTECTION PLAN

The environmental resources within the project boundaries and those affected outside the limits of permanent work under this contract will be protected during the entire period of this contract. The TEC-Weston JV will confine its activities to areas defined by this RIWP. This section is derived predominantly from the *Final Site Inspection and Remedial Investigation Work Plan at Compliance Restoration Sites* (ECC, 2012).

4.1 PROTECTION OF NATURAL RESOURCES

Prior to the beginning of field operations, TEC-Weston JV will identify, in consultation with Camp Ravenna stakeholders, all land resources to be preserved within the work area. The TEC-Weston JV will not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the stakeholders. The RI activities will involve minimal ground disturbance; therefore, impacts to streams and wetlands or and other natural resources will be minimal. Where site work will involve ground disturbance, such as path clearing for drill rig access, best management practices and erosion control methods such as hay bales and silt fences will be installed. Avoidance measures (avoiding impacts/disturbance to streams and wetlands) will also be used. Areas impacted by investigation activities will be restored to pre-investigation conditions. The TEC-Weston JV will conduct a thorough review of the OHARNG 2014 Integrated Natural Resource Management Plan (OHARNG, 2014) and of each site to be aware of the ecological resources at the sites prior to the beginning of work. Erosion controls will be maintained until the site work is completed and 70% of the area is revegetated (see additional details in Section 4.2 of the FSP provided as **Appendix A.1**).

4.2 PROTECTION OF LANDSCAPE

Trees, shrubs, vines, grasses, landforms, and other landscape features to be preserved will be clearly identified. Except in work areas, trees or shrubs will not be removed, cut, defaced, injured, or destroyed without the permission from the stakeholders. The TEC-Weston JV will minimize the removal of vegetation by relocating a sampling point, if necessary. Any brush that is generated as a result of vegetation removal will be chipped and spread onsite.

Tree clearing must be performed between 1 October and 31 March due to the presence of the Northern long-eared bat. If a tree with a diameter at breast height (dbh) equal to or greater than three inches dbh needs to be removed, the OHARNG will be notified prior to removal. A poly liner will protect any areas accessed for the purpose of transporting or transferring IDW or solid waste materials. All clearing of vegetation will be coordinated with the OHARNG prior to removal.

4.3 PROTECTION OF CULTURAL RESOURCES

A large portion of the facility has been surveyed for cultural and archaeological resources. In the unlikely event that archeological or cultural resources are identified during work activities, sites will be handled in accordance with the OHARNG Procedure for Inadvertent Discovery of Cultural Materials (provided as **Attachment 2** and briefly described below). The Phase I Archaeological Survey Work Plan (currently a draft document dated November 2015) will also be used as appropriate, should TEC-Weston JV be required to conduct such surveys (for new wells outside the perimeter fence).

In the event that artifacts or human remains are encountered (within or outside of surveyed areas), the following steps should be followed:

a) Immediately stop the ground disturbing activity.
b) Report any observations or discoveries of artifacts or human remains immediately to Camp Ravenna Range Control (614-336-6041). Range Control will immediately notify the OHARNG Cultural Resources Manager (CRM)/ Camp Ravenna Environmental Office.
c) The Range Control or the CRM will secure any artifacts ort human remains, as appropriate. If human remains are suspected, they are not to be disturbed and Range Control will promptly notify State Highway Patrol or Federal Bureau of Investigation, as appropriate.
d) The CRM and Range Control will take measures to protect the location from further disturbance until appropriate parties are notified.
e) If a site area or burial is identified as the source of the materials discovered, the CRM will make arrangements for site recordation and stabilization, in consultation with the Ohio Historic Preservation Office (OHPO) and any interested Native American Tribes.

4.4 DISPOSAL OF NON-REGULATED WASTE

Disposal of investigation derived waste, trash, and other materials will be handled in accordance with all applicable federal, state, and local rules, regulations, laws, and Camp Ravenna Waste Management Guidelines. Potential non-hazardous waste streams resulting from planned activities (well installation, sampling, and abandonment) could potentially include the generation of water from well development; purging and decontamination activities; drill cuttings; grout remnants (potentially including grout water waste); and concrete, steel surface completions, and casing from abandoned wells. Additional details regarding the handling of IDW is discussed in Section 6.0.

4.5 DISPOSAL OF HAZARDOUS WASTE

The generation of hazardous waste during the completion of the planned activities is not expected to occur. In the unlikely event that they are generated, RCRA hazardous wastes that are generated during execution of the work described herein will be transported offsite and managed properly in accordance with Section 7 of the FSP (**Appendix A.1**).

4.6 PROTECTION OF WATER RESOURCES

The TEC-Weston JV will keep field operations under surveillance, management, and control to avoid pollution of surface water and groundwater. The TEC-Weston JV intends to protect streams and wetlands by not disturbing these areas. Based on review of the 2014 update to the Camp Ravenna INRMP, several new well installation locations currently proposed for the current RI project (See **Figures 1-19 and 3-1 through 3-3** for well locations) were identified to be within 500 feet of surface water features. **Table 4-1** summarizes proposed new well locations with distance and direction to the nearest surface water within 500 feet (water body locations obtained from the December 2014 update to the Camp Ravenna INRMP, [OHARNG, 2014]). During field activities at locations adjacent to water bodies or wetlands precautions will be taken to prevent disturbance and any leaks or spills from the drilling rig or vehicles on site. Frequent inspections will be conducted to ensure equipment leaks are prevented. In the unlikely event of a leak or spill ICP notification and mitigation procedures applicable to non-reportable quantities of petroleum will be followed. A description of impact prevention practices to be utilized during well abandonment is provided in the Well Abandonment Work Plan under separate cover.

4.7 SPILL CONTROL

Special measures will be taken to prevent any chemicals, fuels, oils, greases, waste washings, herbicides, insecticides, rubbish or sewage, and other pollutants from entering surface waters. In addition, the TEC-Weston JV will have spill supplies on hand and will respond to any on-site spills in accordance with the facility spill plans. Although the risk of spills during the completion of the planned field activities is considered to be low, a copy of the March 2015 version of the Camp Ravenna Integrated Contingency Plan (ICP) will be kept onsite at all times. Spill responses will be conducted in accordance with the Camp Ravenna Integrated Contingency Plan, to include actions specified in Section 3.2 Initial Response of the ICP and completion of a First Responder Reporting Form (provided as **Attachment 3**). All spills will be reported to Camp Ravenna Range Control.

5.0 PROJECT DOCUMENTATION AND SAMPLE QA/QC

This section is derived predominantly from the *Final Site Inspection and Remedial Investigation Work Plan at Compliance Restoration Sites* (ECC, 2012).

5.1 PROJECT DOCUMENTATION

5.1.1 Monthly Status Reports

For sampling QA/QC measures, Monthly Status Reports (MSRs) will be submitted by the fifth of each month in accordance with the PWS.

5.1.2 Sample Handling and Tracking

Samples will be prepared, packaged, and shipped in accordance with the FWSAP (SAIC, 2011a) and the FSP (**Appendix A.1**). Exceptions to the FWSAP (SAIC, 2011a) procedures will include:

- All VOC sample containers will be placed in either foam bubble wrap or paper towels to reduce the potential for breakage during shipping.

Sample handling will be in accordance with Section 5 of the FSP (**Appendix A.1)**. The laboratory's chain of custody will be used to document the integrity of all samples collected. A copy of each chain will be forwarded to the TEC-Weston JV office for sample tracking purposes.

5.1.3 Field Activities Coordination

Field activities will be coordinated with the ARNG/OHARNG and Ohio EPA prior to fieldwork. During the performance of the FWGW RI, field activities will be coordinated on a daily basis with Camp Ravenna Range Control. Additionally, weekly updates will be discussed at the bi-weekly contractors' meeting with the ARNG, OHARNG, and any other contractors that are operating within or near the work site. TEC-Weston JV will coordinate closely with the OHARNG with the various field activities required for executing this RIWP, and will coordinate our field activities to avoid interference with on-going OHARNG training and transportation activities during all phases of this work.

5.2 FIELD AND LABORATORY QA/QC

QA/QC samples will be collected as completely separate replicate investigative samples. The QA/QC samples will be collected using the same methods as the original sample, from a set of random locations. These QA/QC samples will be prepared and analyzed in the same manner as the original investigative samples, as more fully described in the SAP (**Appendix A**). Geotechnical logging of subsurface soil materials while drilling for monitoring well installations will be conducted as prescribed in the FWSAP (SAIC, 2011a).

5.3 COMMUNITY RELATIONS

5.3.1 Bi-Weekly Conference Call and Restoration Advisory Board Meetings

The TEC-Weston JV will participate in the bi-weekly conference calls with the ARNG and OHARNG to provide updates on the project activities. Additionally, the TEC-Weston JV will prepare presentation materials, as required, and support the ARNG/OHARNG at Restoration Advisory Board (RAB) meetings to discuss the activities and findings of the field investigations, as directed to do so by the ARNG.

5.3.2 Proposed Plan Notices, Fact Sheets, and Other Support

The TEC-Weston JV will provide public participation support for the Proposed Plan by developing fact sheets, newspaper public notices, press releases/media advisories and briefing sheets, as necessary. We will secure the location for, provide support to, and attend a public meeting to present the Proposed Plan, respond to comments, and provide project information to concerned residents and stakeholders as necessary.

6.0 DISPOSITION OF INVESTIGATION-DERIVED WASTE

This section is derived predominantly from the *Final Site Inspection and Remedial Investigation Work Plan at Compliance Restoration Sites* (ECC, 2012). All IDW, including personal protective equipment, disposable sampling equipment, and decontamination fluids, will be segregated, handled, labeled, characterized, managed, and disposed in accordance with federal, state, and local rules, regulations, and laws, Section 7.5 of the FSP, and the March 2015 Camp Ravenna Waste Management Guidelines. The waste will be temporarily stored at Building 1036 pending disposal.

The IDW will be segregated by type of medium and will be containerized as follows:

- Personal protective equipment and disposable sampling equipment will be containerized in Department of Transportation (DOT)-approved 55-gallon steel drums and staged at the temporary waste accumulation area (Building 1036) pending sample analysis.
- Water used to decontaminate large and small equipment and purge water will be containerized in poly tanks or DOT-approved drums and staged at the temporary waste accumulation area at Building 1036 on secondary containment pending sample and waste characterization analysis.
- Decontamination and preservation fluids will be containerized in poly tanks or DOT-approved drums and staged at the temporary waste accumulation area pending sample and waste characterization analysis.
- Well casing, excess grout and grout water, drill cuttings, concrete, and scrap metal remnants may potentially be generated. These wastes would also be containerized in approved 55-gallon steel drums and staged at the temporary waste accumulation area (east side Building 1036) pending sample analysis.
- Although not expected, any explosive soil will be considered to fall into the MEC category. MEC are defined as follows:

    a) Unexploded ordnance, as defined in 10 United States Code (U.S.C.) 2710(e)(9);
    b) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710 (e)(2); or
    c) Munitions constituents (e.g., TNT, hexahydro-1,3,5-trinitro-1,3,5-trazine [RDX]) present in high enough concentrations to pose an explosive hazard (USACE, 2004). “Pink water” is a listed Resource Conservation and Recovery Act (RCRA) hazardous waste, which may be encountered during this project.

- All IDW will be properly removed and disposed within 90 days of waste generation.

IDW will be characterized as it is generated. It will be sampled for characterization after generation has filled a container with a particular waste stream. The characterization results, classification, and disposition of the IDW will be documented in an IDW Plan that is submitted to the ARNG/OHARNG for review and approval. Weekly waste inspections and logging will be conducted in accordance with the Camp Ravenna Waste Management Guidelines. Characterization, transportation, and disposal of the IDW will comply with federal, state and local rules laws and regulations, as well as the permit requirements for the receiving facility as applicable. In the event environmental sample data indicates that an IDW stream is potentially hazardous, Toxicity Characteristic Leaching Procedure (TCLP) samples (TCLP testing to include VOCs, SVOCs, metals, herbicides, and pesticides) and samples for a determination of reactivity, corrosivity and ignitibility, will be collected for additional characterization purposes (see the FSP, **Appendix A.1** for additional details regarding IDW characterization sampling). All shipments of IDW off-site will be coordinated through the OHARNG Restoration Manager for review, approval, and signature of profiles and manifests. Disposition will be based on the results of the laboratory analyses for the bulk quantity in accordance with all federal, state and local rules, laws and regulations. Labeling of all IDW containers will be in accordance with Section 7.2 of the FSP.

Although not expected to be generated during the pending RI field work, any explosive soil will be considered to fall into the MEC category. MEC are defined as follows:

a) Unexploded ordnance, as defined in 10 United States Code (U.S.C.) 2710(e)(9);
b) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710 (e)(2); or
c) Munitions constituents (e.g., TNT, hexahydro-1,3,5-trinitro-1,3,5-trazine [RDX]) present in high enough concentrations to pose an explosive hazard (USACE, 2004).

With respect to condition (c) above, soil containing a concentration of secondary explosives (e.g., TNT or RDX) of 10 percent or greater by weight is considered an explosive hazard (USACE, 2007). Explosive soil is, therefore, considered MEC, and it carries the RCRA D003 hazardous waste code for reactivity.

7.0 SCREENING LEVELS

The analytical results of the groundwater sampling conducted as part of FWGW RI will be compared to appropriate human health and ESLs. The end result of the initial data screening process will be a list of COPCs and chemicals of potential ecological concern (COPEC).

Human health screening levels will follow the below-listed hierarchy:

- USEPA tap water RSLs (most recent; based on TR of 10-6 and THQ of 0.1).
- Other sources of screening levels (described below).

Results will also be screened against FWGW background chemistry values for inorganic parameters. If chemical concentrations are less than the established background values, those chemicals will not be identified as COPCs. For detected chemicals lacking screening level from the above sources, a surrogate FWCUG will be developed or another approach (i.e., use of an RSL from a surrogate chemical – a chemical with similar chemical characteristics) will be used with concurrence from Ohio EPA, as discussed in the FWCUG Position Paper.

Screening levels for surface water will be used to initially assess potential for groundwater discharge of contaminants. Wells that may discharge to surface water will also be screened against ecological cleanup goals (i.e., AWQC). Statewide water quality criteria for the protection of aquatic life are provided in OAC Rule 3745-1; groundwater will be compared to chemical-specific OMZA criteria. If state criteria are not available for a chemical, other literature sources of surface water screening levels will be used including (but not limited to) USEPA Region 5 ESLs, LANL Eco Risk Database 3.2 ESLs, and USEPA Region 4 ecological screening values (ESVs) for freshwater. Selection of alternative ecological screening levels will be in concurrence with Ohio EPA.

Screening of results will also consider the following:

- Chemicals that were never detected will be eliminated as COPCs and COPECs.
- Chemicals identified as essential nutrients will be screened out (i.e., calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium).

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8.0 SCHEDULE AND DELIVERABLES

8.1 PROJECT SCHEDULE

The project schedule developed for this RIWP is provided as **Figure 8-1**. As illustrated, the FWGW RI fieldwork is comprised of the 1st Half 2016 FWGW sampling event (first of several sampling events) scheduled to occur in April-May 2016 (pending Ohio EPA approval of work plan components associated with the FWGW monitoring program). The first monitoring well installation task is scheduled to occur in August 2016. Production well abandonments are scheduled to begin in August 2017. The monitoring well abandonments are scheduled to begin in 2018, following regulatory approval of the Final RI Report. Ohio EPA approval of the FWGW RI Report is anticipated in March 2018.

8.2 DELIVERABLES

All deliverables generated for the FWGW RI will be submitted in accordance with the most recent version of the Camp Ravenna Submission Format Guidelines (Version 21) (Vista, 2015). At a minimum, each report will be issued in preliminary draft, draft, and final versions. The preliminary draft is typically for ARNG/OHARNG review and comment only. Following ARNG/OHARNG approval of the preliminary draft version, the draft version will then be submitted for Ohio EPA for review and comment. The final version will be submitted to all stakeholders and will be accessible for public viewing following approval by the Ohio EPA. All final submittals will be submitted in hard copy and electronic (compact disc-read only memory [CD-ROM]) formats. A CD-ROM that includes the report, all data, and maps produced will be delivered with each version of a report.

The reports generated during the FWGW RI and other components of the TEC-Weston JV's Task Order consist of the following documents (currently anticipated submittal dates for each are provided on **Figure 8-1**):

- **Semi-Annual and Annual FWGW Reports.** Semi-annual reporting will be a letter format deliverable including summary tables of detected compounds, a general description of sampling methods and processes, sample location maps, issues/problems encountered with recommended corrective actions. The Annual FWGW reports will provide a detailed evaluation of the year's sample results, potentiometric elevation maps for each affected aquifer, analysis of trends and contaminant distribution, and recommendations for the next year's sampling program. The Annual FWGW Reports will include comprehensive laboratory results tables, copies of field data sheets and logbooks, and copies of the original laboratory reports.

- **Semiannual Facility-Wide Groundwater Monitoring Addenda (yearly submittal)**. The addenda provide a list of proposed monitoring wells and test methods for the subject year's semiannual monitoring program. The addenda describe changes to the FWGWM Program recommended from the previous year's monitoring scope, including the basis of recommended changes.
- **Phase I Archaeological Survey Report.** The report will include a discussion of the research design and field methods, summary of background research, results of fieldwork focusing on sites encountered and their descriptive attributes, artifact analysis, National Register of Historic Places (NRHP) significance assessment, recommendations, conclusions, references cited, and appendices.
- **Well Abandonment Report**. The report will summarize the well abandonment processes and procedures used during all field activities conducted. It will describe pre-mobilization, mobilization, site preparation, depth to water and total depth measurements, casing diameters, decontamination, waste management, the chronology of events. It will include associated figures and tables. The report will also include the ODNR well sealing reports for all of the abandoned wells.
- **RI Report**. The RI Report will include: a description of the site history and previous investigations; a description of the current RI activities including the background study; results of the hydrogeologic study regarding the multiple aquifers and surface water system; a description of the nature and extent of contamination (both on-site and off-site); a fate and transport assessment, risk screening using the most current EPA MCLs, RSLs, and FWCUGs; human health and ecological risk assessments (HHRA and ERA); and recommendations for further action.
- **FS Report.** The FS Report will summarize the RI, identify applicable and relevant and appropriate requirements (ARARs); identify preliminary remediation goals (PRGs) and Remedial Action Objectives (RAOs); conduct a technology screening; conduct treatability investigations (as needed); develop remedial alternatives; conduct an initial analysis of alternatives; and conduct an in-depth analysis of remaining alternatives.
- **Proposed Plan.** The Proposed Plan will present a synopsis of the various alternatives detailed in the FS and provide a detailed description of the preferred alternative/alternatives. It will also summarize the relative advantages and disadvantages of each of the considered alternatives as well as the risks associated with each. The remedy selected will meet the overall project goals to address groundwater contamination in the

various water-bearing zones and mitigate the migration of contaminated groundwater to downgradient receptors.

- **Record of Decision.** The Record of Decision (ROD) will describe the remedy selection decision for AOC RVAAP-66 Facility-Wide Groundwater, the comments and recommendations received on the preferred alternative, and the basis for selection of the alternative. This would include any institutional controls and continued groundwater monitoring requirements, as well as active remedies required due to complete exposure pathway findings.

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TABLES

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Table 1-1
Monitoring Well Construction Summary
Camp Ravenna

	Well ID	Ohio State Plane Easting	Ohio State Plan Northing	Ground Level Elevation	Total Drilled Depth	TOC Elevation	Well Head Type	Monitored Zone	Top of Screen (ft bgs)	Top of Screen Elevation	Bottom of Screen (ft bgs)	Bottom of Screen Elevation	Bottom of Inner Casing Plug or End Cap	Stickup Height	Reported Bottom of Inner Casing	May 2014 Measure Bottom of Inner Casing	Sediment Accumulation	Description of Bottom
Atlas Scrap Yard	ASYmw-001	2366260.85	558404.04	978.40	22.0	981.13	A	Sharon	11.0	967.4	21.0	957.4	21.0	2.73	23.7	23.12	0.58	hard
Atlas Scrap Yard	ASYmw-002	2366170.86	557887.86	982.00	20.0	985.24	A	Sharon	10.0	972.0	19.5	962.5	19.5	3.24	22.7	22.93	0.00	soft
Atlas Scrap Yard	ASYmw-003	2366651.49	558015.94	979.70	21.5	982.21	A	Sharon	11.0	968.7	21.0	958.7	21.0	2.51	23.5	23.50	0.00	hard
Atlas Scrap Yard	ASYmw-004	2367166.04	557640.81	977.10	27.8	979.66	A	Sharon	17.0	960.1	27.0	950.1	27.0	2.56	29.6	29.84	0.00	hard
Atlas Scrap Yard	ASYmw-005	2367448.16	557783.01	977.60	25.0	979.80	A	Sharon	14.0	963.6	24.0	953.6	24.0	2.20	26.2	27.15	0.00	hard medium
Atlas Scrap Yard	ASYmw-006	2366746.73	557257.72	980.20	27.0	983.01	A	Sharon	16.0	964.2	26.0	954.2	26.0	2.81	28.8	28.90	0.00	hard
Atlas Scrap Yard	ASYmw-007	2366834.49	556818.08	981.40	28.0	984.16	A	Unconsolidated	16.0	965.4	26.0	955.4	26.0	2.76	28.8	28.88	0.00	medium
Atlas Scrap Yard	ASYmw-008	2367475.07	557087.66	976.20	26.0	978.85	A	Unconsolidated	15.0	961.2	25.0	951.2	25.0	2.65	27.7	27.20	0.50	medium
Atlas Scrap Yard	ASYmw-009	2366631.94	557603.68	979.90	22.0	982.70	A	Sharon	11.5	968.4	21.5	958.4	21.5	2.80	24.3	24.19	0.11	soft
Atlas Scrap Yard	ASYmw-010	2366985.37	557270.61	978.20	28.0	981.05	A	Unconsolidated	17.0	961.2	27.0	951.2	27.0	2.85	29.8	31.14	0.00	hard
Building 1200	B12mw-010	2371292.81	565827.43	1002.72	21.0	1005.92	A	Sharon	10.0	992.7	20.0	982.7	20.0	3.20	23.2	22.80	0.40	hard
Building 1200	B12mw-011	2371416.15	565687.82	1003.76	24.7	1006.70	A	Sharon	14.0	989.8	24.0	979.8	24.0	2.94	26.9	26.68	0.22	hard
Building 1200	B12mw-012	2371430.41	565828.01	1003.43	22.3	1006.32	A	Sharon	12.0	991.4	22.0	981.4	22.0	2.89	24.9	24.82	0.08	hard
Building 1200	B12mw-013	2371221.00	565904.00	1001.80	22.0	1004.48	A	Sharon	11.5	990.3	21.5	980.3	21.8	2.68	24.25	24.15	0.10	hard
Background	BKGmw-004	2368852.97	569464.76	965.16	19.5	967.66	A	Unconsolidated	9.2	956.0	19.2	946.0	19.5	2.50	22	22.22	0.00	hard
Background	BKGmw-005	2340835.86	562288.45	1149.44	19.0	1151.94	A	Unconsolidated	8.2	1141.2	18.2	1131.2	18.5	2.50	21	20.92	0.08	hard
Background	BKGmw-006	2358643.96	571910.47	1026.38	35.1	1028.88	A	Sharon	24.7	1001.7	34.7	991.7	35.1	2.50	37.6	37.56	0.04	hard
Background	BKGmw-008	2372741.08	569654.23	970.40	25.0	972.90	A	Sharon	14.7	955.7	24.7	945.7	25.0	2.50	27.5	27.37	0.13	hard
Background	BKGmw-010	2371372.86	565540.54	1003.80	22.0	1006.18	A	Sharon	8.9	994.9	18.9	984.9	19.2	2.38	21.6	21.97	0.00	hard
Background	BKGmw-012	2367795.23	563918.86	997.57	59.8	1000.07	A	Sharon	38.6	959.0	59.6	938.0	59.8	2.50	62.3	62.01	0.29	soft
Background	BKGmw-013	2361627.39	558269.16	986.59	25.5	989.09	A	Unconsolidated	15.2	971.4	25.2	961.4	25.5	2.50	28	28.01	0.00	hard
Background	BKGmw-015	2361482.22	569339.87	1037.90	51.0	1040.40	A	Sharon	30.1	1007.8	50.1	987.8	50.4	2.50	52.9	52.99	0.00	hard
Background	BKGmw-016	2342407.08	553983.50	1098.42	19.0	1100.92	A	Unconsolidated	8.4	1090.0	18.5	1079.9	18.6	2.50	21.1	21.15	0.00	hard
Background	BKGmw-017	2346115.35	562452.04	1132.80	34.8	1135.30	A	Unconsolidated	23.2	1109.6	33.3	1099.5	33.6	2.50	36.1	35.91	0.19	medium
Background	BKGmw-018	2354993.91	570873.35	1043.06	24.7	1045.56	A	Sharon	14.5	1028.6	24.5	1018.6	24.7	2.50	27.2	27.53	0.00	hard
Background	BKGmw-019	2349882.14	559864.55	1108.24	34.0	1110.74	A	Unconsolidated	23.0	1085.2	33.0	1075.2	33.2	2.50	35.7	35.59	0.11	hard
Background	BKGmw-020	2357856.24	558756.24	1065.00	30.7	1067.50	A	Unconsolidated	20.5	1044.5	30.5	1034.5	30.7	2.50	33.2	33.22	0.00	hard
Background	BKGmw-021	2367622.95	571016.75	972.16	19.0	974.66	A	Unconsolidated	7.7	964.5	17.8	954.4	18.1	2.50	20.6	21.45	0.00	hard
C-Block Quarry	CBLmw-001	2343657.08	559403.12	1178.50	50.0	1181.08	A	Homewood	39.0	1139.5	49.0	1129.5	49.0	2.58	51.6	50.49	1.11	hard
C-Block Quarry	CBLmw-002	2343845.22	559044.48	1172.50	45.3	1175.24	A	Homewood	34.5	1138.0	44.5	1128.0	44.5	2.74	47.2	47.35	0.00	hard
C-Block Quarry	CBLmw-003	2343970.00	559695.52	1172.22	44.0	1175.06	A	Homewood	33.0	1139.2	43.0	1129.2	43.0	2.84	45.8	44.77	1.03	hard
C-Block Quarry	CBLmw-004	2343688.76	559951.58	1172.08	45.0	1174.84	A	Homewood	34.0	1138.1	44.0	1128.1	44.0	2.76	46.8	47.00	0.00	hard
C-Block Quarry	CBLmw-005	2344572.00	558686.00	1155.60	31.0	1158.10	A	Homewood	22.0	1133.6	30.0	1125.6	30.3	2.50	32.42	32.35	0.07	hard
Central Burn Pits	CBPmw-001	2367095.37	561616.01	972.71	32.3	975.84	A	Unconsolidated	21.8	950.9	31.8	940.9	31.8	3.13	34.9	34.25	0.65	medium

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Central Burn Pits	CBPmw-002	2367295.66	561865.83	967.33	30.0	970.04	A	Unconsolidated	19.5	947.8	29.5	937.8	29.5	2.71	32.2	31.61	0.59	medium
Central Burn Pits	CBPmw-003	2366768.68	561944.14	972.04	25.0	974.67	A	Unconsolidated	14.5	957.5	24.5	947.5	24.5	2.63	27.1	30.14	0.00	hard
Central Burn Pits	CBPmw-004	2366978.80	562123.80	968.58	27.5	971.13	A	Unconsolidated	17.0	951.6	27.0	941.6	27.0	2.55	29.5	29.64	0.00	medium
Central Burn Pits	CBPmw-005	2366919.66	562311.88	968.83	25.0	971.59	A	Unconsolidated	14.5	954.3	24.5	944.3	24.5	2.76	27.3	27.38	0.00	medium
Central Burn Pits	CBPmw-006	2367243.68	562311.87	965.01	23.0	967.64	A	Unconsolidated	12.5	952.5	22.5	942.5	22.5	2.63	25.1	25.19	0.00	medium
Central Burn Pits	CBPmw-007	2366512.62	562006.41	973.47	30.0	976.37	A	Unconsolidated	19.5	954.0	29.5	944.0	29.5	2.90	32.4	31.81	0.59	hard
Central Burn Pits	CBPmw-008	2366757.21	562668.84	970.57	25.5	973.19	A	Unconsolidated	15.0	955.6	25.0	945.6	25.0	2.62	27.6	27.94	0.00	hard
Central Burn Pits	CBPmw-009	2367174.00	561797.00	969.90	65.0	972.48	A	Sharon	54.0	915.9	64.0	905.9	64.3	2.58	66.55	66.80	0.00	medium
Cobbs Pond	CPmw-001	2368948.81	560440.91	975.46	16.0	975.26	F	Unconsolidated	5.5	970.0	15.5	960.0	15.5	-0.20	15.3	14.60	0.70	hard
Cobbs Pond	CPmw-002	2368239.23	560311.26	972.72	16.0	972.31	F	Unconsolidated	5.5	967.2	15.5	957.2	15.5	-0.41	15.1	14.95	0.15	hard
Cobbs Pond	CPmw-003	2368796.49	560676.30	973.27	18.5	972.92	F	Unconsolidated	8.0	965.3	18.0	955.3	18.0	-0.35	17.6	17.70	0.00	hard
Cobbs Pond	CPmw-004	2368674.31	561843.46	978.51	20.0	981.20	A	Unconsolidated	9.5	969.0	19.5	959.0	19.5	2.69	22.2	22.62	0.00	hard
Cobbs Pond	CPmw-005	2367900.41	561846.78	970.71	40.0	973.58	A	Unconsolidated	29.5	941.2	39.5	931.2	39.5	2.87	42.4	43.40	0.00	soft
Cobbs Pond	CPmw-006	2367727.13	562830.13	962.97	18.5	965.13	A	Unconsolidated	8.0	955.0	18.0	945.0	18.0	2.16	20.2	20.62	0.00	hard
Demolition Area 2	DA2mw-104	2354773.79	561129.59	1070.82	27.0	1073.89	A	Unconsolidated	16.3	1054.5	26.3	1044.5	26.5	3.07	29.6	29.22	0.38	hard
Demolition Area 2	DA2mw-105	2354557.62	560572.58	1042.66	14.0	1045.34	A	Unconsolidated	8.3	1034.4	13.3	1029.4	13.5	2.68	16.2	16.20	0.00	hard
Demolition Area 2	DA2mw-106	2354848.85	560560.49	1041.19	16.0	1043.79	A	Unconsolidated	8.3	1032.9	15.3	1025.9	15.5	2.60	18.1	16.77	1.33	hard
Demolition Area 2	DA2mw-107	2354924.29	560480.05	1039.18	15.0	1041.63	A	Unconsolidated	8.8	1030.4	13.8	1025.4	14.0	2.45	16.5	16.85	0.00	hard
Demolition Area 2	DA2mw-108	2355604.43	560181.78	1029.92	15.0	1032.36	A	Unconsolidated	9.3	1020.6	14.3	1015.6	14.5	2.44	16.9	17.18	0.00	hard
Demolition Area 2	DA2mw-109	2354793.14	559897.89	1068.66	24.0	1071.29	A	Unconsolidated	11.3	1057.4	21.3	1047.4	21.5	2.63	24.1	24.29	0.00	soft
Demolition Area 2	DA2mw-110	2355195.91	559927.02	1061.39	20.0	1063.78	A	Unconsolidated	9.3	1052.1	19.3	1042.1	19.5	2.39	21.9	22.33	0.00	hard
Demolition Area 2	DA2mw-111	2354728.33	560222.94	1039.63	12.6	1042.12	A	Unconsolidated	7.1	1032.5	12.1	1027.5	12.3	2.49	14.8	14.77	0.03	hard
Demolition Area 2	DA2mw-112	2355018.98	560378.36	1034.87	15.0	1037.44	A	Unconsolidated	8.8	1026.1	13.8	1021.1	14.0	2.57	16.6	17.05	0.00	hard
Demolition Area 2	DA2mw-113	2355153.13	560394.81	1034.51	14.0	1037.11	A	Unconsolidated	8.3	1026.2	13.3	1021.2	13.5	2.60	16.1	16.29	0.00	hard
Demolition Area 2	DA2mw-114	2355785.00	560109.00	1029.50	19.5	1031.90	A	Sharon Shale	9.2	1020.3	19.2	1010.3	19.5	2.40	21.8	21.79	0.01	hard
Demolition Area 2	DA2mw-115	2355269.00	560459.00	1035.40	44.0	1038.08	A	Sharon	33.8	1001.7	43.8	991.7	44.1	2.68	46.8	46.75	0.05	hard
Demolition Area 2	DET-001B	2354959.47	560820.03	1064.35	39.0	1065.85	A	Unconsolidated	34.0	1030.4	39.0	1025.4	39.0	1.50	40.5	38.55	1.95	hard
Demolition Area 2	DET-002	2355360.33	560664.71	1060.24	39.0	1061.24	A	Unconsolidated	34.0	1026.2	39.0	1021.2	39.0	1.00	40	42.06	0.00	soft
Demolition Area 2	DET-003	2355204.94	560456.10	1035.81	15.0	1036.81	A	Unconsolidated	7.0	1028.8	12.0	1023.8	12.0	1.00	13	15.98	0.00	hard
Demolition Area 2	DET-004	2355072.36	560454.22	1037.68	11.0	1038.68	A	Unconsolidated	6.0	1031.7	11.0	1026.7	11.0	1.00	12	13.80	0.00	hard
Erie Burning Grounds	EBGmw-123	2380049.21	571747.04	945.59	32.0	947.82	A	Unconsolidated	21.0	924.6	31.0	914.6	31.5	2.23	33.7	34.74	0.00	hard
Erie Burning Grounds	EBGmw-124	2380030.24	571618.07	939.02	32.0	941.39	A	Unconsolidated	20.0	919.0	30.0	909.0	30.5	2.37	32.9	32.65	0.25	soft
Erie Burning Grounds	EBGmw-125	2379679.20	571655.63	947.55	25.0	949.89	A	Unconsolidated	14.0	933.6	24.0	923.6	24.5	2.34	26.8	27.42	0.00	hard
Erie Burning Grounds	EBGmw-126	2380307.31	572348.81	938.20	28.0	940.61	A	Unconsolidated	15.2	923.0	25.2	913.0	25.5	2.41	27.9	27.75	0.15	hard

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Erie Burning Grounds	EBGmw-127	2380172.16	571083.61	940.21	30.0	943.07	A	Unconsolidated	19.0	921.2	29.0	911.2	29.5	2.86	32.4	32.82	0.00	hard
Erie Burning Grounds	EBGmw-128	2379892.79	570970.32	942.47	28.0	945.13	A	Unconsolidated	15.0	927.5	25.0	917.5	25.3	2.66	28	28.25	0.00	hard
Erie Burning Grounds	EBGmw-129	2379240.52	572035.68	941.97	29.0	944.36	A	Unconsolidated	16.0	926.0	26.0	916.0	26.0	2.39	28.4	30.94	0.00	hard
Erie Burning Grounds	EBGmw-130	2379220.69	570695.61	941.18	26.0	944.00	A	Unconsolidated	15.2	926.0	25.2	916.0	25.5	2.82	28.3	28.36	0.00	hard
Erie Burning Grounds	EBGmw-131	2379666.00	571655.00	947.50	71.0	950.08	A	Sharon	60.5	887.0	70.5	877.0	70.8	2.58	73.1	72.24	0.86	hard
Fuze and Booster Quarry	FBQmw-166	2349584.33	553123.86	1104.87	16.0	1108.86	A	Unconsolidated	5.5	1099.4	15.5	1089.4	15.5	3.99	19.5	19.88	0.00	hard
Fuze and Booster Quarry	FBQmw-167	2349675.45	553556.12	1112.05	18.0	1115.90	A	Unconsolidated	5.0	1107.1	15.0	1097.1	15.0	3.85	18.9	19.04	0.00	hard
Fuze and Booster Quarry	FBQmw-168	2350066.87	553620.85	1131.27	19.5	1133.91	A	Homewood	9.0	1122.3	19.0	1112.3	19.0	2.64	21.6	21.29	0.31	medium
Fuze and Booster Quarry	FBQmw-169	2349730.90	553681.21	1117.36	16.0	1120.58	A	Homewood	5.0	1112.4	15.0	1102.4	15.0	3.22	18.2	18.16	0.04	hard
Fuze and Booster Quarry	FBQmw-170	2350102.41	553975.40	1139.67	30.5	1142.26	A	Homewood	20.0	1119.7	30.0	1109.7	30.0	2.59	32.6	32.76	0.00	hard
Fuze and Booster Quarry	FBQmw-171	2350072.44	554230.93	1140.49	30.0	1143.55	A	Homewood	18.0	1122.5	28.0	1112.5	28.0	3.06	31.1	31.48	0.00	hard
Fuze and Booster Quarry	FBQmw-172	2349907.37	554322.17	1145.71	33.0	1150.09	A	Homewood	20.0	1125.7	30.0	1115.7	30.0	4.38	34.4	34.43	0.00	hard
Fuze and Booster Quarry	FBQmw-173	2350449.01	554491.35	1162.43	50.0	1165.94	A	Homewood	29.5	1132.9	49.5	1112.9	49.5	3.51	53	53.02	0.00	hard
Fuze and Booster Quarry	FBQmw-174	2350289.81	554142.44	1135.78	22.5	1139.97	A	Homewood	12.0	1123.8	22.0	1113.8	22.0	4.19	26.2	23.08	3.12	hard
Fuze and Booster Quarry	FBQmw-175	2350297.98	553989.24	1137.16	22.5	1140.73	A	Homewood	12.0	1125.2	22.0	1115.2	22.0	3.57	25.6	25.79	0.00	hard
Fuze and Booster Quarry	FBQmw-176	2350219.45	553273.33	1129.57	21.5	1131.91	A	Unconsolidated	11.0	1118.6	21.0	1108.6	21.0	2.34	23.3	23.56	0.00	soft
Fuze and Booster Quarry	FBQmw-177	2350112.18	553321.94	1125.73	22.5	1128.57	A	Homewood	12.0	1113.7	22.0	1103.7	22.0	2.84	24.8	24.72	0.08	soft
Facility-Wide	FWGmw-001	2368321.00	565739.00	953.60	17.5	956.62	A	Unconsolidated	7.0	946.6	17.0	936.6	17.3	3.02	20.05	19.99	0.06	hard
Facility-Wide	FWGmw-002	2367606.00	571015.00	970.60	71.0	973.10	A	Unconsolidated	57.0	913.6	67.0	903.6	67.3	2.50	70.05	69.60	0.45	medium
Facility-Wide	FWGmw-003	2344042.00	563118.00	1129.40	19.0	1131.96	A	Unconsolidated	8.5	1120.9	18.5	1110.9	18.8	2.56	21.1	21.06	0.04	hard
Facility-Wide	FWGmw-004	2356970.00	549319.00	1034.50	20.0	1037.15	A	Unconsolidated	9.5	1025.0	19.5	1015.0	19.8	2.65	22.6	22.47	0.13	medium
Facility-Wide	FWGmw-005	2338973.00	558510.00	1167.50	29.5	1170.10	A	Homewood	19.3	1148.3	29.3	1138.3	29.6	2.60	31.9	31.97	0.00	soft
Facility-Wide	FWGmw-006	2335421.00	553142.00	1181.90	18.0	1184.33	A	Unconsolidated	7.5	1174.4	17.5	1164.4	17.8	2.43	19.25	19.28	0.00	hard
Facility-Wide	FWGmw-007	2344785.00	548356.00	1072.80	30.0	1075.41	A	Unconsolidated	19.5	1053.3	29.5	1043.3	29.8	2.61	32.35	32.15	0.20	hard
Facility-Wide	FWGmw-008	2341569.00	555735.00	1109.00	21.0	1111.61	A	Unconsolidated	10.0	1099.0	20.0	1089.0	20.3	2.61	22.1	21.80	0.30	medium
Facility-Wide	FWGmw-009	2341998.00	556784.00	1099.50	18.5	1102.14	A	Unconsolidated	8.0	1091.5	18.0	1081.5	18.3	2.64	20.4	20.37	0.03	medium
Facility-Wide	FWGmw-010	2379060.00	565077.00	959.50	17.3	962.15	A	Unconsolidated	6.0	953.5	16.0	943.5	16.3	2.65	19.1	19.15	0.00	medium
Facility-Wide	FWGmw-011	2380390.00	566801.00	939.00	17.5	941.61	A	Unconsolidated	6.0	933.0	16.0	923.0	16.3	2.61	17.8	17.76	0.04	soft
Facility-Wide	FWGmw-012	2380389.00	566790.00	938.90	40.0	941.39	A	Sharon Shale	29.5	909.4	39.5	899.4	39.8	2.49	42.45	42.49	0.00	soft
Facility-Wide	FWGmw-013	2357460.00	559483.00	1057.10	34.5	1059.51	A	Sharon	24.0	1033.1	34.0	1023.1	34.3	2.41	36.7	36.70	0.00	hard
Facility-Wide	FWGmw-014	2341064.00	560957.00	1135.00	18.5	1137.57	A	Unconsolidated	8.3	1126.8	18.3	1116.8	18.6	2.57	21.15	21.11	0.04	hard
Facility-Wide	FWGmw-015	2358353.00	550179.00	1012.10	26.0	1014.51	A	Unconsolidated	13.5	998.6	23.5	988.6	23.8	2.41	26.35	26.24	0.11	soft
Facility-Wide	FWGmw-016	2358364.00	550171.00	1011.90	65.0	1014.39	A	Sharon	54.5	957.4	64.5	947.4	64.8	2.49	67.5	68.15	0.00	hard
Load Line 1	LL1mw-063	2376841.36	563650.53	992.20	27.4	994.84	A	Sharon	17.1	975.1	27.1	965.1	27.4	2.64	30	30.10	0.00	hard

Table 1-1
Monitoring Well Construction Summary
Camp Ravenna

	Well ID	Ohio State Plane Easting	Ohio State Plan Northing	Ground Level Elevation	Total Drilled Depth	TOC Elevation	Well Head Type	Monitored Zone	Top of Screen (ft bgs)	Top of Screen Elevation	Bottom of Screen (ft bgs)	Bottom of Screen Elevation	Bottom of Inner Casing Plug or End Cap	Stickup Height	Reported Bottom of Inner Casing	May 2014 Measure Bottom of Inner Casing	Sediment Accumulation	Description of Bottom
Load Line 1	LL1mw-064	2380286.97	563118.74	932.32	18.4	935.10	A	Unconsolidated	8.0	924.3	18.0	914.3	18.4	2.78	21.1	21.09	0.01	hard
Load Line 1	LL1mw-065	2380452.00	560916.92	941.53	20.5	944.41	A	Unconsolidated	10.2	931.3	20.2	921.3	20.5	2.88	23.4	23.12	0.28	hard
Load Line 1	LL1mw-067	2376545.30	565201.14	977.55	22.8	980.36	A	Sharon	12.8	964.8	22.5	955.1	22.8	2.81	25.6	25.73	0.00	hard
Load Line 1	LL1mw-078	2376275.85	564623.87	993.40	38.7	995.84	A	Sharon	28.7	964.7	38.2	955.2	38.7	2.44	41.1	41.14	0.00	hard
Load Line 1	LL1mw-079	2376228.31	563739.63	995.30	29.5	997.87	A	Sharon	29.5	965.8	38.9	956.4	39.5	2.57	42	41.94	0.06	hard
Load Line 1	LL1mw-080	2376845.07	562479.73	993.70	19.5	996.27	A	Sharon	9.5	984.2	19.0	974.7	19.5	2.57	22	22.38	0.00	hard
Load Line 1	LL1mw-081	2376672.66	563462.73	996.40	39.4	998.92	A	Sharon	29.4	967.0	38.9	957.5	39.4	2.52	41.9	42.02	0.00	hard
Load Line 1	LL1mw-082	2376977.38	562956.86	1003.70	39.0	1006.45	A	Sharon	28.9	974.8	38.5	965.2	39.0	2.75	41.8	41.51	0.29	hard
Load Line 1	LL1mw-083	2377074.80	563612.75	992.80	39.3	995.20	A	Sharon	29.1	963.7	38.6	954.2	39.3	2.40	41.7	41.45	0.25	hard
Load Line 1	LL1mw-084	2377316.02	563160.44	996.40	37.0	998.73	A	Sharon	26.7	969.7	36.3	960.1	37.0	2.33	39.3	39.11	0.19	hard
Load Line 1	LL1mw-085	2377246.94	562046.25	994.30	42.1	996.84	A	Sharon	32.2	962.1	41.6	952.7	42.1	2.54	44.7	45.24	0.00	hard
Load Line 1	LL1mw-086	2380437.00	561714.00	938.00	75.0	940.63	A	Unconsolidated	64.5	873.5	74.5	863.5	74.8	2.63	77.38	77.76	0.00	medium
Load Line 1	LL1mw-087	2378732.00	560375.00	941.80	17.5	944.32	A	Unconsolidated	7.0	934.8	17.0	924.8	17.3	2.52	18.55	18.13	0.42	medium
Load Line 1	LL1mw-088	2380525.00	561746.00	936.30	24.0	938.63	A	Unconsolidated	13.9	922.4	23.9	912.4	24.5	3.00	27.54	27.33	0.21	medium
Load Line 2	LL2mw-059	2375453.00	558020.00	964.33	19.5	966.67	A	Sharon	9.3	955.0	19.1	945.2	19.5	2.34	21.8	21.91	0.00	hard
Load Line 2	LL2mw-060	2375978.00	558022.00	958.93	18.3	961.57	A	Sharon	8.1	950.8	17.9	941.0	18.3	2.64	20.9	20.83	0.07	hard
Load Line 2	LL2mw-261	2373317.81	561898.25	1009.55	22.5	1011.40	A	Sharon	9.8	999.8	19.8	989.8	20.0	1.85	21.9	22.48	0.00	hard
Load Line 2	LL2mw-262	2373970.79	562219.87	1011.12	21.2	1012.62	A	Sharon	10.6	1000.5	20.6	990.5	20.8	1.50	22.3	22.68	0.00	hard
Load Line 2	LL2mw-263	2374289.51	561591.19	1009.42	22.2	1011.47	A	Sharon	10.8	998.6	20.8	988.6	21.0	2.05	23	23.46	0.00	hard
Load Line 2	LL2mw-264	2374532.00	561173.60	1010.10	20.5	1011.88	A	Sharon	9.8	1000.3	19.8	990.3	20.0	1.78	21.7	22.40	0.00	hard
Load Line 2	LL2mw-265	2375594.06	557972.91	959.47	22.5	961.24	A	Sharon	11.8	947.7	21.8	937.7	22.0	1.77	23.8	24.45	0.00	hard
Load Line 2	LL2mw-266	2373744.03	561981.86	1014.09	20.5	1016.28	A	Sharon	9.8	1004.3	19.8	994.3	20.0	2.19	22.2	22.73	0.00	hard
Load Line 2	LL2mw-267	2373715.04	561393.22	1012.81	20.5	1014.81	A	Sharon	9.8	1003.0	19.8	993.0	20.0	2.00	22	22.08	0.00	hard
Load Line 2	LL2mw-268	2374157.30	560831.04	1015.47	28.8	1017.28	A	Sharon	17.3	998.2	27.3	988.2	27.5	1.81	29.3	29.90	0.00	hard
Load Line 2	LL2mw-269	2374756.07	559484.12	1009.49	28.0	1011.62	A	Sharon	17.1	992.4	27.1	982.4	27.3	2.13	29.4	30.30	0.00	hard
Load Line 2	LL2mw-270	2372858.41	562655.93	1009.93	20.5	1010.18	A	Sharon	9.8	1000.1	19.8	990.1	20.0	0.25	20.3	22.44	0.00	hard
Load Line 2	LL2mw-271	2375714.00	557827.00	958.70	24.0	961.19	A	Sharon	14.6	944.1	24.6	934.1	24.8	3.00	27.8	27.78	0.02	hard
Load Line 3	LL3mw-232	2369862.96	561365.91	998.59	37.8	1000.41	A	Sharon	26.8	971.8	36.8	961.8	37.0	1.82	38.8	39.77	0.00	soft
Load Line 3	LL3mw-233	2369934.52	560750.41	1002.47	31.1	1004.36	A	Sharon	20.1	982.4	30.1	972.4	30.3	1.89	32.2	31.49	0.71	soft
Load Line 3	LL3mw-234	2370297.47	560058.89	1004.47	20.5	1006.56	A	Sharon	9.8	994.7	19.8	984.7	20.0	2.09	22.1	22.64	0.00	medium
Load Line 3	LL3mw-235	2370642.47	559812.63	1008.05	21.2	1009.94	A	Sharon	10.1	998.0	20.1	988.0	20.3	1.89	22.2	22.97	0.00	hard
Load Line 3	LL3mw-236	2371178.58	559866.75	1008.94	25.5	1011.17	A	Sharon	13.8	995.1	23.8	985.1	24.0	2.23	26.2	26.60	0.00	hard
Load Line 3	LL3mw-237	2371475.00	559328.09	1003.57	23.9	1005.57	A	Sharon	12.7	990.9	22.7	980.9	22.9	2.00	24.9	25.78	0.00	hard
Load Line 3	LL3mw-238	2370625.34	559569.06	1004.75	20.7	1006.91	A	Sharon	10.5	994.3	20.5	984.3	20.7	2.16	22.9	23.37	0.00	hard

Table 1-1
Monitoring Well Construction Summary
Camp Ravenna

	Well ID	Ohio State Plane Easting	Ohio State Plan Northing	Ground Level Elevation	Total Drilled Depth	TOC Elevation	Well Head Type	Monitored Zone	Top of Screen (ft bgs)	Top of Screen Elevation	Bottom of Screen (ft bgs)	Bottom of Screen Elevation	Bottom of Inner Casing Plug or End Cap	Stickup Height	Reported Bottom of Inner Casing	May 2014 Measure Bottom of Inner Casing	Sediment Accumulation	Description of Bottom
Load Line 3	LL3mw-239	2370895.01	559101.39	1001.70	35.7	1003.50	A	Sharon	24.9	976.8	34.9	966.8	35.0	1.80	36.8	36.90	0.00	soft
Load Line 3	LL3mw-240	2371309.57	558204.34	1005.60	35.5	1007.52	A	Sharon	24.4	981.2	34.4	971.2	34.6	1.92	36.5	36.64	0.00	soft
Load Line 3	LL3mw-241	2370332.80	559298.09	992.41	23.8	994.65	A	Sharon	12.7	979.7	22.7	969.7	22.9	2.24	25.1	25.57	0.00	hard
Load Line 3	LL3mw-242	2371993.30	557034.21	997.39	20.5	999.32	A	Sharon	9.8	987.6	19.8	977.6	20.0	1.93	21.9	22.53	0.00	hard
Load Line 3	LL3mw-243	2371532.61	556688.92	989.36	24.5	991.16	A	Sharon	13.8	975.6	23.8	965.6	24.0	1.80	25.8	26.36	0.00	hard
Load Line 3	LL3mw-244	2371456.00	556033.00	986.20	45.0	988.78	A	Sharon	34.5	951.7	44.5	941.7	44.8	2.58	47.25	46.87	0.38	medium
Load Line 3	LL3mw-245	2369249.00	558573.00	978.70	47.0	981.24	A	Sharon	36.5	942.2	46.5	932.2	46.8	2.54	48.9	48.78	0.12	medium
Load Line 3	LL3mw-246	2371441.00	555969.00	986.50	43.0	988.84	A	Sharon	32.8	953.7	42.8	943.7	43.0	2.75	45.75	45.59	0.16	hard
Load Line 4	LL4mw-193	2364237.44	554959.74	980.88	21.9	982.92	A	Unconsolidated	11.3	969.6	21.3	959.6	21.5	2.04	23.5	24.15	0.00	hard
Load Line 4	LL4mw-194	2364584.76	555088.18	981.87	22.0	983.76	A	Unconsolidated	11.3	970.6	21.3	960.6	21.5	1.89	23.4	23.49	0.00	hard
Load Line 4	LL4mw-195	2365198.84	555045.69	980.83	21.0	982.59	A	Unconsolidated	10.3	970.5	20.3	960.5	20.5	1.76	22.3	22.71	0.00	hard
Load Line 4	LL4mw-196	2365297.28	555212.59	982.56	20.0	984.55	A	Unconsolidated	9.2	973.4	19.2	963.4	19.4	1.99	21.4	21.76	0.00	hard
Load Line 4	LL4mw-197	2365385.95	555396.55	983.79	21.7	985.46	A	Unconsolidated	10.8	973.0	20.8	963.0	21.0	1.67	22.7	23.52	0.00	hard
Load Line 4	LL4mw-198	2364991.12	555440.99	981.61	22.0	983.42	A	Unconsolidated	10.3	971.3	20.3	961.3	20.5	1.81	22.3	21.70	0.60	hard
Load Line 4	LL4mw-199	2365421.66	554621.06	975.20	22.0	977.28	A	Unconsolidated	10.3	964.9	20.3	954.9	20.5	2.08	22.6	23.12	0.00	hard
Load Line 4	LL4mw-200	2365904.12	554579.72	985.97	23.5	987.93	A	Unconsolidated	12.6	973.4	22.6	963.4	23.0	1.96	25	25.10	0.00	hard
Load Line 4	LL4mw-201	2365417.00	554607.00	975.90	67.0	978.02	A	Sharon	56.5	919.4	66.5	909.4	66.8		70.15	70.00	0.15	hard
Load Line 5	LL5mw-001	2354625.07	554319.25	1125.00	24.0	1127.92	A	Homewood	14.0	1111.0	24.0	1101.0	24.0	2.92	26.9	27.33	0.00	medium
Load Line 5	LL5mw-002	2354571.52	554604.01	1125.80	25.0	1128.68	A	Homewood	15.0	1110.8	25.0	1100.8	25.0	2.88	27.9	27.54	0.36	hard
Load Line 5	LL5mw-003	2354964.47	554535.41	1124.70	21.0	1127.70	A	Unconsolidated	11.0	1113.7	21.0	1103.7	21.0	3.00	24	23.99	0.01	soft
Load Line 5	LL5mw-004	2355006.44	554073.73	1122.90	22.4	1125.81	A	Homewood	12.0	1110.9	22.0	1100.9	22.0	2.91	24.9	25.39	0.00	soft
Load Line 5	LL5mw-005	2354422.02	554152.73	1126.50	27.8	1129.42	A	Homewood	17.0	1109.5	27.0	1099.5	27.0	2.92	29.9	29.95	0.00	soft
Load Line 5	LL5mw-006	2354730.78	553984.82	1125.10	24.5	1128.00	A	Homewood	14.0	1111.1	24.0	1101.1	24.0	2.90	26.9	27.15	0.00	soft
Load Line 6	LL6mw-001	2353153.23	554214.84	NA	18.0	1124.16	F	Unconsolidated	7.0	NA	17.0	NA	17.0	0.00	17	17.61	0.00	hard
Load Line 6	LL6mw-002	2353820.09	553589.88	NA	23.0	1129.36	F	Unconsolidated	12.5	NA	22.5	NA	22.5	0.00	22.5	24.44	0.00	hard
Load Line 6	LL6mw-003	2353048.68	553544.34	NA	23.4	1125.38	A	Homewood	12.5	NA	22.5	NA	22.5	3.35	25.9	25.61	0.29	soft
Load Line 6	LL6mw-004	2353368.79	553431.82	NA	23.0	1125.39	A	Homewood	12.5	NA	22.5	NA	22.5	2.58	25.1	24.59	0.51	hard
Load Line 6	LL6mw-005	2353194.52	553170.76	NA	19.9	1120.47	A	Homewood	9.5	NA	19.5	NA	19.5	2.96	22.5	22.02	0.48	soft
Load Line 6	LL6mw-006	2352419.15	553165.28	NA	20.0	1124.37	A	Unconsolidated	7.0	NA	17.0	NA	17.0	0.00	17	17.82	0.00	hard
Load Line 6	LL6mw-007	2353354.89	552677.17	NA	20.0	1115.62	F	Homewood	9.5	NA	19.5	NA	19.5	0.00	19.5	19.41	0.09	hard
Load Line 6	LL6mw-008	2353616.00	553154.00	1121.30	17.8	1124.15	A	Unconsolidated	7.2	1114.1	17.2	1104.1	17.5	2.85	20.2	20.14	0.06	hard
Load Line 6	LL6mw-009	2353604.00	553149.00	1121.40	39.5	1123.75	A	Homewood	29.0	1092.4	39.0	1082.4	39.3	2.35	41.4	41.77	0.00	soft
Load Line 7	LL7mw-001	2352192.91	554925.77	1126.90	30.0	1129.64	A	Homewood	19.5	1107.4	29.5	1097.4	29.5	2.74	32.2	33.04	0.00	hard
Load Line 7	LL7mw-002	2351918.23	555126.55	1126.70	26.5	1129.55	A	Homewood	15.0	1111.7	25.0	1101.7	25.0	2.85	27.8	27.25	0.55	hard

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Load Line 7	LL7mw-003	2352351.04	555417.04	1118.23	31.5	1120.84	A	Homewood	21.0	1097.2	31.0	1087.2	31.0	2.61	33.6	33.54	0.06	hard
Load Line 7	LL7mw-004	2352035.20	555581.14	1123.30	29.5	1126.32	A	Homewood	19.5	1103.8	29.5	1093.8	29.5	3.02	32.5	32.25	0.25	hard
Load Line 7	LL7mw-005	2351741.47	555581.80	1133.30	28.2	1135.87	A	Homewood	18.0	1115.3	28.0	1105.3	28.0	2.57	30.6	30.37	0.23	hard
Load Line 7	LL7mw-006	2351879.92	555990.59	1120.70	28.0	1123.56	A	Homewood	17.5	1103.2	27.5	1093.2	27.5	2.86	30.4	30.34	0.06	hard
Load Line 8	LL8mw-001	2351666.10	552607.06	1118.69	24.0	1121.46	A	Unconsolidated	14.0	1104.7	24.0	1094.7	24.0	2.77	26.8	27.44	0.00	soft
Load Line 8	LL8mw-002	2351010.33	552408.18	1121.67	30.4	1124.51	A	Unconsolidated	20.0	1101.7	30.0	1091.7	30.0	2.84	32.8	32.02	0.78	medium
Load Line 8	LL8mw-003	2351359.25	552231.14	1116.30	21.0	1119.05	A	Unconsolidated	10.5	1105.8	20.5	1095.8	20.5	2.75	23.3	23.04	0.26	hard
Load Line 8	LL8mw-004	2351261.83	551807.58	1112.73	20.5	1115.75	A	Unconsolidated	10.0	1102.7	20.0	1092.7	20.0	3.02	23	22.74	0.26	hard
Load Line 8	LL8mw-005	2351748.32	551522.48	1112.51	24.0	1115.73	A	Homewood	14.0	1098.5	24.0	1088.5	24.0	3.22	27.2	26.93	0.27	soft
Load Line 8	LL8mw-006	2351483.58	551296.77	1114.33	24.2	1117.17	A	Homewood	14.0	1100.3	24.0	1090.3	24.0	2.84	26.8	27.08	0.00	medium
Load Line 9	LL9mw-001	2355817.04	556125.81	NA	21.6	1134.62	A	Homewood	10.5	NA	20.5	NA	20.5	2.78	23.3	23.32	0.00	hard
Load Line 9	LL9mw-002	2355907.76	556755.11	NA	21.0	1127.30	A	Homewood	10.0	NA	20.0	NA	20.0	2.42	22.4	22.75	0.00	hard
Load Line 9	LL9mw-003	2356635.21	556445.31	NA	22.0	1135.76	A	Homewood	11.5	NA	21.5	NA	21.5	2.30	23.8	24.22	0.00	hard
Load Line 9	LL9mw-004	2357338.76	556002.00	NA	33.0	1131.83	A	Homewood	22.0	NA	32.0	NA	32.0	2.91	34.9	34.67	0.23	hard
Load Line 9	LL9mw-005	2356505.95	557063.36	NA	20.6	1130.93	A	Homewood	10.0	NA	20.0	NA	20.0	3.30	23.3	23.51	0.00	hard
Load Line 9	LL9mw-006	2357446.67	556434.79	NA	26.8	1129.88	A	Homewood	16.0	NA	26.0	NA	26.0	2.90	28.9	28.84	0.06	hard
Load Line 9	LL9mw-007	2357024.34	557000.56	NA	19.0	1119.99	F	Homewood	8.5	NA	18.5	NA	18.5	0.00	18.5	17.94	0.56	hard
Load Line 10	LL10mw-001	2355272.22	555816.25	1130.00	28.0	1132.77	A	Homewood	17.0	1113.0	27.0	1103.0	27.0	2.77	29.8	29.59	0.21	hard
Load Line 10	LL10mw-002	2355710.51	555523.36	1124.40	28.0	1127.13	A	Homewood	17.0	1107.4	27.0	1097.4	27.0	2.73	29.7	29.81	0.00	hard
Load Line 10	LL10mw-003	2355389.92	555494.71	1127.40	26.4	1130.28	A	Homewood	16.0	1111.4	26.0	1101.4	26.0	2.88	28.9	28.54	0.36	hard
Load Line 10	LL10mw-004	2355438.20	555236.59	1119.60	31.2	1122.39	A	Homewood	21.0	1098.6	31.0	1088.6	31.0	2.79	33.8	33.53	0.27	hard
Load Line 10	LL10mw-005	2355943.55	555380.53	1122.90	27.0	1125.67	A	Homewood	16.5	1106.4	26.5	1096.4	26.5	2.77	29.3	29.24	0.06	hard
Load Line 10	LL10mw-006	2355654.80	554995.25	1121.20	24.0	1123.83	A	Unconsolidated	13.5	1107.7	23.5	1097.7	23.5	2.63	26.1	26.50	0.00	medium
Load Line 11	LL11mw-001	2352778.89	557505.03	1097.46	23.0	1100.16	A	Unconsolidated	11.4	1086.1	21.4	1076.1	21.4	2.70	24.1	23.40	0.70	hard
Load Line 11	LL11mw-002	2353354.28	558310.52	1080.29	20.0	1080.00	F	Unconsolidated	6.3	1074.0	16.3	1064.0	16.3	-0.29	16	16.45	0.00	hard
Load Line 11	LL11mw-003	2352737.87	557999.62	1088.45	17.0	1088.48	F	Unconsolidated	5.9	1082.6	15.9	1072.6	15.9	0.03	15.9	16.00	0.00	hard
Load Line 11	LL11mw-004	2352737.24	558164.36	1084.60	17.0	1084.72	F	Unconsolidated	6.1	1078.5	16.1	1068.5	16.1	0.12	16.2	16.18	0.02	hard
Load Line 11	LL11mw-005	2352847.56	558501.02	1079.60	17.0	1079.40	F	Unconsolidated	6.2	1073.4	16.2	1063.4	16.2	-0.20	16	16.42	0.00	hard
Load Line 11	LL11mw-006	2352521.36	558263.28	1086.61	17.0	1086.50	F	Unconsolidated	5.6	1081.0	15.6	1071.0	15.6	-0.11	15.5	15.70	0.00	hard
Load Line 11	LL11mw-007	2352094.81	558189.71	1079.22	23.0	1082.00	A	Unconsolidated	12.4	1066.8	22.4	1056.8	22.4	2.78	25.2	25.26	0.00	soft
Load Line 11	LL11mw-008	2352388.60	557981.17	1087.90	17.0	1087.74	F	Unconsolidated	5.6	1082.3	15.6	1072.3	15.6	-0.16	15.4	15.60	0.00	hard
Load Line 11	LL11mw-009	2352577.18	557901.18	1088.38	17.0	1091.54	F	Unconsolidated	6.7	1081.7	16.7	1071.7	16.7	-0.10	16.6	19.48	0.00	hard
Load Line 11	LL11mw-010	2352039.00	557675.43	1080.22	22.0	1082.68	A	Unconsolidated	10.9	1069.3	20.9	1059.3	20.9	2.46	23.4	23.40	0.00	soft
Load Line 11	LL11mw-011	2351119.00	558680.00	1077.40	18.5	1080.20	A	Unconsolidated	7.8	1069.6	17.8	1059.6	18.1	2.80	20.45	20.31	0.14	hard

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	Well ID	Ohio State Plane Easting	Ohio State Plan Northing	Ground Level Elevation	Total Drilled Depth	TOC Elevation	Well Head Type	Monitored Zone	Top of Screen (ft bgs)	Top of Screen Elevation	Bottom of Screen (ft bgs)	Bottom of Screen Elevation	Bottom of Inner Casing Plug or End Cap	Stickup Height	Reported Bottom of Inner Casing	May 2014 Measure Bottom of Inner Casing	Sediment Accumulation	Description of Bottom
Load Line 11	LL11mw-012	2351125.00	558691.00	1077.90	115.0	1080.36	A	Sharon Shale	104.5	973.4	114.5	963.4	114.8	2.46	119.45	119.43	0.02	hard
Load Line 12	LL12mw-088	2368667.75	556393.79	978.94	29.0	981.06	A	Unconsolidated	14.8	964.1	24.8	954.1	25.0	2.12	27.1	27.32	0.00	hard
Load Line 12	LL12mw-107	2368595.67	556759.02	978.03	33.0	980.15	A	Unconsolidated	20.7	957.3	30.7	947.3	31.0	2.12	33.1	33.66	0.00	hard
Load Line 12	LL12mw-113	2368223.73	558345.37	977.67	23.0	980.18	A	Sharon Shale	12.3	965.4	22.3	955.4	22.5	2.51	25	20.65	4.35	soft
Load Line 12	LL12mw-128	2368293.20	557371.54	976.21	34.0	978.24	A	Unconsolidated	21.1	955.1	31.1	945.1	31.3	2.03	33.3	33.90	0.00	soft
Load Line 12	LL12mw-153	2368138.87	557823.23	975.34	26.0	977.85	A	Unconsolidated	12.3	963.0	22.3	953.0	22.5	2.51	25	25.06	0.00	hard
Load Line 12	LL12mw-154	2368183.88	557754.56	977.00	29.0	979.06	A	Unconsolidated	16.4	960.6	26.4	950.6	26.6	2.06	28.7	28.62	0.08	hard
Load Line 12	LL12mw-182	2368853.20	555890.35	982.20	36.1	984.42	A	Unconsolidated	25.2	957.0	35.2	947.0	35.5	2.22	37.7	38.01	0.00	hard
Load Line 12	LL12mw-182ss	2368867.00	555897.00	982.30	36.0	985.02	A	Unconsolidated	25.3	957.1	35.3	947.1	35.6	2.72	38.5	37.40	1.10	hard
Load Line 12	LL12mw-183	2369224.36	556068.15	980.59	36.0	982.98	A	Sharon Shale	23.3	957.3	33.3	947.3	33.6	2.39	36	36.32	0.00	hard
Load Line 12	LL12mw-184	2368997.48	556399.46	980.96	29.5	983.16	A	Unconsolidated	18.8	962.2	28.8	952.2	29.0	2.20	31.2	31.35	0.00	hard
Load Line 12	LL12mw-185	2368829.86	556946.75	979.09	24.0	981.31	A	Unconsolidated	10.8	968.3	20.8	958.3	21.0	2.22	23.2	23.24	0.00	hard
Load Line 12	LL12mw-186	2367912.39	559065.95	976.34	23.0	978.31	A	Sharon Shale	8.8	967.5	18.8	957.5	19.0	1.97	21	21.00	0.00	hard
Load Line 12	LL12mw-187	2368524.14	557633.10	977.90	29.0	979.94	A	Unconsolidated	17.2	960.7	27.2	950.7	27.4	2.04	29.4	29.90	0.00	hard
Load Line 12	LL12mw-188	2367908.82	558132.59	978.46	20.5	980.63	A	Unconsolidated	9.8	968.7	19.8	958.7	20.0	2.17	22.2	22.01	0.19	hard
Load Line 12	LL12mw-189	2367945.92	558569.27	976.17	18.5	978.04	A	Sharon Shale	7.5	968.7	17.5	958.7	17.7	1.87	19.6	19.55	0.05	hard
Load Line 12	LL12mw-242	2368545.29	558020.51	978.40	26.3	981.20	A	Unconsolidated	15.5	962.9	25.5	952.9	25.5	2.80	28.3	28.60	0.00	hard
Load Line 12	LL12mw-243	2368190.04	557376.32	978.10	24.0	980.79	A	Unconsolidated	13.0	965.1	23.0	955.1	23.0	2.69	25.7	24.30	1.40	hard
Load Line 12	LL12mw-244	2368751.42	557377.17	978.10	30.0	980.65	A	Unconsolidated	19.5	958.6	29.5	948.6	29.5	2.55	32.1	30.61	1.49	hard
Load Line 12	LL12mw-245	2368370.74	557044.55	977.50	29.0	980.04	A	Unconsolidated	18.0	959.5	28.0	949.5	28.0	2.54	30.5	29.84	0.66	hard
Load Line 12	LL12mw-246	2369432.17	556658.89	982.00	32.0	984.83	A	Unconsolidated	21.5	960.5	31.5	950.5	31.5	2.83	34.3	35.00	0.00	hard
Load Line 12	LL12mw-247	2368932.00	555141.00	981.30	20.5	984.25	A	Unconsolidated	10.0	971.3	20.0	961.3	20.3	2.95	22.6	22.54	0.06	hard
Landfill North of Winklepeck	LNWmw-024	2358403.21	564825.89	1035.30	24.0	1038.00	A	Unconsolidated	10.0	1025.3	20.0	1015.3	20.0	2.70	22.7	22.50	0.20	hard
Landfill North of Winklepeck	LNWmw-025	2358417.06	565071.92	1027.20	19.0	1029.13	A	Unconsolidated	8.0	1019.2	18.0	1009.2	18.0	1.93	19.9	20.30	0.00	hard
Landfill North of Winklepeck	LNWmw-026	2358952.24	564658.16	1025.00	24.0	1027.80	A	Unconsolidated	13.0	1012.0	23.0	1002.0	23.0	2.80	25.8	25.93	0.00	hard
Landfill North of Winklepeck	LNWmw-027	2358628.75	564517.41	1024.40	25.0	1027.13	A	Unconsolidated	14.0	1010.4	24.0	1000.4	24.0	2.73	26.7	26.82	0.00	hard
Suspected Mustard Agent Burial Site	MBS-001	2345323.00	550759.50	1079.68	30.0	1082.20	A	Unconsolidated	19.0	1060.7	28.7	1051.0	29.0	2.52	31.5	30.99	0.51	hard
Suspected Mustard Agent Burial Site	MBS-002	2345322.30	550886.20	1080.50	30.0	1083.22	A	Unconsolidated	18.0	1062.5	27.3	1053.2	28.0	2.72	30.7	31.12	0.00	hard
Suspected Mustard Agent Burial Site	MBS-003	2345172.40	550922.80	1082.45	30.0	1084.45	A	Unconsolidated	18.5	1064.0	28.2	1054.3	28.5	2.00	30.5	30.70	0.00	hard
Suspected Mustard Agent Burial Site	MBS-004	2345134.20	550767.90	1079.55	26.0	1081.80	A	Unconsolidated	14.7	1064.9	24.4	1055.2	24.7	2.25	27	27.19	0.00	hard
Suspected Mustard Agent Burial Site	MBS-005	2345354.10	550800.70	1080.50	30.0	1082.42	A	Unconsolidated	18.0	1062.5	28.0	1052.5	28.1	1.92	30.2	29.94	0.26	soft
Suspected Mustard Agent Burial Site	MBS-006	2345282.30	550726.10	1080.29	28.0	1081.83	A	Unconsolidated	16.5	1063.8	26.5	1053.8	26.6	1.54	28.2	28.06	0.14	hard
NACA Test Area	NTAmw-107	2345433.40	551697.29	1077.65	23.0	1080.30	A	Unconsolidated	12.0	1065.7	22.0	1055.7	22.0	2.65	24.6	24.16	0.44	soft
NACA Test Area	NTAmw-108	2345781.60	551916.22	1083.22	23.0	1085.62	A	Unconsolidated	12.0	1071.2	22.0	1061.2	22.0	2.40	24.4	24.51	0.00	medium

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NACA Test Area	NTAmw-109	2345997.72	551293.25	1076.89	19.0	1079.84	A	Unconsolidated	8.0	1068.9	18.0	1058.9	18.0	2.95	20.9	20.54	0.36	soft
NACA Test Area	NTAmw-110	2346438.94	551351.46	1080.03	28.0	1082.62	A	Unconsolidated	17.0	1063.0	27.0	1053.0	27.0	2.59	29.6	29.80	0.00	hard
NACA Test Area	NTAmw-111	2346638.01	551538.60	1078.07	20.0	1080.94	A	Unconsolidated	9.5	1068.6	19.5	1058.6	19.5	2.87	22.4	22.12	0.28	hard
NACA Test Area	NTAmw-112	2346889.48	551712.14	1075.36	23.9	1078.33	A	Unconsolidated	13.9	1061.5	23.9	1051.5	23.9	2.97	26.9	26.72	0.18	soft
NACA Test Area	NTAmw-113	2347082.83	551488.52	1072.61	27.5	1075.68	A	Unconsolidated	17.0	1055.6	27.0	1045.6	27.5	3.07	30.6	29.69	0.91	hard
NACA Test Area	NTAmw-114	2347301.57	551592.94	1075.61	20.0	1078.71	A	Unconsolidated	9.5	1066.1	19.5	1056.1	19.5	3.10	22.6	22.81	0.00	hard
NACA Test Area	NTAmw-115	2347581.16	551791.78	1086.91	24.0	1089.65	A	Unconsolidated	12.5	1074.4	22.5	1064.4	22.5	2.74	25.2	25.31	0.00	hard
NACA Test Area	NTAmw-116	2348196.39	551748.00	1091.68	22.0	1094.33	A	Unconsolidated	10.0	1081.7	20.0	1071.7	20.0	2.65	22.6	22.61	0.00	hard
NACA Test Area	NTAmw-117	2347994.83	551584.57	1091.67	25.0	1094.54	A	Unconsolidated	14.5	1077.2	24.5	1067.2	24.5	2.87	27.4	27.56	0.00	hard
NACA Test Area	NTAmw-118	2347609.41	551335.04	1078.86	22.5	1081.44	A	Unconsolidated	12.0	1066.9	22.0	1056.9	22.0	2.58	24.6	24.77	0.00	soft
NACA Test Area	NTAmw-119	2346013.00	551286.00	1077.40	130.0	1080.07	A	Unconsolidated	90.0	987.4	100.0	977.4	100.3	2.67	104.6	104.41	0.19	soft
Ramsdell Quarry Landfill	RQLmw-006	2375927.71	566091.26	993.52	42.1	995.39	A	Sharon	19.4	974.1	39.4	954.1	39.6	1.87	41.4	42.01	0.00	hard
Ramsdell Quarry Landfill	RQLmw-007	2375872.56	566544.36	963.86	18.7	965.91	A	Sharon	6.0	957.9	16.0	947.9	16.2	2.05	18.2	18.62	0.00	hard
Ramsdell Quarry Landfill	RQLmw-008	2376011.08	566327.94	963.82	18.7	966.08	A	Sharon	6.0	957.8	16.0	947.8	16.2	2.26	18.5	18.68	0.00	hard
Ramsdell Quarry Landfill	RQLmw-009	2376253.65	566351.20	962.60	18.8	964.58	A	Sharon	5.9	956.7	15.9	946.7	16.4	1.98	18.4	18.78	0.00	hard
Ramsdell Quarry Landfill	RQLmw-010	2376048.58	566857.39	980.04	35.4	982.14	A	Sharon	12.5	967.5	32.5	947.5	33.0	2.10	35.1	35.34	0.00	soft
Ramsdell Quarry Landfill	RQLmw-011	2376398.19	566819.66	974.60	35.4	976.57	A	Sharon	12.4	962.2	32.4	942.2	32.6	1.97	34.6	35.38	0.00	hard
Ramsdell Quarry Landfill	RQLmw-012	2376558.19	566551.95	975.12	30.5	977.65	A	Sharon	19.8	955.3	29.8	945.3	30.0	2.53	32.5	32.65	0.00	hard
Ramsdell Quarry Landfill	RQLmw-013	2376204.93	566928.09	978.04	34.4	980.71	A	Sharon	23.7	954.3	33.7	944.3	33.9	2.67	36.6	35.96	0.64	soft
Ramsdell Quarry Landfill	RQLmw-014	2376519.38	566941.29	970.83	29.4	973.49	A	Sharon	18.6	952.2	28.6	942.2	28.9	2.66	31.6	31.53	0.07	hard
Ramsdell Quarry Landfill	RQLmw-015	2375490.96	566560.90	989.19	40.1	991.26	A	Sharon	29.2	960.0	39.2	950.0	39.5	2.07	41.6	41.97	0.00	soft
Ramsdell Quarry Landfill	RQLmw-016	2375649.55	566177.68	994.02	39.5	996.60	A	Sharon	28.5	965.5	38.5	955.5	39.0	2.58	41.6	41.66	0.00	hard
Ramsdell Quarry Landfill	RQLmw-017	2376124.18	565931.38	988.69	30.5	991.23	A	Sharon	19.8	968.9	29.8	958.9	30.0	2.54	32.5	32.75	0.00	hard
Sharon Conglomerate	SCFmw-001	2353178.98	554768.62	1118.53	230.0	1120.71	A	Sharon Cong.	201.0	917.5	211.0	907.5	NA	2.18	213.61	214.30	0.00	hard
Sharon Conglomerate	SCFmw-002	2368927.36	555152.38	982.28	153.0	984.56	A	Sharon Cong.	137.0	845.3	147.0	835.3	NA	2.28	149.65	150.05	0.00	medium
Sharon Conglomerate	SCFmw-003	2375843.20	557957.67	956.14	140.0	958.47	A	Sharon Cong.	125.5	830.6	135.5	820.6	NA	2.33	139.65	139.63	0.02	hard
Sharon Conglomerate	SCFmw-004	2378730.23	560361.03	941.87	120.0	944.17	A	Sharon Cong.	100.0	841.9	110.0	831.9	NA	2.30	112.47	112.50	0.00	hard
Sharon Conglomerate	SCFmw-005	2377014.05	567302.35	958.43	160.0	960.80	A	Sharon Cong.	139.0	819.4	154.0	804.4	NA	2.37	156.41	156.10	0.31	hard
Sharon Conglomerate	SCFmw-006	2369394.54	569583.41	963.69	90.0	965.92	A	Sharon Cong.	76.0	887.7	86.0	877.7	NA	2.23	88.32	87.90	0.42	hard
Winklepeck Burning Grounds	WBGmw-005	2357163.55	563037.18	1052.20	19.0	1054.70	A	Unconsolidated	8.3	1043.9	18.3	1033.9	18.6	2.50	21.1	21.18	0.00	hard
Winklepeck Burning Grounds	WBGmw-006	2359087.79	563008.87	1012.16	19.0	1014.66	A	Unconsolidated	7.6	1004.6	17.6	994.6	17.9	2.50	20.4	20.18	0.22	hard
Winklepeck Burning Grounds	WBGmw-007	2360420.44	562479.87	998.09	24.0	1000.59	A	Unconsolidated	13.5	984.6	23.5	974.6	23.8	2.50	26.3	26.42	0.00	hard
Winklepeck Burning Grounds	WBGmw-008	2359700.57	562010.35	1005.71	18.5	1008.21	A	Unconsolidated	8.1	997.6	18.2	987.5	18.5	2.50	21	20.85	0.15	medium
Winklepeck Burning Grounds	WBGmw-009	2357159.20	561603.54	1045.03	24.0	1047.53	A	Unconsolidated	11.4	1033.6	21.4	1023.6	21.5	2.50	24	24.28	0.00	hard

Table 1-1
Monitoring Well Construction Summary
Camp Ravenna

	Well ID	Ohio State Plane Easting	Ohio State Plan Northing	Ground Level Elevation	Total Drilled Depth	TOC Elevation	Well Head Type	Monitored Zone	Top of Screen (ft bgs)	Top of Screen Elevation	Bottom of Screen (ft bgs)	Bottom of Screen Elevation	Bottom of Inner Casing Plug or End Cap	Stickup Height	Reported Bottom of Inner Casing	May 2014 Measure Bottom of Inner Casing	Sediment Accumulation	Description of Bottom
Winklepeck Burning Grounds	WBGmw-010	2356051.96	562893.20	1067.10	21.0	1069.85	A	Unconsolidated	10.5	1056.6	20.5	1046.6	20.8	2.75	23.6	23.35	0.25	hard
Winklepeck Burning Grounds	WBGmw-011	2356187.29	562609.18	1069.70	22.0	1072.38	A	Unconsolidated	11.0	1058.7	21.0	1048.7	21.3	2.68	24	23.79	0.21	soft
Winklepeck Burning Grounds	WBGmw-012	2354810.65	562240.90	1076.50	30.0	1079.11	A	Unconsolidated	19.0	1057.5	29.0	1047.5	29.4	2.61	32	31.62	0.38	hard
Winklepeck Burning Grounds	WBGmw-013	2355223.25	561518.27	1069.10	22.0	1071.70	A	Unconsolidated	11.0	1058.1	21.0	1048.1	21.3	2.60	23.9	24.08	0.00	hard
Winklepeck Burning Grounds	WBGmw-014	2360439.22	562061.26	994.10	23.0	996.78	A	Unconsolidated	12.0	982.1	22.0	972.1	22.3	2.68	25	25.00	0.00	hard
Winklepeck Burning Grounds	WBGmw-015	2359182.41	562340.12	1009.10	22.0	1011.60	A	Unconsolidated	11.0	998.1	21.0	988.1	21.3	2.50	23.8	23.41	0.39	hard
Winklepeck Burning Grounds	WBGmw-016	2360645.88	562709.13	994.90	24.0	997.03	A	Unconsolidated	13.0	981.9	23.0	971.9	23.3	2.13	25.4	25.11	0.29	medium
Winklepeck Burning Grounds	WBGmw-017	2359603.84	562913.24	1004.00	22.0	1006.62	A	Unconsolidated	11.0	993.0	21.0	983.0	21.3	2.62	23.9	23.34	0.56	soft
Winklepeck Burning Grounds	WBGmw-018	2361302.00	562659.00	990.50	24.0	991.45	A	Unconsolidated	13.5	977.0	23.5	967.0	23.8	0.95	24.8	24.81	0.00	medium
Winklepeck Burning Grounds	WBGmw-019	2361304.00	562645.00	989.30	50.0	990.25	A	Sharon	39.6	949.8	49.6	939.8	49.9	0.95	50.5	50.49	0.01	hard
Winklepeck Burning Grounds	WBGmw-020	2357161.00	561623.00	1043.40	43.3	1044.31	A	Sharon	32.9	1010.5	42.9	1000.5	43.2	0.91	43.8	43.58	0.22	hard
Winklepeck Burning Grounds	WBGmw-021	2359106.00	563009.00	1010.00	42.5	1010.92	A	Sharon	32.0	978.0	42.0	968.0	42.3	0.92	43.1	43.01	0.09	hard

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Table 1-2
Summary of Well Turbidity Screening
Camp Ravenna

Monitoring Well ID	Site ID	Monitored Formation	Most-Recent Sample Event	Most-Recent Sample Date Collected	Turbidity Result (NTU)	Sediment Accumulation (ft)	Re-develop?	Reason
ASYmw-001	RVAAP-50 Atlas Scrap Yard	Sharon	FWGW 2010 Event 1	01/20/10	297	0.58	Yes	Turbidity > 20 NTU and Sedimentation > 0.5 feet
ASYmw-005	RVAAP-50 Atlas Scrap Yard	Sharon	FWGW 2010 Event 1	01/20/10	60.4	0.00	Yes	Turbidity > 20 NTU
ASYmw-006	RVAAP-50 Atlas Scrap Yard	Sharon	FWGW 2010 Event 1	01/20/10	163	0.00	Yes	Turbidity > 20 NTU
ASYmw-010	RVAAP-50 Atlas Scrap Yard	Unconsolidated	FWGW 2010 Event 1	01/20/10	746	0.00	Yes	Turbidity > 20 NTU
B12mw-011	RVAAP-13 Building 1200	Sharon	FWGW 2009 Event 4	10/21/09	117	0.22	Yes	Turbidity > 20 NTU
B12mw-012	RVAAP-13 Building 1200	Sharon	FWGW 2013 Event 1	01/23/13	8.7	0.08	No	Turbidity < 10 NTU
BKGmw-004	Site-wide Background Areas	Unconsolidated	FWGW 2009 Event 4	10/21/09	65	0.00	Yes	Turbidity > 20 NTU
BKGmw-008	Site-wide Background Areas	Sharon	FWGW 2011 Event 2	04/06/11	101.8	0.13	Yes	Turbidity > 20 NTU
BKGmw-010	Site-wide Background Areas	Sharon	FWGW 2013 August	08/20/13	10	0.00	No	Turbidity < 10 NTU
CBLmw-001	RVAAP-06 C Block Quarry	Homewood	FWGW 2009 Event 4	10/21/09	17.5	1.11	Yes	Turbidity > 10 NTU and Sedimentation > 0.5 feet
CBLmw-002	RVAAP-06 C Block Quarry	Homewood	FWGW 2013 Event 1	01/23/13	2	0.00	No	Turbidity < 10 NTU
CBLmw-003	RVAAP-06 C Block Quarry	Homewood	FWGW 2009 Event 4	10/22/09	9.3	1.03	Yes	Sedimentation > 0.5 feet
CBLmw-004	RVAAP-06 C Block Quarry	Homewood	FWGW 2011 Event 2	04/07/11	97	0.00	Yes	Turbidity > 20 NTU
CBPmw-002	RVAAP-49 Central Burn Pits	Unconsolidated	FWGW 2013 Event 1	01/22/13	477	0.59	Yes	Turbidity > 20 NTU and Sedimentation > 0.5 feet
CBPmw-008	RVAAP-49 Central Burn Pits	Unconsolidated	FWGW 2011 Event 1	01/20/11	11.9	0.00	No	Turbidity only slightly exceeds 10 NTU
CBPmw-009	RVAAP-49 Central Burn Pits	Sharon	FWGW 2013 Event 1	01/23/13	3.7	0.00	No	Turbidity < 10 NTU
DA2mw-104	RVAAP-04 Open Demolition Area #2	Unconsolidated	FWGW 2011 Event 4	10/14/11	556	0.38	Yes	Turbidity > 20 NTU
DA2mw-114	RVAAP-04 Open Demolition Area #2	Sharon Shale	FWGW 2014 Event 3	07/24/14	1.2	0.01	No	Turbidity < 10 NTU
DET-3	RVAAP-04 Open Demolition Area #2	Unconsolidated	FWGW 2015 July	07/23/15	0	0.00	No	Turbidity < 10 NTU
DET-4	RVAAP-04 Open Demolition Area #2	Unconsolidated	FWGW 2015 July	07/23/15	21	0.00	Yes	Turbidity > 20 NTU and Non-Producing Well
EBGmw-123	RVAAP-02 Erie Burning Grounds	Unconsolidated	FWGW 2011 Event 1	01/20/11	69.1	0.00	Yes	Turbidity > 20 NTU
EBGmw-125	RVAAP-02 Erie Burning Grounds	Unconsolidated	FWGW 2013 Event 1	01/21/13	93	0.00	Yes	Turbidity > 20 NTU
EBGmw-126	RVAAP-02 Erie Burning Grounds	Unconsolidated	FWGW 2011 Event 1	01/20/11	146	0.15	Yes	Turbidity > 20 NTU
EBGmw-128	RVAAP-02 Erie Burning Grounds	Unconsolidated	FWGW 2009 Event 4	10/19/09	10.5	0.00	No	Turbidity only slightly exceeds 10 NTU
EBGmw-129	RVAAP-02 Erie Burning Grounds	Unconsolidated	FWGW 2011 Event 1	01/20/11	495	0.00	Yes	Turbidity > 20 NTU
EBGmw-131	RVAAP-02 Erie Burning Grounds	Sharon	FWGW 2013 August	08/19/13	25.4	0.86	Yes	Turbidity > 20 NTU and Sedimentation > 0.5 feet
FBQmw-166	RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FWGW 2009 Event 4	10/22/09	78.5	0.00	Yes	Turbidity > 20 NTU
FBQmw-167	RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FWGW 2009 Event 4	10/22/09	773	0.00	Yes	Turbidity > 20 NTU
FBQmw-168	RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FWGW 2009 Event 4	10/22/09	77	0.31	Yes	Turbidity > 20 NTU
FBQmw-174	RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FWGW 2015 July	07/20/15	3.5	3.12	No	Turbidity < 10 NTU
FBQmw-176	RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FWGW 2009 Event 4	10/22/09	900	0.00	Yes	Turbidity > 20 NTU
FWGmw-004	RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGW 2015 July	07/23/15	0	0.13	No	Turbidity < 10 NTU
FWGmw-010	RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGW 2013 Event 1	01/21/13	120	0.00	Yes	Turbidity > 20 NTU
FWGmw-013	RVAAP-66 Facility-wide Groundwater	Sharon	FWGW 2013 Event 1	01/24/13	4.5	0.00	No	Turbidity < 10 NTU
FWGmw-015	RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGW 2015 July	07/23/15	0	0.11	No	Turbidity < 10 NTU
FWGmw-016	RVAAP-66 Facility-wide Groundwater	Sharon	FWGW 2015 July	07/23/15	0	0.00	No	Turbidity < 10 NTU
LL10mw-001	RVAAP-43 Load Line 10	Homewood	FWGW 2009 Event 4	10/13/09	280	0.21	Yes	Turbidity > 20 NTU
LL10mw-003	RVAAP-43 Load Line 10	Homewood	FWGW 2015 July	07/23/15	0	0.36	No	Turbidity < 10 NTU
LL11mw-002	RVAAP-44 Load Line 11	Unconsolidated	FWGW 2010 Event 4	10/13/10	154	0.00	Yes	Turbidity > 20 NTU
LL11mw-003	RVAAP-44 Load Line 11	Unconsolidated	FWGW 2009 Event 4	10/14/09	400	0.00	Yes	Turbidity > 20 NTU
LL11mw-005	RVAAP-44 Load Line 11	Unconsolidated	FWGW 2009 Event 4	10/14/09	34	0.00	Yes	Turbidity > 20 NTU
LL11mw-006	RVAAP-44 Load Line 11	Unconsolidated	FWGW 2009 Event 4	10/14/09	42.2	0.00	Yes	Turbidity > 20 NTU
LL12mw-154	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2011 Event 3	08/03/11	275	0.08	Yes	Turbidity > 20 NTU
LL12mw-182	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2013 Event 1	01/22/13	69.9	0.00	Yes	Turbidity > 20 NTU

Table 1-2
Summary of Well Turbidity Screening
Camp Ravenna

Monitoring Well ID	Site ID	Monitored Formation	Most-Recent Sample Event	Most-Recent Sample Date Collected	Turbidity Result (NTU)	Sediment Accumulation (ft)	Re-develop?	Reason
LL12mw-185	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2015 July	07/21/15	0	0.00	No	Turbidity < 10 NTU
LL12mw-187	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2015 July	07/22/15	0	0.00	No	Turbidity < 10 NTU
LL12mw-242	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2015 July	07/21/15	407	0.00	Yes	Turbidity > 20 NTU
LL12mw-245	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2015 July	07/22/15	7.1	0.66	Yes	Sedimentation > 0.5 ft.
LL12mw-246	RVAAP-12 Load Line 12	Unconsolidated	FWGW 2013 Event 1	01/22/13	170	0.00	Yes	Turbidity > 20 NTU
LL1mw-064	RVAAP-08 Load Line 1	Unconsolidated	FWGW 2015 July	07/20/15	7.9	0.01	No	Turbidity < 10 NTU
LL1mw-065	RVAAP-08 Load Line 1	Unconsolidated	FWGW 2015 July	07/23/15	0	0.28	No	Turbidity < 10 NTU
LL1mw-067	RVAAP-08 Load Line 1	Sharon	FWGW 2011 Event 2	04/05/11	511	0.00	Yes	Turbidity > 20 NTU
LL1mw-078	RVAAP-08 Load Line 1	Sharon	FWGW 2010 Event 3	07/14/10	7.9	0.00	Yes	Turbidity exceedingly high in previous rounds
LL1mw-083	RVAAP-08 Load Line 1	Sharon	FWGW 2015 July	07/20/15	2.7	0.25	No	Turbidity < 10 NTU
LL1mw-084	RVAAP-08 Load Line 1	Sharon	FWGW 2015 July	07/20/15	0	0.19	No	Turbidity < 10 NTU
LL1mw-086	RVAAP-08 Load Line 1	Unconsolidated	FWGW 2015 July	07/21/15	0	0.00	Yes	Turbidity exceedingly high in previous rounds
LL1mw-087	RVAAP-08 Load Line 1	Unconsolidated	FWGW 2015 July	07/21/15	10	0.42	No	Turbidity < 10 NTU
LL1mw-088	RVAAP-08 Load Line 1	Unconsolidated	FWGW 2015 July	07/21/15	8.8	0.21	Yes	Turbidity exceedingly high in previous rounds
LL2mw-059	RVAAP-09 Load Line 2	Sharon	FWGW 2015 July	07/20/15	4.8	0.00	No	Turbidity < 10 NTU
LL2mw-060	RVAAP-09 Load Line 2	Sharon	FWGW 2015 July	07/20/15	0.5	0.07	No	Turbidity < 10 NTU
LL2mw-261	RVAAP-09 Load Line 2	Sharon	FWGW 2010 Event 3	07/15/10	49	0.00	Yes	Turbidity > 20 NTU
LL2mw-262	RVAAP-09 Load Line 2	Sharon	FWGW 2010 Event 3	07/09/10	33.2	0.00	Yes	Turbidity > 20 NTU
LL2mw-265	RVAAP-09 Load Line 2	Sharon	FWGW 2014 Event 3	07/23/14	9.8	0.00	No	Turbidity < 10 NTU
LL2mw-266	RVAAP-09 Load Line 2	Sharon	FWGW 2011 Event 2	04/07/11	28.9	0.00	Yes	Turbidity > 20 NTU
LL2mw-267	RVAAP-09 Load Line 2	Sharon	FWGW 2015 July	07/23/15	6.1	0.00	Yes	Turbidity exceedingly high in previous rounds
LL2mw-270	RVAAP-09 Load Line 2	Sharon	FWGW 2010 Event 3	07/15/10	42.7	0.00	Yes	Turbidity > 20 NTU
LL3mw-234	RVAAP-10 Load Line 3	Sharon	FWGW 2011 Event 3	08/03/11	488	0.00	Yes	Turbidity > 20 NTU
LL3mw-236	RVAAP-10 Load Line 3	Sharon	FWGW 2011 Event 3	08/04/11	86	0.00	Yes	Turbidity > 20 NTU
LL3mw-238	RVAAP-10 Load Line 3	Sharon	FWGW 2015 July	07/20/15	41.3	0.00	Yes	Turbidity > 20 NTU
LL3mw-241	RVAAP-10 Load Line 3	Sharon	FWGW 2015 July	07/20/15	0	0.00	No	Turbidity < 10 NTU
LL3mw-244	RVAAP-10 Load Line 3	Sharon	FWGW 2015 July	07/21/15	0	0.38	No	Turbidity < 10 NTU
LL3mw-246	RVAAP-10 Load Line 3	Sharon	FWGW 2015 July	07/21/15	0	0.16	No	Turbidity < 10 NTU
LL4mw-193	RVAAP-11 Load Line 4	Unconsolidated	FWGW 2011 Event 2	04/04/11	53.9	0.00	Yes	Turbidity > 20 NTU
LL4mw-194	RVAAP-11 Load Line 4	Unconsolidated	FWGW 2009 Event 4	10/16/09	999	0.00	Yes	Turbidity > 20 NTU
LL4mw-199	RVAAP-11 Load Line 4	Unconsolidated	FWGW 2013 Event 1	01/23/13	332	0.00	Yes	Turbidity > 20 NTU
LL4mw-201	RVAAP-11 Load Line 4	Sharon	FWGW 2013 Event 1	01/23/13	32.3	0.15	Yes	Turbidity > 20 NTU
LL5mw-002	RVAAP-39 Load Line 5	Homewood	FWGW 2009 Event 4	10/21/09	999	0.36	Yes	Turbidity > 20 NTU
LL5mw-006	RVAAP-39 Load Line 5	Homewood	FWGW 2009 Event 4	10/21/09	999	0.00	Yes	Turbidity > 20 NTU
LL6mw-002	RVAAP-33 Load Line 6	Unconsolidated	FWGW 2013 Event 1	01/23/13	67.3	0.00	Yes	Turbidity > 20 NTU
LL6mw-007	RVAAP-33 Load Line 6	Homewood	FWGW 2011 Event 4	10/12/11	469	0.09	Yes	Turbidity > 20 NTU
LL7mw-006	RVAAP-40 Load Line 7	Homewood	FWGW 2009 Event 4	10/12/09	39.8	0.06	Yes	Turbidity > 20 NTU
LL8mw-001	RVAAP-41 Load Line 8	Unconsolidated	FWGW 2009 Event 4	10/13/09	532	0.00	Yes	Turbidity > 20 NTU
LL8mw-003	RVAAP-41 Load Line 8	Unconsolidated	FWGW 2010 Event 4	10/13/10	42.6	0.26	Yes	Turbidity > 20 NTU
LL8mw-004	RVAAP-41 Load Line 8	Unconsolidated	FWGW 2009 Event 4	10/13/09	308	0.26	Yes	Turbidity > 20 NTU
MBSmw-004	RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	FWGW 2011 Event 4	11/03/11	11.3	0.00	No	Turbidity only slightly exceeds 10 NTU
MBSmw-006	RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	FWGW 2011 Event 4	11/03/11	43.8	0.14	Yes	Turbidity > 20 NTU
NTAmw-113	RVAAP-38 NACA Test Area	Unconsolidated	FWGW 2011 Event 1	01/18/11	750	0.91	Yes	Turbidity > 20 NTU and Sedimentation > 0.5 feet
NTAmw-116	RVAAP-38 NACA Test Area	Unconsolidated	FWGW 2009 Event 4	10/20/09	540	0.00	Yes	Turbidity > 20 NTU

Table 1-2
Summary of Well Turbidity Screening
Camp Ravenna

Monitoring Well ID	Site ID	Monitored Formation	Most-Recent Sample Event	Most-Recent Sample Date Collected	Turbidity Result (NTU)	Sediment Accumulation (ft)	Re-develop?	Reason
NTAmw-119	RVAAP-38 NACA Test Area	Unconsolidated	FWGW 2015 July	07/20/15	22.9	0.19	Yes	Turbidity > 20 NTU
RQLmw-007	RVAAP-01 Ramsdell Quarrry Landfill	Sharon	FWGW 2015 July	07/22/15	0.6	0.00	No	Turbidity < 10 NTU
RQLmw-008	RVAAP-01 Ramsdell Quarrry Landfill	Sharon	FWGW 2015 July	07/22/15	46.6	0.00	Yes	Turbidity > 20 NTU
RQLmw-009	RVAAP-01 Ramsdell Quarrry Landfill	Sharon	FWGW 2015 July	07/22/15	0	0.00	No	Turbidity < 10 NTU
RQLmw-011	RVAAP-01 Ramsdell Quarrry Landfill	Sharon	FWGW 2013 August	08/19/13	49.6	0.00	Yes	Turbidity > 20 NTU
SCFmw-002	Sharon Conglomerate Formation Wells	Sharon Cong.	FWGW 2015 July	07/21/15	0	0.00	No	Turbidity < 10 NTU
SCFmw-004	Sharon Conglomerate Formation Wells	Sharon Cong.	FWGW 2015 July	07/21/15	0	0.00	No	Turbidity < 10 NTU
SCFmw-006	Sharon Conglomerate Formation Wells	Sharon Cong.	FWGW 2011 Event 2	04/05/11	0.725	0.42	No	Turbidity < 10 NTU
WBGmw-005	RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	FWGW 2011 Event 1	01/19/11	144	0.00	Yes	Turbidity > 20 NTU
WBGmw-006	RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	FWGW 2015 July	07/22/15	3	0.22	No	Turbidity < 10 NTU in 2 of last 3 previous rounds
WBGmw-009	RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	FWGW 2015 July	07/22/15	9.9	0.00	No	Turbidity < 10 NTU
WBGmw-015	RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	FWGW 2009 Event 4	10/20/09	122	0.39	Yes	Turbidity > 20 NTU
WBGmw-019	RVAAP-05 Winklepeck Burning Grounds	Sharon	FWGW 2013 August	08/21/13	0	0.01	No	Turbidity < 10 NTU
WBGmw-021	RVAAP-05 Winklepeck Burning Grounds	Sharon	FWGW 2015 July	07/22/15	1.4	0.09	No	Turbidity < 10 NTU

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Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
C-1	Erie Burning Grounds (EBG), RVAAP-002-R-01, RVAAP-02	<u>MRS site description (RVAAP-002-R-01):</u> From 1941 to 1951, bulk, obsolete, off spec propellants, conventional explosives, rags, and large explosive contaminated items were thermally treated by open burning on the ground surface. Presumably, materials were either tipped out of railcars, were set on fire and allowed to burn. No history of the use of fire suppressants at the site has been identified. Aerial photos of the site from the 1940s and 1950s depict open boxcars staged at the end of the rail spur, known as Track 49. Perfluorinated compounds (PFCs) are synthetic materials used to extinguish petroleum fires since the 1970s. These types of foams were not abundant until the 1970s when they were readily available on a commercial and industrial basis. Burning activities were conducted at the site prior to the use of PFCs, which were not prominently used until the 1970s; therefore, PFCs are not thought to be a concern at the site. No history of the use of fire suppressants has been identified. A Final RI Report was accepted by OEPA 22 September 2015. An FS was recommended to deal with munitions constituents (MC) and munitions and explosives of concern (MEC). The MRS is collocated with an IRP AOC (RVAAP 02) and is 33.9 acres. <u>IRP site description (RVAAP-02):</u> The water table at EBG is typically less than 10 ft. Groundwater flow is from north to south across the AOC, consistent with surface drainage patterns. A high degree of interaction exists between groundwater and surface water. Results of slug tests performed during a Phase II RI reveal moderately high horizontal hydraulic conductivities in the unconsolidated material underlying the EBG. <u>Unconsolidated Aquifer</u> Additional review of site specific groundwater flow dynamics in the Unconsolidated Aquifer with respect to the potentiometric low at EBGmw 125 and to surface water; Potentiometric surface elevation contours generated from the most recent groundwater gauging measurements indicate water table flow in the unconsolidated aquifer is influenced by wetlands and stream features in the center of the site. <u>Upper Sharon Sandstone Aquifer</u> Vertical delineation of non-metals COPCs in the Unconsolidated Aquifer is apparently provided by EBGmw 131 installed in the Sharon SS/Cong. <u>DGA EBG(A) and DGA EBG(B)</u> Unconsolidated Aquifer 1. Several EBG wells historically identified with site-related compounds (SRCs) above current screening levels have not been sampled within the last 3 years+. Current groundwater conditions in these wells will need to be characterized to support the BRA. 2. Review of historical COPC concentration levels and distribution indicates no SRCs are present at EBGmw 127 at levels requiring additional assessment. The need for additional sampling of EBGmw 127 will be based on results for wells planned for updating during the RI.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
C-2	Load Line 1 (LL1)/RVAAP-08, RVAAP-008-R-01, CC RVAAP-73, CC RVAAP-79, RVAAP-31	IRP site description (RVAAP-08): Load Line 1 was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond, known as Criggy's Pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in some instances. MRS site description (RVAAP-008-R-01): The load line also was used for the demilitarization of projectiles and the production and reconditioning of anti-tank mines from 1973 -1974. RVAAP-008-R-01 is an area at the northern end of LL1 where propellants were historically identified. The principle sources of MEC at LL1 MRS were reported to be accidental releases during the loading of munitions during World War II and the Korean War. CRS site descriptions (CC RVAAP-73, CC RVAAP-79/RVAAP-31): CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. CC RVAAP-79/RVAAP-31: Various ores were historically stored (stock-piled) in aboveground storage tanks (ASTs) for the General Services Administration (GSA). The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils. Unconsolidated Aquifer Historical sampling results indicate LL1mw-088 provides down-gradient delineation of nitroglycerin at mw-086. Pesticide concentration at LL1mw-088 is consistent with prescribed use (i.e., not indicative of a CERCLA regulated release). Measured pH values at LL1mw-086 have been reported outside of the naturally occurring range expected for groundwater. DGA-LL1B The historical dataset indicates the presence of perchlorate in groundwater above MDLs but below screening levels in recent sample results at LL1mw-087 (January 2013). Additional sampling of LL1mw-087 is necessary to monitor groundwater conditions migrating off-post to the southeast. Upper Sharon Sandstone Aquifer Ramsdell Quarry Landfill (RQL) wells to the northeast will be evaluated for impact from LL1 COPCs. Measured pH values at LL1mw-083, LL1mw-084, and LL1mw-086 have been reported outside of the naturally occurring range expected for groundwater. DGA-LL1A Additional characterization of groundwater required to determine COPCs potentially present to the east of the central load line area will be accomplished through installation of a new monitoring well. Basal Sharon Conglomerate Aquifer Vertical delineation of non-metals COPCs in the downgradient direction of LL1 is provided to the south-southeast by SCFmw-004.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
C-3	Ramsdell Quarry Landfill (RQL)/ RVAAP-01, RVAAP-001-R-01	IRP site description (RVAAP-01): Unlined landfill in former quarry excavated to the underlying Sharon Sandstone/Conglomerate. A pool of water is intermittently present at the bottom of the quarry at approximately 10.7 meters (35 ft) below ground surface (bgs). This landfill was used from 1941 to 1989. During the period of 1946 to 1950 the site was used as a land-surface burning site to thermally destroy waste explosives from Load Line 1 and napalm bombs. Munitions were set on fire and allowed to burn. No history of the use of fire suppressants has been identified at the site. Additionally, burning activities were conducted at the site prior to the prominent use of PFCs at DoD facilities; therefore, PFCs are not thought to be a concern at the RQL site. Dioxins and furans are not suspected to be present at the RQL site as a result of the historical napalm open burn activities (NGB, 2016). From 1976 to 1989, a portion of the site was used strictly as a nonhazardous solid waste landfill. No historical information has been located for 1950 to 1976. The landfill ceased operation in September 1989. Closure of the landfill was completed in May 1990 under state of Ohio solid waste regulations. Land Use Controls (LUCs) are in place including fencing to restrict exposure. Site is included in the RVAAP Five Year Review process. MRS site description (RVAAP-001-R-01): The MRS is comprised of two separate areas: a northern area where OB/OD operations were conducted in a former quarry, and a southern area that contains a small inactive quarry and wooded area where installation personnel had found munitions debris. The northern quarry area is collocated with an IRP AOC (RVAAP-01). Munition debris was identified as part of the field investigation of the IRP site. There are two sites Area one and Area two. Area one is the actual quarry, Area two is south of the railroad tracks. Area one is recommended for NFA. Area two is recommended for a FS to be conducted. Unconsolidated Aquifer Saturated unconsolidated matrix materials have not been characterized to date for potential impact from RVAAP-01/RVAAP-01-R. Based on documented historical contaminant release characteristics, groundwater impact from these source areas is limited to the Upper Sharon Sandstone Aquifer. Upper Sharon Sandstone Aquifer Continued sampling is required to monitor groundwater COPC conditions migrating down-gradient to the northeast. Horizontal delineation is provided by FWGmw-012 to the east. However, FWGmw-012 has historically been designated as a Sharon Shale well. The actual monitored formation and suitability of this well to provided horizontal delineation of the COPCs in the Upper Sharon formation will be further evaluated during the RI. Measured pH values at RQLmw-011, RQLmw-012, and RQLmw-013 have been reported outside of the naturally occurring range expected for groundwater. Basal Sharon Conglomerate Vertical delineation of non-metals site COPCs is provided to the northeast by SCFmw-005.
C-4	Load Line 2 (LL2)/ RVAAP-09, CC RVAAP-68, CC RVAAP-73	RP site description (RVAAP-09): Load Line 2 (RVAAP-09) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		would be swept out through doorways onto the ground surrounding the buildings, in some instances. The settling pond, known as Kelley's Pond, was an unlined triangular-shaped pond approximately 1 acre in size with an average depth of 4 ft. Water from the impoundment discharged to a stream that ultimately exited the installation. <u>CRS site description (CC RVAAP-68, CC RVAAP-73):</u> Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. The East Substation is located close to the intersection of Remalia Road and Load Line No. 2 Road. The substation comprises an area of approximately 12,300 ft^2, which includes the land surrounding Building 25-27. There are no documented releases. However, stained concrete was noted in the building during the historical records review. Target analytes noted in the Historical Records Review (HRR) included Target Analyte List (TAL) metals, PCBs, and SVOCs. <u>Unconsolidated Aquifer</u> Saturated unconsolidated matrix materials have not been characterized to date for potential impact from RVAAP-09. Based on documented historical contaminant release characteristics, groundwater impact from LL2 source areas is limited to the Upper Sharon Sandstone Aquifer. <u>Upper Sharon Sandstone Aquifer</u> A potentiometric rise in the center of LL2 results in radial flow in the Upper Sharon. Horizontal delineation of non-metals COPCs is provided to current screening levels by LL2mw-271 and LL2mw-060 to the southeast. However, reported concentrations are above laboratory MDLs. <u>Basal Sharon Conglomerate</u> The historical dataset indicates the presence of potential SRCs in groundwater above MDLs but below screening levels in the most recent sample results at SCFmw-003. <u>DGA-LL2(A)</u> <u>Upper Sharon Sandstone Aquifer</u> A horizontal delineation gap is present to the southwest of LL2mw-267. <u>Basal Sharon Conglomerate</u> A vertical delineation gap is present to the south-southwest of LL2mw-267. <u>DGA-LL2(B)</u> Upper Sharon Sandstone Aquifer Additional review of historical/pending RI sampling COPC concentrations at LL2mw-270 and evaluation of area hydrogeology (e.g., the potential for discharge of site contaminants to surface water) will be conducted to determine the need for additional characterization to the northwest of LL2. <u>DGA-LL2(C)</u> Upper Sharon Sandstone Aquifer A horizontal and vertical delineation gap is present south-southeast of LL2mw-059.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>Preliminary CSM Inputs</th></tr>
<tr><td>C-5</td><td>Load Line 3 (LL3)/
RVAAP-10,
RVAAP-063,
CC RVAAP-79</td><td><u>IRP sites description (RVAAP-10):</u> Load Line 3 (RVAAP-10) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in some instances. Water from the impoundment discharged to a stream that flowed in a northerly direction and ultimately discharged into RVAAP-29 Cobbs Pond. Predominant groundwater flow direction is to the east. Site-specific assessment/investigation for the presence of residual contamination associated with historical site uses has not been conducted for RVAAP-063.

<u>CRS site description (CC-RVAAP-079):</u> Various ores were historically stored (stock-piled) in ASTs for the GSA. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils.

<u>Unconsolidated Aquifer</u>
Saturated unconsolidated matrix materials have not been characterized to date for potential impact from RVAAP-10/CC-RVAAP-79. Based on the documented historical contaminant release characteristics, groundwater impact from these source areas is limited to the Upper Sharon Sandstone Aquifer. Groundwater conditions associated with Unconsolidated Aquifer wells visible in the western portion of Map C-5 are discussed with review of conditions on Maps C-7 and C-8.

<u>Upper Sharon Sandstone Aquifer</u>
A statistics-based evaluation of historical COPC concentration trends for LL3mw-238 and LL3mw-241 indicates stable to declining COPC concentrations with a low potential for contamination to have migrated downgradient such that current concentrations between these wells and the proposed location of FWG-SS/C3 are at levels higher than at LL3mw-241. Horizontal delineation of LL3 groundwater contaminants is provided to current screening levels by LL3mw-246 to the south. However, reported concentrations are above laboratory MDLs.

<u>DGA-LL3(A)</u>
Upper Sharon Sandstone Aquifer
A horizontal delineation gap is potentially present to the southwest of LL3mw-241 to the west of LL3mw-246.

<u>DGA-LL3(B)</u>
Upper Sharon Sandstone Aquifer
Review of historical sampling results and site hydrogeology is necessary to determine why LL3mw-246 has not exhibited non-metals constituents above current screening levels while the same does not apply for LL3mw-244 (adjacent to the northeast).</td></tr>
</table>

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
C-6	Building 1200/ RVAAP-13, CC RVAAP-79, CC RVAAP-80, RVAAP-51	IRP site description (RVAAP-13, RVAAP-51): From approximately 1941 to 1971, ammunition was demilitarized by steaming out munitions rounds at building 1200 (RVAAP-13). The steam decontamination generated pink water, which drained to a man-made ditch. The ditch discharged into a 0.5-acre sedimentation pond, and the overflow from this pond discharged into Sand Creek. The site buildings have been demolished and all foundations and footings were removed. CRS site description (CC RVAAP-79, CC RVAAP-80): Site is also identified with the DLA Ore Storage Area 2 (Ammunition Storage Area) and the Group 2 Propellant Can Tops (CC RVAAP-80). CC RVAAP-80 consists of approximately 539,572 ft^2 (12.4 acres). Propellant can tops were identified at the ground surface at the southern end of the former Group 2 Ammunition Storage Area. The area is addressed by CC RVAAP-80. The tops were observed by OHARNG trainees in fall 2008 in the vegetative area located immediately south of the ammunition storage magazines near the railroad spur lines. As a result, the Louisville District USACE performed an initial geophysical survey of the southern area ground surface. Results of the initial investigation revealed multiple magnetic anomalies in the surface and near surface soils. On-site unexploded ordnance (UXO) personnel visually identified the surface anomalies as propellant can lids or tops. CC RVAAP-79 is associated with storage of various ores historically stored (stock-piled) in ASTs for the GSA. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils Upper Sharon Sandstone Aquifer, Basal Sharon Conglomerate Aquifer, and Unconsolidated Aquifer Based on most recent groundwater results, there is no indication of non-metal COPCs requiring additional assessment at this AOC. Additional review of site hydrogeology is required to confirm direction of flow and the influence of surface water in this portion of post on contaminant fate and transport. Additional evaluation of historical groundwater sampling results for monitoring wells located downgradient of CC RVAAP-79, CC-RVAAP-80 and RVAAP-51 is necessary to determine the potential for impact from these sites. DGA-FWG(A) Measured pH values at FWGmw-002 (Unconsolidated Aquifer) have been reported outside of the naturally occurring range expected for groundwater.
C-7	Load Line 12 (LL12)/ RVAAP-12, RVAAP-18, RVAAP-29, RVAAP-012-R-01 CC RVAAP-73	IRP site description (RVAAP-12, RVAAP-18, RVAAP-29): From 1941-1943 and 1946-1950, ammonium nitrate was produced at Load Line 12 (RVAAP-12). From 1949 to 1993, munitions were periodically demilitarized at this AOC. Building wash-down water and wastewater from the bomb melt out facility operations was collected in a house gutter system, and flowed through a piping system to two stainless steel tanks. The first tank was used for settling, and the second tank was used for filtration. Prior to the 1980s, the water leaked under the building and ponded there. Building wash-down water from Building F-904 was also swept out through doorways onto the ground surrounding the building. After 1981, the water was treated in the Load Line 12 wastewater treatment system, which discharged to an on-site pond then discharged to a receiving stream that ultimately entered into RVAAP-29, Cobbs Ponds. RVAAP-29 is comprised of approximately 5 acres (Upper Cobbs Pond) and 4 acres (Lower Cobbs Pond). The Upper and Lower Cobbs Ponds are unlined ponds that contain abundant fish and wildlife. A ponded area known as "a backwater area" is located south of Upper Cobbs Pond. This area, approximately 1 acre, was created by beaver activity and was not present

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		during facility operations. The Upper and Lower Cobbs Ponds were used as sedimentation basins for Load Line 12 (RVAAP-12) and Load Line 3 (RVAAP10) wastewater effluent from 1941 to 1971 and storm water runoff. The COCs at this site include explosive compounds, nitrates, and heavy metals. Media of concern include soil, surface water, sediment, and groundwater. <u>MRS site description (RVAAP-012-R-01):</u> Site-specific assessment/investigation for the presence of residual contamination associated with historical site uses has not been conducted for RVAAP-012-R-01. <u>CRS site description (CC RVAAP-73):</u> Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. <u>Unconsolidated, Upper and Lower Sharon Aquifers</u> Evaluation of the effect of the variable direction of groundwater flow in the Unconsolidated, Upper and Lower Sharon aquifers is required to determine the nature and extent of COPCs related to historical operations at LL12. The continued CSM development and results of groundwater modeling will be used to confirm the adequacy of currently existing Upper Sharon and Basal Sharon Conglomerate delineation wells to the southwest of LL12. <u>DGA-LL3(A)</u> Unconsolidated Aquifer Horizontal and vertical delineation gaps are present to the southeast of the LL12.
C-8	Upper and Lower Cobbs Ponds (ULCP), Central Burn Pits (CBP)/ RVAAP-29, RVAAP-49	<u>IRP site description (RVAAP-29, RVAAP-49):</u> RVAAP-29 is comprised of approximately 5 acres (Upper Cobbs Pond) and 4 acres (Lower Cobbs Pond). The Upper and Lower Cobbs Ponds are unlined ponds that contain abundant fish and wildlife. A ponded area known as "a backwater area" is located south of Upper Cobbs Pond. This area, approximately 1 acre, was created by beaver activity and was not present during facility operations. The Upper and Lower Cobbs Ponds were used as sedimentation basins for Load Line 12 (RVAAP-12) and Load Line 3 (RVAAP-10) wastewater effluent from 1941 to 1971 and storm water runoff. Waste types associated with this site include but are not limited to TNT, RDX, HMX, Composition B, lead, chromium, mercury, and aluminum chloride. Currently fishing at Cobbs Pond is catch and release only. The CBP (RVAAP-49) is an approximately 20-acre AOC used early in RVAAP history as a construction yard by Cleveland Builders Supply. Multiple areas within the site were later used to burn non-explosive combustible scrap, and to dump construction/industrial waste. Sand Creek forms the west boundary of the AOC. There are several (approximately 15) debris piles located in the central portion of the site, and another near the western edge of the AOC. <u>Unconsolidated Aquifer</u> Evaluate the effect of area surface water on localized direction of flow in the Unconsolidated Aquifer. Low levels of historically documented impact at the Cobbs Ponds will be updated during RI. <u>Upper Sharon Sandstone Aquifer</u> Vertical delineation is generally provided by CBPmw-009, with the exception of bis(2-ethylhexyl) phthatlate (DEHP). The potential presence of DEHP as a SRC, rather than an introduced laboratory cross-contaminant, will be evaluated during the RI.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		Basal Sharon Conglomerate No wells within AOC.
C-9	RVAAP 34/34R, RVAAP-034-R-01	IRP site description (RVAAP-34): RVAAP-34 was reported by former workers at RVAAP to have been an open dump for materials including, but not limited to, concrete, wood, asbestos debris, lab bottles, 55-gallon drums and fluorescent light tubes. Debris was disposed at the surface, but became covered by vegetation. The site is approximately 2.7 acres and located adjacent to Sand Creek. The dates of operation of this site are unknown, but believed to be between 1950 and 1960. This site used to carry the facility-wide non-groundwater LTM and programmatic support requirements. These requirements are now carried in Program Management and RVAAP-66. MMRP issues will be addressed separately under RVAAP-034-R-01. MRS site description (RVAAP-034-R-01): The Sand Creek Dump is a munitions response site collated with an IRP site Sand Creek Disposal Road Landfill (RVAAP-34). The MRS portion of the site is 0.9 acres in size. This site was identified in the SI as a smaller area located within the IR site. There is no MC or MEC potential in the area. The Draft RI Report for RVAAP-34 Sand Creek Disposal Landfill (USACE, 2016) indicates a potential leaching hazard to groundwater from two explosives (2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene), three SVOCs (1,4-dichlorobenzene, carbazole, and pentachlorophenol), and one VOC (benzene). DGA-SCL(A) Unconsolidated Aquifer Sample groundwater for the presence of explosives, SVOC and VOC constituents leaching from soil to groundwater above current screening levels.
C-10	Atlas Scrap Yard (ASY), RVAAP-50, RVAAP-050-R-01, CC RVAAP-73,	IRP site description (RVAAP-50): In the 1940s, RVAAP-50 (Atlas Scrap Yard) contained a complex of buildings including barracks type housing that supported the principal construction and engineering company staff and included barracks type housing. After WWII, a majority of the Atlas building complex was demolished leaving the remaining portion of structures to support the installation roads and grounds maintenance staff and equipment as well as a large contingent of railroad maintenance personnel. The post WWII structures stood until after the Vietnam War at which point all remaining buildings were demolished and the site became a storage/stockpile yard for various types of bulk materials used in the day-to-day installation operations such as gravel, railroad ballast, sand, culvert pipe, railroad ties, and telephone poles. In the mid to late-1980s, the southeastern portion of the old Atlas area became a staging area for salvaged ammunition boxes from the demilitarization of defunct Vietnam War era munitions. MRS site description (RVAAP-050-R-01): The Atlas Scrap Yard (RVAAP-050-R-01), which is collocated with IRP AOC RVAAP-50, consists of mostly open land that contains a network of roads. Originally used as a construction camp, the site, which is 66 acres, was formerly used for scrap storage and currently consists of scattered piles of debris. CRS site description (CC RVAAP-73): CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		Unconsolidated Aquifer Additional evaluation of the effect of the variable direction of groundwater flow in the Unconsolidated aquifer is required to determine the nature and extent of COPCs related to historical operations at the Atlas Scrap Yard. Additional sampling of ASYmw-010 to monitor groundwater COPC conditions migrating down-gradient to the west. Upper Sharon Sandstone Additional evaluation of the effect of the variable direction of groundwater flow in the Upper Sharon Sandstone is required to determine the nature and extent of COPCs related to historical operations at the Atlas Scrap Yard. Additional characterization of groundwater is required to determine COPCs in the central and eastern portions of the Atlas Scrap Yard. Sharon Conglomerate Additional evaluation of the effect of the variable direction of groundwater flow in the Sharon Conglomerate is required to determine the nature and extent of COPCs related to historical operations at the Atlas Scrap Yard potentially present at SCFmw-002. DGA-ASY(A) Unconsolidated Aquifer Evaluate potential contribution of contamination on the western edge of LL12 to the Atlas Scrap Yard groundwater plume. Determine if the absence of Unconsolidated Aquifer wells in the central part of the site (in the area of ASYmw-004) constitutes a data gap.
C-11	Load Line 4 (LL4)/ RVAAP-11, CC-RVAAP-73 (LL4 Powerhouse Coal Storage), CC RVAAP-79 (DLA Ore Storage Building 841 Area)	RP site description (RVAAP-11): Load Line 4 (RVAAP-11) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in some instances. The on-site settling pond, known as Load Line 4 Pond, was an unlined earthen impoundment approximately 1 acre, based on a Geographic Information Systems approximation. Water from the impoundment discharged to a stream that ultimately exited through the southern side of the installation. CRS site descriptions (CC RVAAP-73, CC RVAAP-79): CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. CC RVAAP-79: Various ores were historically stored (stock-piled) in ASTs for the GSA. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils. Unconsolidated Aquifer Update COPC conditions at LL4mw-199 and LL4mw-200 to determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		Upper Sharon Sandstone Aquifer Update COPC conditions at LL4mw-201 to determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs. Basal Sharon Conglomerate Aquifer Confirm vertical delineation of non-metals COPCs is provided by SCFmw-002, DGA-LL4(A) Unconsolidated, Upper and Lower Sharon Aquifers Additional evaluation of the effect of the variable direction of groundwater flow in the Unconsolidated Aquifer is required to determine the nature and extent of COPCs related to historical operations at LL4.
C-12	Winklepeck Burning Grounds (WBG), Landfill North of Winklepeck Burning Grounds (LNW)/ RVAAP-05, RVAAP-07 (Building 1601 Hazardous Waste Storage), RVAAP-17 (Deactivation Furnace), RVAAP-19, RVAAP-019-R-01, RVAAP-36 (Pistol Range), RVAAP-47 (Building T-5301)	IRP site description (RVAAP-05, RVAAP-07, RVAAP-17, RVAAP-19, RVAAP-36, RVAAP-47): The Winklepeck Burning Grounds (RVAAP-05), consisted of approximately 216 acres and, operated from 1948 to 1998. Prior to 1980, there were open-burning activities performed in unlined pits, pads, and sometimes on the roads within the 216 acre area. Materials that were burned included: RDX, antimony sulfide, Composition B, lead azide, TNT, propellants, black powder, waste oils, sludge from the load lines, domestic wastes, explosively contaminated wastes (e.g., rags, papers, cardboard) and small amounts of laboratory chemicals. The pre-1980 burning was conducted on bare ground and resulting ash was abandoned in-place. Munitions, munitions debris (primarily scrap metal) and explosive constituents are present at the site. From 1980-1998, burning of scrap explosives, propellants, and explosively contaminated materials was conducted within raised refractory-lined trays located within a 1.5-acre area. Historical operations at WBG included destruction of explosives from various types of munitions by open burning. Historical activities at WBG also included destruction of bulk explosives, propellants, and explosive-contaminated combustible material using open burning. In some instances, black powder and explosives were laid out along roads and burned. Prior to 1980, materials destroyed by burning included bulk explosives and explosives-contaminated burnable wastes, propellants, black powder, sludge and sawdust from load lines, and domestic wastes. After 1980, burns were conducted in two metal refractory lined trays set on top of a bed of slag. These trays were located at Pad 37. Ash residues were drummed and stored in Building 1601 until being tested for proper disposal. Burning at this location ceased in the early 1990's and this area was closed under RCRA in 1999. It was common practice for munitions and wastes to be set on fire and allowed to burn overnight. No history of the use of fire suppressants has been identified at the site; therefore, PFCs are not thought to be a concern at the site. RVAAP-07 (Building 1601 Hazardous Waste Storage): Historical reports indicate RVAAP-07 is addressed under RVAAP-05. RVAAP-17 (Deactivation Furnace): Historical reports did not include a site description for RVAAP-17. RVAAP-19: RVAAP-19 is a 2.5-acre unlined and unpermitted landfill (a non-regulated solid waste disposal unit), which operated from 1969 to 1976 and is located upgradient of a wetland. The general appearance of the site suggests that a trench and fill method type of operation was used for waste disposal. Waste types possibly associated with this landfill include booster cups, aluminum liners,

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		municipal waste, explosive and munitions waste and ash, and scrap metal from the Winklepeck Burning Grounds (RVAAP-05). The landfill was covered with soil in 1978. Site recommended for Restricted Access. <u>RVAAP-36:</u> The 1.2 acre Pistol Range is located in the north-central region of RVAAP, west of George Road, east of Greenleaf Road and due north of the WBG. The shooting qualifier stood on the south side of the creek and shot over the creek toward targets on the north side. A soil embankment or berm on the north side of the creek acted as a backstop for the bullets. The embankment is approximately 165 ft. long by 48 ft. high and is located 150 to 200 ft from the edge of the creek. The Pistol Range was used regularly from 1941 to 1993 by the Army and the local police departments, and currently is inactive. <u>RVAAP-47:</u> Building T-5301 was located on the east side of George Road at the entrance to the WBG. A small Guard Post (Building T3402) was located adjacent to George Road and the gravel driveway. Originally built as a smokehouse, Building T25301 was utilized to decontaminate and steam clean small miscellaneous production equipment of explosives and propellants as the equipment left the WBG. The quantity of decontamination fluids wastes produced is unknown. The dates of usage of this building are unknown, but would roughly correspond to dates of production occurring at the installation (i.e., intermittently from World War II to Vietnam). Transite asbestos sheets were used to partition the building into two separate areas - a larger cleaning area and a small area for boilers. Within the interior of the building there was a floor drain that exited out of the southern wall of the building and materials would have discharged into two concrete sedimentation basins that drained, via a ditch, towards Sand Creek located to the southeast. <u>MRS site description (RVAAP-019-R-01):</u> The Landfill North of Winklepeck MRS encompasses a 2.3 acre area that lies adjacent and downstream from the former landfill. The MRS footprint was reconfigured during the historical records review to exclude the former landfill, which is covered with soil and the dump area is considered to be a Response Complete site under the MMRP. Based on the SI, it includes the area adjacent and along the length of the former landfill extending down and including the unnamed stream. <u>Unconsolidated Aquifer</u> Evaluate potential groundwater contaminant contributions from Open Demolition Area #2 to the western portion of WBG. <u>Upper Sharon Sandstone Aquifer</u> Horizontal delineation of all constituents in the downgradient direction of WBG is provided to the east by WBGmw-019. <u>Basal Sharon Conglomerate Aquifer</u> Evaluate site hydrogeology, contaminant mass, and vertical gradients to determine if a Basal Sharon Conglomerate well is required to characterize historical site COPCs potentially present at depth outside of the current well network. <u>DGA-WBG(A)</u> Unconsolidated Aquifer Update groundwater COPC conditions to evaluate a potential horizontal delineation gap downgradient of WBGmw-12.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		DGA-LNW(A) Unconsolidated Aquifer Update groundwater COPC conditions to evaluate a potential horizontal delineation gap to the east of LNWmw-026. Evaluate the potential presence of the Sharon Shale indicated by coal content described in monitoring well logs at LNW.
C-13	Motor Pool Area RVAAP-25, RVAAP-37, CC RVAAP-69, CC RVAAP-73, CC RVAAP-74, CC RVAAP-77, CC RVAAP-83	IRP site description (RVAAP-25, RVAAP-37): Historical documentation indicates that RVAAP-25 is addressed under CC-RVAAP-74, and RVAAP-37 is addressed under CC-RVAAP-70. CRS site descriptions (CC RVAAP-69, CC RVAAP-73, CC RVAAP-74, CC RVAAP-77, CC RVAAP-83): CC RVAAP-69: The Building 1048 Fire Station (CC RVAAP-69) AOC was located in the former plant administration area in the northwest quadrant of the intersection of George Road and South Service Road. In 1968, the fire station was referred to as the Fire and Guard Building, and consisted of 12,130 ft^2. The fire station building was demolished in late 2008, and the site currently remains undeveloped. The AOC consists of the ground area located west/northwest of the former building. The area is currently marked with Siebert stakes. Reportedly, it was common practice for the fire department to clean out fire extinguishers behind the west side of the fire building, and to allow the contents of the fire extinguishers (carbon tetrachloride) to spill onto the ground surface. The area of potential impact (ground surface west of the building) is approximately 28,000 ft^2. CC RVAAP-70: Classification yards were used for the switching and maintenance of railroad cars. This yard was equipped with a locomotive repair building (Round House), an herbicide storage shed, several outbuildings, a washrack area, and a storage tank area. The herbicide shed contained a mobile herbicide tank. The AOC area consists of the following areas within the East Classification Yard: storage tank area, herbicide shed, Round House building, and former washrack area. CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. CC RVAAP-74: An in-ground hydraulic floor lift system located at Building 1034 has been identified and included in CC RVAAP-74. The hydraulic floor lift system is depicted in a 1969 drawing as a twin-post lift system constructed of metal. The below-grade system consists of a cast in concrete L- shaped pit measuring approximately 12 ft in length and 4 ft in length, 3 ft in width, and 4 ft in height. The pit is reportedly buried at depths ranging from 4 ft bgs to approximately 8 ft bgs. The twin-post lift reportedly has a clearance of 6 ft between the floor surface and the bottom of the lift (height in the air). The floor lift system remains in place, and has reportedly exhibited a slow leak of hydraulic fluids for an extended period of time. The potential COCs associated with the floor lift system are total petroleum hydrocarbons, PAHs, and PCBs. CC RVAAP-77: CC RVAAP-77 consists of a former below ground concrete sump located on the north side of Building 1037. The sump had a capacity of approximately 5,765 gallons. The unit was previously used as a settling tank for

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		the discharge of laundry rinse water. Wash water was emptied approximately 12 times during 8 hours of operation and rinsing 3 times each 8 hours. The wash water entering the tank prior to the rinse water discharge had sufficient settling time so that the increase in rate from the rinse water did not disturb the settled matter on the tank bottom. Rinse water was then sent to CC RVAAP-75 (George Road Sewage Treatment Plant). Wastes of concern are TNT and RDX. The concrete wastewater sump was removed in 2009. <u>CC RVAAP-83:</u> Building 1039 - Former Laboratory Building: This former Laboratory Building measured approximately 16,500 ft^2. The structure contained three powder test rooms for the routine analyses of lead azide, mercury fulminate, and percussion element mixes. The laboratory was used for the testing of Load Line materials. During operations, the building contained and operated a photography laboratory, a chemistry laboratory, and a medical x-ray facility. The photo laboratory was historically used for all large scale photo development activities until its closure in the early-1970s. Waste x-ray acid/silver mix solutions were reportedly disposed in the sanitary George Road sewage treatment system. The Defense Property Disposal Organization/Defense Reutilization and Marketing Office termed the waste as a reclaimed precious metal resource. <u>Unconsolidated Aquifer</u> Historical non-metals sampling results indicate no COPCs are present at monitoring well FWGmw-015 (south of motor pool area). Groundwater has not been characterized to determine potential impact from historical site use associated with AOC and CRS sites in the Motor Pool area. <u>Upper Sharon Sandstone Aquifer</u> Historical non-metals sampling results indicate no COPCs are present at monitoring wells and FWGmw-016. However, historical results for FWGmw-015 indicate the potential for off-post migration of perchlorate below screening levels but above laboratory MDLs. <u>DGA-FWG(B)</u> Evaluation of cyanide concentrations is required at FWGmw-004 (Unconsolidated Aquifer).
C-14	Load Line 9 (LL9), Load Line 10 (LL10), Load Line 5 (LL5)	<u>IRP Site Description (RVAAP-39, RVAAP-42, and RVAAP-43):</u> RVAAP-39 (Load Line 5) operated from 1941 to 1945 to produce fuzes for artillery projectiles. Load Line 5 was deactivated and its equipment was removed in 1945. RVAAP-42 (Load Line 9) operated from 1941 to 1945 to produce detonators. Load Line 9 was deactivated and its equipment removed in 1945. RVAAP-43 (Load Line 10) operated from 1941 to 1945 to produce percussion elements. Load Line 10 went on standby status in 1945. From 1951 to 1957, Load Line 10 produced primers and percussion elements. From 1969 to 1971, Load Line 10 was reactivated, and produced munitions primers. The load line has been inactive since that time. <u>CRS Site Description (CC RVAAP-68 and CC RVAAP-73):</u> Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. The West Substation is located west of Load Line 5 on Fuze & Booster Service Road. The substation is

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		comprised of an area of approximately 3,000 ft^2, which includes the area north/northeast of Building 28-28 This AOC excludes Building 28-28. One spill of approximately 500 gallons of transformer fluid occurred on the north side of the building. The impacted area was cleaned up by Emerald Environmental in 1997. Possible impacted soils may exist outside the building around the former transformers. No visual evidence of impacts was noted during the historical records review, Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. Substation No. 3 is located in the Fuze & Booster area between Load Lines 10 and 11. The substation comprises an area of approximately 10,000 ft^2. The substation and all transformer equipment have been removed from the site. There are no documented releases and no visual evidence of impacts was noted during the historical records review. Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 ft^2 (about 5 acres). <u>Unconsolidated Aquifer</u> The potential for naphthalene identified in soil to have impacted groundwater underlying CC-RVAAP-68 Electrical Substation No. 3 will be evaluated through installation of groundwater monitoring wells during the RI. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL5 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. Additional evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer, and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport. Evaluate the potential for discharge of site groundwater COPCS to surface water. <u>Sharon Sandstone Aquifer</u> Vertical delineation of groundwater COPCs is not provided by the current monitoring well network. <u>Basal Sharon Conglomerate</u> Vertical delineation of groundwater COPCs is not provided by the current monitoring well network.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		DGA-LL5/LL10/LL9(A) Homewood Aquifer Determine the extent of hydraulic connection between these three sites and the associated effect on COPC distribution in this area of the post. Sharon Sandstone Aquifer Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at LL9 and LL10. The new well will be installed adjacent to the paved access road between LL9 and LL10, outside of the LL10 perimeter fence and approximately 400 ft northeast of LL10mw-005. Basal Sharon Conglomerate Aquifer Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated and Homewood Aquifers at LL5, LL9, and LL10. The new well will be installed as a nested well adjacent to FWG-SS/C5 on the southeastern edge of LL10. DGA-ES3(A) Unconsolidated Aquifer Check for the presence of naphthalene leaching from soil to groundwater above current screening levels.
C-15	DA2/ RVAAP-45 RVAAP-004-R-01	IRP Site Description (RVAAP 04, RVAAP 45): RVAAP 45 (Wet Storage Area) was used from 1941 to 1945 to store primary explosives in water filled tanks and metal carboys. There is no documentation of any spills in the area. Four of the six igloos were demolished in spring 2003 2004. RVAAP-04 was moved to the MMRP program under RVAAP-004-R-01. Building T-5301 (designated as RVAAP-47) was located on the east side of George Road at the entrance to the Winklepeck Burning Grounds (WBG). A small Guard Post (Building T3402) was located adjacent to George Road and the gravel driveway that led up to Building T-5301. Originally built as a smokehouse, Building T25301 was utilized to decontaminate and steam clean small miscellaneous production equipment of explosives and propellants as the equipment left the WBG. The quantity of decontamination fluids wastes produced is unknown. In addition, the dates of usage of this building are unknown, but would roughly correspond to dates of production occurring at the installation, i.e., intermittently from World War II to Vietnam. The building was essentially a 25-foot by 25-foot sheet-metal structure with a concrete block wall extending approximately 3 ft above ground surface. Transite asbestos sheets were used to partition the building into two separate areas - a larger cleaning area and a small area for boilers. Within the interior of the building there was a floor drain that exited out of the southern wall of the building and materials would have discharged into two concrete sedimentation basins that drained, via a ditch, towards Sand Creek located to the southeast. MRS Site Description (RVAAP-004-R-01): The 35.4 acre Open Demolition Area #2 was used from 1948 until 1991 to detonate large caliber munitions and off- specification bulk explosives and for burial of white phosphorus and bombs of unknown type. The MRS is collocated with an IRP AOC (RVAAP-04). The MRS consists of the former demolition area, Burial Sites 1 and 2, Rocket Ridge, the Bomb Disposal Area located adjacent to the northwestern section of the MRS, and all areas in between. The depth to

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		groundwater at the MRS ranges between 4 to 30 ft bgs and the past munitions OB/OD and burial activities at the MRS occurred at the higher elevations of the MRS, away from Sand Creek where the lower depths to groundwater are found. Evaluation of the groundwater beneath the Open Demolition Area #2 MRS is included as part of the facility-wide groundwater monitoring program. There are COCs, MD, and MC on the site. A FS is recommended to be completed for the site. A RTC to OEPA comments on MFR were sent 21 January 2015 an approval was received from OEPA on 24 February 2015. <u>Unconsolidated Aquifer</u> Direction of flow in the Unconsolidated Aquifer is heavily influenced by the area stream locations, additional review of localized gradients is required to determine effect on contaminant fate and transport. Based on lack of GW COPCs in soil at RVAAP-45, no additional evaluation of this AOC is applicable for the current project. <u>Sharon Shale Aquifer</u> Vertical delineation for DA2 is provided by monitoring well DA2mw-114 (Sharon Shale).
C-16	Block D Igloo/ RVAAP-060-R-01	<u>MRS Site Description (RVAAP-060-R-01):</u> The Block D Igloo MRS resulted when fuzed bombs in Igloo 7-D-15 (D Block) exploded on 24 March 1943. The initial 3,000-foot radial MRS boundary was established by the USACE, Huntsville District to capture the probable debris field resulting from the explosion and was based on the type of munitions stored in the bunker at the time of the explosion. In 1943 a response action was performed by USACE immediately after the explosion. As described below, the area of this site was adjusted based on the 2008 SI findings. Historical assessment of the Block D Igloo site indicates no potential for residual contamination is present at levels indicating unacceptable risk to human and ecological receptors.
C-17	LL6/ RVAAP-14, RVAAP15, RVAAP-33, RVAAP-033-R-01, CC RVAAP-73	<u>IRP Site Description (RVAAP-14, RVAAP-15, and RVAAP-33):</u> Load Line 6 (RVAAP-33) is approximately 45 acres and operated primarily as a fuze assembly line from 1941 to 1945. Demolition of all Load Line 6 buildings was competed July 2006. A portion of the AOC was reactivated in 1950 when the Firestone Defense Products Division became a tenant which lasted until the late-1980s. During this time Firestone sold its Defense Products Division to Physics International. Three years later, Physics International became a subsidiary of Olin Corporation and Olin remained as a tenant until early 1993. Throughout the history of the tenant occupancy the work regimen remained the same. As reported by former workers at RVAAP, Load Line 6 was a classified experimental test facility for munitions. Shaped charges were constructed and tested under contract for the Department of Defense. The site consisted of a pond (underwater test chamber), two above ground test-firing chambers, and several buildings. The test chamber foundation and the concrete blocks around the test pond remain at the site. No original file documentation exists for this site. The contaminants of potential concern are explosives and metals. RVAAP-14 (Evaporation Unit) and RVAAP-15 (Treatment Plant) are being addressed under RVAAP-33. <u>CRS Site Description (CC RVAAP-73):</u> Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP0-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 ft^2 (about 5 acres). MRS Site Description (RVAAP-033-R-01): The 0.4 acre Firestone Test Facility (RVAAP-033-R-01) consisted of two buildings used as test chambers for tube-launched, optically-tracked, wire-guided missiles and Dragon missiles. In addition, shaped charges were tested in a small nearby pond. The site was used from the late-1960s to 1993. The former test chambers have been demolished and all of the debris removed. The test chamber foundations remain. Another suspect area was included in the SI fieldwork that consists of a small clearing and piles of dirt and large timbers. The site is collocated with an IRP AOC Load Line 6 (RVAAP-33). Unconsolidated Aquifer Additional evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer, and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport. Based on current monitoring well locations, an apparent potential for hydraulic connection between LL5 and LL6. Homewood Aquifer Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL6 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours.
C-18	Load Line 11 (LL11)/ RVAAP-44, CC RVAAP-68	RP Site Description (RVAAP-44): RVAAP-44 (Load Line 11) operated from 1941 to 1945 to produce primers for artillery projectiles. Load Line 11 was placed on standby in 1945. From 1951 to 1957, Load Line 11 was used to produce primers and fuzes. CRS Site Description (CC RVAAP-68): Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. Substation No. 3 is located in the Fuze & Booster area between Load Lines 10 and 11. The substation comprises an area of approximately 10,000 ft^2. The substation and all transformer equipment have been removed from the site. There are no documented releases and no visual evidence of impacts was noted during the historical records review. Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. Unconsolidated Aquifer Direction of flow in the Unconsolidated Aquifer is heavily influenced by the area stream locations, additional review of localized gradients is required to determine effect on contaminant fate and transport.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		<u>DGA-LL11(A)</u> Upper Sharon Sandstone Aquifer Review of site-specific hydrogeology and historically characterized contaminant mass to determine if additional well installations are required to address vertical delineation of groundwater COPCs.
C-19	Load Line 7 (LL7)/ RVAAP-30, RVAAP-40 RVAAP-062-R-01	<u>IRP Site Description (RVAAP-30 and RVAAP-40):</u> The Load Line 7 Treatment Plant was a pink water treatment plant operation from 1989 to 1993. This AOC was closed out in January 2000. Load Line 7, formerly known as Booster Line #1, is a 37-acre fenced AOC located on the west side of Fuze and Booster Spur Road, south of Load Line 11, and northeast of Water Works #4 in the south- central portion of RVAAP. A fence exists as the perimeter boundary of the AOC. From 1941 to 1945, Load Line 7 operated at full capacity to produce booster charges for artillery projectiles. At the end of World War II, Load Line 7 was deactivated, and the process equipment was removed. In 1968, Load Line 7 was modified for the production of M-406 High Explosive and M- 407A1 practice 40mm projectiles. Load Line 7 was reactivated from 1969 to 1970. During this time, 16,000,000 40mm projectiles were assembled and produced at Load Line 7. In 1970, Load Line 7 was deactivated, and the process equipment was removed. Topographic relief at the AOC is moderate, with a topographic high on the western boundary of the AOC that slopes downward to the topographic low in the northeastern boundary of the AOC. Surface water follows topographic relief and drains into ditches that exit the AOC. <u>MRS Site Description (RVAAP-062-R-01):</u> The Water Works #4 Dump is an approximate 0.77 acre open area located immediately west of Water Works No.4 and Load Line 7, in the southwestern portion of RVAAP. <u>Unconsolidated Aquifer</u> Conclusions of the Draft RI/FS Report for Soil, Sediment, and Surface Water at RVAAP-40 Load-Line 7, dated 27 January 2016, indicate that the groundwater table occurs within bedrock throughout the AOC. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL7 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. Evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer, and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport. Review of historical monitoring well installation logs should be conducted to confirm the indicated extent of the Homewood Sandstone Aquifer at LL7.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		<u>DGA-LL7(A)</u> Homewood Aquifer Determine the extent of hydraulic connection between the Fuze and Booster Quarry and LL7, evaluate any associated effect on COPC distribution in this area of the post. Evaluate the potential for discharge of site groundwater COPCS to surface water. Sharon Sandstone Aquifer Review of site-specific hydrogeology and historically characterized contaminant mass should be conducted to determine if additional well installations are required to address vertical delineation of groundwater COPCs.
C-20	RVAAP-32 RVAAP-032-R-01, RVAAP -062-R-01	<u>IRP Site Description (RVAAP-32):</u> The 1.3-acre 40mm Firing Range is a former test range for the 40mm cartridge and is surrounded by forest. The MRS was used from 1969 to 1971. The impact area was located in the western portion of the site while the firing point was sited at the opposite end. MEC was reported to be present beyond the impact area, on the slope that leads down to the Fuze and Booster Quarry. Evaluation of residual contamination associated with the site was addressed under RVAAP-032-R-01. <u>CRS Site Description(RVAAP-032-R-01 and RVAAP-062-R-01):</u> The Water Works #4 Dump (RVAAP-032-R-01) is an approximate 0.77 acre open area located immediately west of Water Works No.4 and Load Line 7, in the southwestern portion of RVAAP. The Final RI report for RVAAAP-31-R-01 indicates that “no SRCs were detected in the surface soil samples collected during the RI field activities (CB&I, 2015)”.
C-21	Load Line 8 (LL8)/ RVAAP-41	<u>IRP Site Description (RVAAP-41):</u> Load Line 8, formerly known as Booster Line #2, is a 44-acre fenced AOC located on Fuze and 6 Booster Road, west of Load Line 6, and south of the former 40mm Test Area in the south-central 7 portion of RVAAP. From 1941 to 1945, Load Line 8 operated at full capacity to produce booster 8 charges for artillery projectiles. At the end of World War II, Load Line 8 was deactivated, and the 9 process equipment was removed. Load Line 8 has not been used since 1945. <u>Unconsolidated Aquifer</u> Horizontal delineation of LL8 groundwater COPCs is provided at LL8mw-002 and LL8mw-004. Vertical delineation of COPCs is provided by Homewood Sandstone wells LL8mw-006 and LL8mw-005. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL8 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		DGA-LL8(A) Unconsolidated Aquifer Historical dataset indicates presence of cyanide in groundwater above screening levels at LL8mw-001, but has not been sampled since 2009.
C-22	Fuze and Booster Quarry (FBQ)/ RVAAP-16, RVAAP-26, RVAAP-32, CC RVAAP-78	IRP Site Description (RVAAP-16, RVAAP-26, and RVAAP-32): RVAAP-16: The 4.9 acre Fuze and Booster Quarry (RVAAP 16) site consists of three elongated ponds separated by berms which were constructed within an abandoned rock quarry. The ponds were used for open burning of various types of munitions from 1945 to 1975. RVAAP-26 (Fuze and Booster Area Settling Tanks) is addressed under Fuze and Booster Quarry (RVAAP-16). RVAAP-32: see discussion in C-20. CRS Site Description (CC RVAAP-78): The Quarry Pond Surface Dump (CC RVAAP-78) consists of an area of former dumping along a small topographic ridge located north and northeast of the northern-most quarry pond within the Fuze and Booster Quarry. The potentially impacted area consists of approximately 8,750 (250 ft by 35 ft) ft^2. The debris pile appears to have an average thickness of about 5 ft (where present). Contents of the debris pile appear to consist of potential ACM, construction debris, scrap metal, and other unknown materials. A former burn location is also present along the northeastern portion of the surface dump and is characterized by ground charring. The Quarry Pond Surface Dump appears to be a possible northern extension of the existing Fuze and Booster Quarry AOC (RVAAP-16). Constituents of concern include explosives, propellants, VOCs, SVOCs, metals, asbestos, and PCBs in soil and groundwater. MRS Site Description (RVAAP-016-R-01 and RVAAP-032-R-01): See IRP Site Description. Unconsolidated Aquifer Confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant migration to the north and west. Homewood Aquifer Review of local geology resources with respect to upper contact bedrock formations indicates a portion of the FBQ wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. Evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport; especially radial flow indicated from the center of the site. Determine the extent of hydraulic connection between the Fuze and Booster Quarry and LL7, evaluate any

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		associated effect on COPC distribution in this area of the post. Confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant migration to the north and west. Measured pH values at FBQmw-174 have been reported outside of the naturally occurring range expected for groundwater. Upper Sharon Sandstone Aquifer Vertical delineation of COPCs is absent at the FBQ site. DGA-FBQ(A) Homewood Aquifer Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at the FBQ. DGA-FBQ(B) Unconsolidated Aquifer Historical dataset indicates presence of 2,6-dinitrotoluene in groundwater above screening levels at FBQmw-166, but has not been sampled since 2009. Horizontal delineation in the downgradient (southwest) direction has not been achieved.
C-23	RVAAP-46/46-R-01, CC RVAAP-73	IRP Site Description (RVAAP-46): RVAAP-46 (Building F-15 and F-16) was used during World War II, the Korean Conflict, and Vietnam War to test disassembly processes and munitions surveillance. Quantities and types of materials utilized as well as exact dates of testing are unknown. MRS site description (RVAAP-046-R-01): No historical documentation was available for this MRS site. CRS Site Description (CC RVAAP-73): Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP0-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 ft^2 (about 5 acres). Unconsolidated Aquifer There are currently no AOC-specific permanent monitoring wells installed at RVAAP-46. Based on documented historical contaminant release characteristics, impact form documented sources at the site is limited to near-surface, unsaturated soil.
C-24	NACA Test Area (NTA), Suspected Mustard Burial Site (MBS)/ RVAAP-03, RVAAP-28, RVAAP-38, CC RVAAP-71	IRP Site Description (RVAAP-38, RVAAP-28, and RVAAP-03): RVAAP-38 (NACA Test Area), an approximately 69-acre site, was previously used as an aircraft test area by NACA. Surplus military aircraft crashed into constructed barriers, using a fixed rail attached to the aircraft landing gear, in an attempt to develop crash-worthy fuel tanks and/or high flashpoint aviation fuel. Burial of some demolished aircraft occurred at the site after the tests. Based on review of historical assessment documents for RVAAP 38 NACA Test Area, aircraft crash testing and associated firefighting responses were conducted from 1947 through 1953. Because of the nature of available materials at the time

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>Preliminary CSM Inputs</th></tr>
<tr><td></td><td></td><td>of firefighting activities and the high temperatures that result from the combustion of the plane engines, bromochloromethane was the fire-extinguishing agent that was used at the NACA Test Area. According to the Phase I RI (SAIC, 2001), the site was used for “training and parking” after 1969. As PFCs were not used in firefighting foam products prior to 1970, assessment of these compounds is not warranted at the NACA Test Area (SAIC, 2001).
RVAAP-28 (Mustard Agent Burial Site) consists of three potential disposal areas:
1. Records indicate that in 1969 an EOD unit excavated a suspected mustard agent burial site near the west end of the NACA crash strip. Recovered from the site in 1969 were one 190-liter drum and seven rusty canisters. All recovered items were empty and no evidence of contamination was found.
2. Another suspected area, located to the southwest across Hinckley Creek, is presently marked by reflective Seibert stakes.
3. An additional potential burial area located at the west end of the NACA crash strip was suggested by a member of public and investigated in FY08.

RVAAP-03 (Open Demolition Area 1), consisting of approximately 6 acres, was used to thermally treat munitions by OB/OD. The site now consists of a circular 1-ft berm surrounding a grassed area of approximately 1.5-acres. The entire AOC is located within the NACA Test Area. Contaminants of concern include explosive compounds and metals. The 1989 report from Jacobs Engineering indicates that munition fragments including scrap metal, small arms primers, and fuzes were found outside the bermed area and that the area was operational from 1941 through 1949. Fires and live ammunition were prohibited at the site after 1960 when it became a training area. The Draft Phase II RI for RVAAP-03 (Shaw, 2016) indicates potential leaching of 2,4,6-trinitrotoluene from soil to groundwater at levels above current regulatory screening levels.

<u>CRS Site Description (CC RVAAP-71):</u>
Barn No. 5 was formerly located on the south central portion of the RVAAP close to the Post No. 6 gate. A letter dated May 13, 1964, documents the release of approximately 20 barrels of gasoline (840 gallons) to the ground surface inside of the south fence south of Barn No. 5. Reportedly, the release occurred from a buried pipeline that runs parallel to, and outside of, the RVAAP fence line at this location. This release is addressed by CC RVAAP-71. The area of potential impact consists of approximately 0.6 acres, which includes the footprint of the former barn area and the land between the former barn and the fence line. Potential COCs consist of VOCs, SVOCs, and lead.

<u>Unconsolidated Aquifer</u>
The NACA Test Area overlies a buried glacial valley feature in the upper contact of the Sharon Member Sandstone/Conglomerate Unit (see Figure 1-11). Preferential flow paths associated with coarse-grained alluvial deposits present at the site tending to direct water table groundwater flow toward surface water features and the thickness of low-permeability glacial till material underling the site effectively limit the extent of downward contaminant migration at the site. The relatively low levels of contaminant concentrations reported at the site, which have continued to attenuate over time, further limit the potential for downward migration of contaminants.</td></tr>
</table>

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		DGA-NTA(A) Unconsolidated Aquifer Current COPC conditions for the site at large need to be updated to determine potential horizontal and vertical delineation needs for various non-metals COPCs present in the Unconsolidated Aquifer of the NTA area. Evaluate the potential for Unconsolidated Aquifer discharge to surface water in the southern portions of the NTA site. Upper Sharon Sandstone Aquifer 1. The potential for NTA contaminants to have impacted the Upper Sharon Sandstone Aquifer will be evaluated by installation of a new monitoring well downgradient (based on presumed direction of flow in that formation) to the east. DGA-MBS(A) Unconsolidated Aquifer Current COPC conditions for the site at large need to be updated to determine potential horizontal and vertical delineation needs for various non-metals COPCs present in the Unconsolidated Aquifer of the MBS area. DGA-ODA1(A) Unconsolidated Aquifer Groundwater monitoring wells are not present downgradient from the soil RI sample location determined to present a potential for 2,4,6-trinitoluene leaching from soil to groundwater.
C-25	C Block Quarry/ RVAAP-06, RVAAP-21, RVAAP-24 CC RVAAP-73, CC RVAAP-76	IRP Site Description (RVAAP-06 and RVAAP-24): Block Quarry is a 0.96-acre AOC located between roads 3C and 4C of the C Block Storage Area, north of Newton Falls Road, in the northwestern portion of RVAAP. The C Block Storage Area 31 contains parallel roads of above ground cement igloos that formerly stored munitions. In the 1940s and 1950s, this area was used to mine Homewood Sandstone. The sandstone was quarried for the purpose of road and construction base material. The AOC was used as a disposal area for annealing process waste for a short duration during the 1950s. Liquid waste, including annealing process liquids and spent pickle liquor containing lead, mercury, chromium, and sulfuric acid from brass finishing operations, were dumped on the ground surface in the bottom of the abandoned unlined borrow pit. Potential C Block Quarry chemicals are residues from the storage of materials at the AOC, such as TAL metals, and SVOCs, explosives, and ACM. The quarry bottom within C Block has a maximum depth of 25 ft below the surrounding grade. The AOC is currently heavily forested with brush and trees of at least 1 ft in diameter. Construction debris assumed to be the result of dumping is present at the AOC. Site-specific assessment/investigation for the presence of residual contamination associated with historical site uses has not been conducted for RVAAP-021 or RVAAP-24. CRS Site Description (CC RVAAP-79, CC RVAAP-73, and CC RVAAP-76): Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP0-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 ft^2 (about 5 acres).

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		The Depot Area (CC RVAAP-76) consists of multiple historical operations including: fueling stations, locomotive repair shop, motor repair shop, petroleum storage building, solid waste incinerator, demilitarization activities at Building U-10, service station and AST associated with Building U-5. The steel 400 gallon AST located between Depot Buildings U-5 and U-4 has been removed, but the soils beneath and around the former tank are stained. The tank sat on crushed slag next to the motor oil storage shed. Waste oil from the motor pool area was stored in the AST until it was removed by an oil reclaimer. The AST was in operation from 1983 through 1993. In 1993, the contents of the AST were removed and the tank remained inactive until its removal (after 1996). <u>CC RVAAP-73:</u> Various ores were historically stored (stock-piled) at this facility for the General Services Administration. The DLA, Defense National Stockpile Center leased space at the Ravenna facility for the storage of the ore materials on the ground and in ASTs, which are addressed by CC RVAAP-79. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with underlying soils. The following GSA materials were stock-piled on the ground surface: brass ingots, chemical chrome ore, copper ingots, ferrochrome ore, ferro manganese ore, and metallurgical manganese ore. The following GSA materials were stored in strategic material tanks: magnesium, kyanite, antimony sulfide, asbestos (raw), cobalt rutile sand, silicon carbide, talc, and zircon sand ore. The monazite sand contained radioactive element Thorium 232. <u>Homewood Aquifer</u> Evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport; especially radial flow indicated from the center of the site. Evaluate the potential for discharge of site groundwater COPCS to surface water to the east. Confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant horizontal or vertical migration. <u>DGA-CBL(A)</u> Homewood Aquifer Evaluate the potential for historically detected COPCs to have migrated downgradient after the collection of RI samples. Sharon Shale Aquifer Evaluate the effect of the Sharon Shale on vertical contaminant migration.

Table 1-4
Background Study Monitoring Well Network

Currently Existing Monitoring Wells Planned for Use as Background Wells							
Unconsolidated	**Location**	**Homewood**	**Location**	**Basal SCF**	**Location**	**Upper Sharon SS**	**Location**
BKGmw-017	Central/Western	FWGmw-005	Western	SCFmw-006	Eastern	BKGmw-006	Central
BKGmw-016	Western	N/A	N/A	N/A	N/A	BKGmw-018	Central
BKGmw-005	Western	N/A	N/A	N/A	N/A	BKGmw-008	Eastern
BKGmw-021	Eastern	N/A	N/A	N/A	N/A	BKGmw-015	Central
New Monitoring Wells to be Installed as New Background Wells							
Unconsolidated	**Location**	**Homewood**	**Location**	**Basal SCF**	**Location**	**Upper Sharon SS**	**Location**
N/A	N/A	FWBKG-HSS1	Western	FWBKG-SCON1	Eastern	N/A	N/A
N/A	N/A	FWBKG-HSS2	Western	FWBKG-SCON2	Western	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>RI Goals and Objectives for Each AOC/MRS/CRS Site</th></tr>
<tr><td>C-1</td><td>Erie Burning Grounds (EBG) RVAAP-02</td><td>Update groundwater COPC conditions as necessary for the baseline risk assessment (BRA) for the following constituents:
<u>Constituents:</u> Nitrobenzene; Cyanide
<u>DGA-EBG(A):</u>
RI sampling wells: EBG-126
No new wells currently proposed for this DGA.
<u>DGA-EBG(B):</u>
Evaluate the need for additional sampling of EBGmw-127 based on sampling results for DGA-EBG(C) wells.
<u>RI Wells outside DGAs:</u> EBGmw-123; EBGmw-125 (additional review of site-specific groundwater flow dynamics); EBGmw-126; EBGmw-128; EBGmw-131 (confirmation of current vertical delineation)

<u>FWGWMP Wells:</u> None currently planned.</td></tr>
<tr><td>C-2</td><td>Load Line 1 (LL1)</td><td>Update groundwater COPC conditions as necessary for the BRA for the following constituents:
<u>Constituents:</u> 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Cyanide; Nitroglycerin; RDX
<u>DGA-LL1(A):</u>
RI sampling wells: LL1mw-063; LL1mw-080; LL1mw-081; LL1mw-083*; LL1mw-084*; LL1mw-86*; FWGmw-010 (confirmation of downgradient conditions indicative of no COPC results exceeding screening level)
Install a horizontal delineation well in the Sharon SS/Cong to the northeast of the central load line area.
<u>DGA-LL1(B):</u>
RI sampling wells: None currently planned.
No new wells currently proposed for this DGA.
<u>RI Wells Outside DGAs:</u> LL1mw-064*

<u>FWGWMP Wells:</u> FWGmw-011, LL1mw-064*; LL1mw-065; LL1mw-083*; LL1mw-084*; LL1mw-086*; LL1mw-087; LL1mw-088; SCFmw-004

<u>Alkalinity Assessment:</u> LL1mw-083, LL1mw-084, LL1mw-086, LL1mw-088, and new well FWGmw-SS/C1 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.</td></tr>
</table>

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-3	Ramsdell Quarry Landfill (RQL), RVAAP-01	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: 2,4-Dinitrolouene; 2,6-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; Nitroglycerin; Cyanide; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,1,2,2-Tetrachloroethene; Benzene; DEHP DGA-RQL(A): • RI sampling wells: RQLmw-007*; RQLmw011*; RQLmw-012*; RQLmw-014; RQLmw-015 (PCBs only), RQLmw-016, RQLmw-017 (PCBs only) • Confirm monitored formation for RQLmw-012. • No new wells currently proposed for this DGA. FWGWMP Wells: RQLmw-007*; RQLmw-008; RQLmw-009; RQLmw011*; RQLmw012*[1]; RQLmw-013; FWGmw-012 Alkalinity Assessment: RQLmw-011, RQLmw-012, RQLmw-013, RQLmw-014 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.
C-4	Load Line 2 (LL2), CC RVAAP-68, CC RVAAP-73	Update groundwater COPC conditions as necessary for the BRA and determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs for the following constituents: • Constituents: 2,4-Dinitrotluene; 2,6-Dinitrotoluene; RDX; Cyanide; Pentachlorophenol; Benzene DGA-LL2(A): • RI sampling wells: None currently planned. • A horizontal delineation well will be installed to the south of LL2mw-267. The potential need for installation of an additional down-gradient delineation well will be evaluated following obtaining sample results for the new well. DGA-LL2(B): • RI sampling wells: LL2mw-270. • No new wells currently proposed for this DGA DGA-LL2(C): • RI sampling wells: LL2mw-059*, SCFmw-003 (confirmation of current vertical delineation only) • Horizontal and vertical delineation wells will be installed in the Upper Sharon SS/Cong and Basal Sharon Conglomerate in the area of the post boundary to the south of LL2mw-271. RI Wells outside DGAs: LL2mw-059*; LL2mw-261 (update current conditions); LL2mw-267; LL2mw-268 FWGWMP Wells: LL2mw-059*; LL2mw-060; LL2mw-267*; LLWmw-271

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>RI Goals and Objectives for Each AOC/MRS/CRS Site</th></tr>
<tr><td>C-5</td><td>Load Line 3 (LL3)</td><td>Update groundwater COPC conditions as necessary for the BRA for the following constituents:
<u>Constituents:</u> 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Nitrobenzene; RDX; Cyanide; Pentachlorophenol, DEHP
<u>DGA-LL3(A):</u>
RI sampling wells: None currently planned.
Horizontal and vertical delineation is not provided by the current monitoring well network for non-metals COPCs present in the Unconsolidated Aquifer at LL12 and in the Upper Sharon formation at LL3 to determine the potential for off-post migration of SRCs. The new well will be installed across Route 5 to the southeast of LL12.
<u>DGA-LL3(B):</u>
RI sampling wells: None currently planned.
Determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs at LL3mw-246. A horizontal delineation well will be installed to the south of LL3mw-246.
<u>RI Wells outside DGAs:</u> LL3mw-234; LL3mw-236; LL3mw-237; LL3mw-238*; LL3mw-239; LL3mw-241*; LL3mw-243; LL3mw-244*

<u>FWGMP Wells:</u> LL3mw-238*; LL3mw-241*; LL3mw-244*; LL3mw-246</td></tr>
<tr><td>C-6</td><td>Building 1200, CC RVAAP-79, CC RVAAP-80, and RVAAP-51</td><td>Update groundwater COPC conditions at Building 1200 as necessary for the BRA for the following constituents:
<u>Constituents:</u> Di-n-octylphthalate; Indeno(1,2,3-cd)pyrene
<u>RI Wells:</u> B12mw-011 (confirmation of current upgradient delineation); B12mw-012; BKGmw-004(characterize current conditions downgradient of AOC); BKGmw-008 (characterize current conditions downgradient of AOC); SCFmw-006 (confirmation of current conditions downgradient of AOC)

<u>DGA-FWGmw002(A):</u>

<u>FWGMP Wells:</u> None currently planned.

<u>Alkalinity Assessment:</u> FWGmw-002 and BKGmw-021 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.</td></tr>
</table>

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-7	Load Line 12 (LL12)	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; RDX; Cyanide; Benz(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,2-Dichloroethene; 2,6-Dinitrotoluene; 3-Nitrotoluene; Nitroglycerin; Hydrazine; Benzene DGA-LL3(A): • RI sampling wells: L12mw-182 • New Sharon SS/Cong and Basal Sharon Conglomerate wells will be installed for vertical and horizontal delineation of non-metals COPCs that is not provided by the current monitoring network to the southeast of LL12. RI Wells outside DGAs: L12mw-107; L12mw-154; L12mw-182;L12mw-153 (DEHP only); L12mw-183 (DEHP only); L12mw-186; L12mw-187*; L12mw-188; L12mw-189; L12mw-243; L12mw-244; L12mw-245* FWGMP Wells: L12mw-185; L12mw-187*; L12mw-242; L12mw-245*; L12mw-247; SCFmw-002
C-8	Upper and Lower Cobbs Ponds (ULCP), Central Burn Pits (CBP)	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents (ULCP): 2,6-Dinitrotoluene; Cyanide; Naphthalene • Constituents (CBP): 2,6-Dinitrotoluene; Nitroglycerin; Cyanide, bis(2-ethylhexylphthalate (DEHP) DGA-CBP-(A): • RI sampling wells: CBP-004; CBP-006; CBPmw-008 (confirm downgradient delineation) • Additional characterization of groundwater conditions. • No new wells currently proposed for this DGA. RI Wells outside DGA: ULCPmw-001; ULCPmw-003; ULCPmw-006; CBPmw-001; CBP-002; CBPmw-009 FWGMP Wells: None currently planned.
C-9	RVAAP 34/34-R-01	DGA-SCL(A): • Install three groundwater monitoring wells in the Unconsolidated Aquifer. The wells will be installed to assess the potential presence of 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene leaching to groundwater from impacted soil. The wells will be installed at or in proximity to the AOC maximum concentrations in soil for each of the constituents identified to be a potential leaching hazard to groundwater.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-10	Atlas Scrap Yard (ASY), RVAAP-50, CC RVAAP-73, RVAAP-050-R-01	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: 2,6-Dinitrotoluene; Cyanide DGA-ASY(A): • RI sampling wells: ASYmw-004; ASYmw-005 • Evaluate potential contribution of contamination on the western edge of LL12 to the ASY groundwater plume. • Determine if the absence of Unconsolidated Aquifer wells in the central part of the site (in the area of ASYmw-004 and ASYmw-006) constitutes a data gap. • No new wells currently proposed for this DGA. RI Wells Outside DGA: ASYmw-006, ASYmw-010 (confirmation of current downgradient delineation) FWGMP Wells: None currently planned.
C-11	Load Line 4 (LL4)	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: Naphthalene; 2,6-Dinitrotoluene; Cyanide; Benzene DGA-LL4(A): • RI sampling wells: LL4mw-193; LL4mw-194 (confirmation of current conditions); LL4mw-197 • No new wells currently proposed for this DGA. RI Wells outside DGA: Confirm no off-post migration of SRCs below screening levels but above laboratory MDLs at LL4mw-199, LL4mw-200, and LL4mw-201. FWGMP Wells: None currently planned.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-12	Winkelpeck Burning Grounds (WBG), Landfill North of Winklepeck Burning Grounds (LNW), RVAAP-36, RVAAP-17, RVAAP-07, RVAAP-47	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: (WBG): Cyanide; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Nitrotoluene; 3-Nitrotoluene; RDX; DEHP • Constituents: (LNWBG): Cyanide; 2,6-Dinitrotoluene, DEHP DGA-WBG(A): • RI sampling wells: None currently planned. • Update groundwater COPC conditions to evaluate a potential horizontal delineation gap downgradient of WBGmw-12. • No new wells currently proposed for this DGA. DGA-LNW(A): • RI sampling wells: LNWmw-026 • Update groundwater COPC conditions to evaluate a potential horizontal delineation gap to the east of LNWmw-026. • No new wells currently proposed for this DGA. RI Wells outside DGAs: OBG-1; OBG-4 (3-nitrotoluene only), WBGmw006*; WBGmw007; WBGmw009*; WBGmw014; WBGmw-018; WBGmw-019 (confirm current conditions downgradient to the east); WBGmw-021*; LNWmw-025 Other RI activities: Evaluate the potential presence of the Sharon Shale indicated by coal content described in monitoring well logs at LNW. FWGMP Wells: WBGmw006*; WBGmw009*; WBGmw020; WBGmw021*
C-13	Motor Pool Area: CC RVAAP-83, CC RVAAP-69, CC RVAAP-73, CC RVAAP-74, CC RVAAP-77, CC RVAAP-83, RVAAP-25, RVAAP-37	Unconsolidated Aquifer monitoring wells will be installed in the motor pool area during site-specific investigations planned to be conducted by ARNG/OHARNG during 2016 under other contracts. Continued monitoring of groundwater wells installed during the investigation with confirmed contamination levels requiring additional assessment/monitoring will be incorporated into the FWGWM Program after four quarters of initial characterization sampling have been completed. Conduct additional sampling at FWGmw-015 to determine the potential for off-post migration of perchlorate below screening levels but above laboratory MDLs. • Constituents: cyanide; perchlorate(both constituent due to being above MDLs but below EPA screening levels) DGA-MPA(A): • RI sampling wells: None currently planned. • No new wells currently proposed for this DGA. FWGMP Wells: FWGmw-004; FWGmw-015; FWGmw-016

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-14	Load Line 9 (LL9), Load Line 10 (LL10), Load Line 5 (LL5)	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents: • <u>Constituents:</u> 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, cyanide, carbon tetrachloride <u>DGA-LL5/LL10/LL9(A):</u> • RI sampling wells: LL5mw-001 (PCBs only), LL5mw-002, LL9mw-003, LL9mw-007, LL9mw-004 (confirmation of current conditions downgradient to the southeast), LL10mw-001, L10mw-003*; L10mw-006. New wells will be installed in the Upper Sharon formation and in the Basal Sharon Conglomerate for vertical delineation not provided for non-metal COPCs by the current monitoring well network. The Upper Sharon Sandstone and Basal Sharon Conglomerate wells will be installed in the area of highest COPC concentrations for the series of AOCs (near LL10). <u>RI Wells outside DGA:</u> LL5mw-006 (confirmation of horizontal delineation southwest of DGA-LL5/LL10/LL9(A); SCFmw-001 (confirmation of current conditions with respect to nitroglycerin and cyanide) <u>FWGMP Wells:</u> LL10mw-003* <u>DGA-ES3(A):</u> Based on coordination with OEPA during a preliminary RTC review meeting on 26 April 2016, three temporary monitoring wells will be installed at the CC-RVAAP-68 Electrical Substation No. 3 to sample groundwater in the Unconsolidated Aquifer for naphthalene. The temporary wells will be installed at the approximate location of the maximum naphthalene concentrations identified in soil during the Soil RI (ECC & AMEC, 2015), and to enable a triangulation of well gauging points to determine groundwater flow direction. The temporary wells will be plugged and abandoned immediately after gauging and sampling. The need for additional characterization of naphthalene in groundwater (e.g., the installation of permanent wells) will be based on the temporary well sampling results.
C-15	DA2, RVAAP-45	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • <u>Constituents:</u> 2,6-dinitrotoluene, cyanide, nitroglycerin, RDX, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, naphthalene <u>RI Wells not associated with DGA:</u> DA2mw-104, DA2mw-105, DA2mw-108, DET-4*, FWGmw-013 (confirm current conditions for cyanide such that no COPCs are above screening levels) <u>FWGMP Wells:</u> DA2mw-115, DET-3, DET-4*
C-16	Block D Igloo	None

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-17	LL6, CC RVAAP-73	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents: • <u>Constituents:</u> 2,6-dinitrotoluene, cyanide, nitroglycerin, 4-nitrobenzenamine, DEHP <u>RI Wells not associated with DGA:</u> LL6mw-001; LL6mw-002 (confirmation of horizontal delineation upgradient to the northeast), LL6mw-003; LL6mw-006 LL6mw-007 (confirmation of downgradient vertical delineation, LL6mw-008 (confirmation of current conditions downgradient to the southeast) <u>FWGMP Wells:</u> None currently planned.
C-18	Load Line 11 (LL11)	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • <u>Constituents</u>: 2,6-dinitrotoluene, cyanide, trichloroethene, DEHP <u>DGA-LL11(A):</u> • LL11mw-002 (confirm delineation of COPCs); LL11mw-003 (confirm current conditions indicative of no COPCs exceed screening levels; LL11mw-005 (confirm downgradient delineation); LL11mw-006 • No new wells currently proposed for this DGA. <u>RI Wells outside DGA:</u> LL11mw-001 (DEHP only); LL11mw-010 <u>FWGMP Wells:</u> None currently planned.
C-19	Load Line 7 (LL7)	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA. • <u>Constituents</u>: 1,1-dichloroethane, cyanide, RDX <u>DGA-LL7(A):</u> • RI sampling wells: LL7mw-005; LL7mw-006 • No new wells currently proposed for this DGA. 1. Review site specific hydrogeology and contaminant trends following RI sampling to determine if additional well installations are required to address vertical delineation of groundwater COPCs. <u>RI Wells outside DGA</u>: LL7mw-001* <u>FWGMP Wells:</u> LL7mw-001*
C-20	RVAAP-032-R-01, RVAAP -062-R-01	None

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-21	Load Line 8 (LL8)	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: Cyanide DGA-LL8(A): • RI Wells: LL8mw-001 • No new wells currently proposed for this DGA. FWGMP Wells: None currently planned.
C-22	Fuze and Booster Quarry (FBQ)	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene,; Nitrobenzene; Cyanide; Trichloroethene, DEHP DGA-FBQ(A): • RI sampling wells: FBQmw-174* • Vertical delineation is not provided by the current monitoring well network for non-metal COPCs present in the Homewood Aquifer. A vertical delineation well will be installed in the Upper Sharon formation to the east of FBQmw-174. The need for additional characterization of potential vertical migration of contaminants underlying AOC-specific source areas will be based on relative localized gradients determined between the aquifers and on sample results obtained from currently existing and new wells during the RI. DGA-FBQ(B): • RI sampling wells: FBQmw-166; FBQmw-167 (confirmation of current conditions indicative of no COPCs exceeding SLs); FBQmw-168; FBQmw-176 (confirmation of current conditions indicative of no COPCs exceeding SLs) • No new wells currently proposed for this DGA. RI Wells not associated with DGA: FBQmw-171; FBQ-172; FBQmw-173; FBQmw-175 FWGMP Wells: FBQmw-174* Alkalinity Assessment: FBQmw-171, FBQmw-174, FBQmw-175 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.
C-23	RVAAP-46/46-R-01, CC RVAAP-73	Update groundwater COPC conditions as necessary for the BRA.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-24	NACA Test Area (NTA), Suspected Mustard Burial Site (MBS), RVAAP-03, CC RVAAP-71	Update groundwater COPC conditions as necessary for the BRA. For the following constituents: • Constituents: 2,6-dinitrotoluene, cyanide, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, bromochloromethane DGA-NTA(A): • RI sampling wells: NTAmw-113: NTA-mw-115; NTAmw-116; NTAmw-118; • Evaluate the potential for Unconsolidated Aquifer discharge to surface water in the southern portions of the NTA site. • Vertical delineation is not provided by the current monitoring well network for non-metal COPCs present in the Unconsolidated Aquifer. A vertical delineation well will be installed in the Upper Sharon formation at the approximate location of the current existing well NTAmw-113. The need for additional characterization of potential vertical migration of contaminants underlying AOC-specific source areas will be based on relative localized gradients determined between the aquifers and on sample results obtained from the currently planned new well installations. DGA-MBS(A): • RI sampling wells: MBSmw-004; MBSmw-006 • No new wells currently proposed for this DGA DGA-ODA1(A): • The potential for leaching of 2,4,6-trinitrotoluene from soil to groundwater above current screening levels will be assessed through installation of a temporary monitoring well to the south of the maximum constituent soil sample result location at ODA1. Gauging measurements will be collected from the temporary well and currently existing wells NTAmw-109, NTA-110 and NTAmw-119 to determine a localized direction of groundwater flow. RI Wells outside DGAs: NTAmw-109 (PCBs only), NTAmw-119* FWGMP Wells: NTAmw-119*, FWGmw-007
C-25	C Block Quarry, CC RVAAP-73, CC RVAAP-76, RVAAP-21, RVAAP-24	Update groundwater COPC conditions as necessary for the BRA for the following constituents: • Constituents: Cyanide, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, DEHP DGA-CBL(A): • RI sampling wells: CBLmw-001; CBLmw-003; CBLmw-004 • No new wells currently proposed for this DGA. • Evaluate the potential for historically detected COPCs to have migrated downgradient after the collection of RI samples. • Evaluate the effect of the Sharon Shale on vertical contaminant migration. RI Wells outside DGA: CBLmw-002 (confirm delineation downgradient of AOC) FWGMP Wells: None currently planned.

Notes:
*Well proposed for RI and FWGMP sampling.
[1]FWGWMP Wells: Identified for pH testing only.

Table 3-1. Summary of New Well Locations by Aquifer

Monitored Aquifer/Preliminary Well ID	Purpose/Location
Homewood	
FWBKG-HSS1	Background Study, Northwest of CBL
FWBKG-HSS2	Background Study, Northwest of CBL
Basal SCF	
FWBKG-SCON1	Background Study, collocated with BKGmw-018
FWBKG-SCON2	Background Study, Northwest of CBL
FWG-SCON3	Vertical delineation of non-metals COPCs: • 2-amino-4,6-Dintrotoluene, 4-amino-2,6-Dintrotoluene, perchlorate; Determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs at LL2mw-060 and LL2mw-271. The new well will be installed on federal government property across Route 5, south of LL2mw-271.
FWG-SCON4	Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated Aquifer at LL12: • 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; RDX; Cyanide; Benz(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,2-Dichloroethene; 2,6-Dinitrotoluene; 3-Nitrotoluene; Nitroglycerin; Hydrazine; Benzene and in the Upper Sharon formation at LL3: • 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Nitrobenzene; RDX; Cyanide; Pentachlorophenol, DEHP. Determine the potential for off-post migration of SRCs. The new well will be installed on federal government property across Route 5 to the southeast of LL12.
FWG-SCON5	Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated and Homewood Aquifers at LL5, LL9, and LL10: • 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, cyanide, carbon tetrachloride; PCB-1248 The new well will be installed adjacent to the paved access road between LL9 and LL10, outside of the LL10 perimeter fence and approximately 400 feet northeast of LL10mw-005 (same general location as for FWG-SS/C5 below).

Monitored Aquifer/Preliminary Well ID	Purpose/Location
Sharon SS/Cong	
FWG-SS/C1	Horizontal delineation of various non-metals COPCs in the Upper Sharon formation reported in sampling results for LL1mw-083 and LL1mw-084: • 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; RDX; Cyanide; 2,6-Dinitrotoluene; DEHP The new well will be installed approximately 1,100 feet east of LL1mw-083.
FWG-SS/C2	Horizontal delineation of LL2 non-metals COPCs: • 2,4-Dinitrotluene; 2,6-Dinitrotoluene; RDX; Cyanide; Pentachlorophenol; Benzene. The new well will be installed at a position about 650 feet down-gradient of LL2mw-267.
FWG-SS/C3	Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated Aquifer at LL12 • 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; RDX; Cyanide; Benz(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,2-Dichloroethene; 2,6-Dinitrotoluene; 3-Nitrotoluene; Nitroglycerin; Hydrazine; Benzene and in the Upper Sharon formation at LL3: • 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Nitrobenzene; RDX; Cyanide; Pentachlorophenol, DEHP Determine the potential for off-post migration of SRCs. The new well will be installed on federal government property across Route 5 to the southeast of LL12.
FWG-SS/C4	Horizontal delineation of perchlorate to determine the potential for off-post migration of groundwater concentrations below screening levels but above laboratory MDLs at LL3mw-246. The new well will be installed on federal government property across Route 5 to the south of LL3mw-246.
FWG-SS/C5	Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at LL9 and LL10: • 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, cyanide, carbon tetrachloride The new well will be installed adjacent to the paved access road between LL9 and LL10, outside of the LL10 perimeter fence and approximately 400 feet northeast of LL10mw-005.

Monitored Aquifer/Preliminary Well ID	Purpose/Location
FWG-SS/C6	Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at the FBQ: • 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene,; Nitrobenzene; Cyanide; Trichloroethene, DEHP The new well will be installed approximately 1,100 feet east of FBQmw-174.
FWG-SS/C7	Vertical delineation for various non-metals COPCs present in the Unconsolidated Aquifer of the NTA area: • 2,6-dinitrotoluene, cyanide, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, bromochloromethane The new well will be installed immediately adjacent to currently existing well NTAmw-113.
FWG-SS/C8	Horizontal delineation of non-metals COPCs: • 2-amino-4,6-Dintrotoluene, 4-amino-2,6-Dintrotoluene, perchlorate Determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs at LL2mw-060 and LL2mw-271. The new well will be installed on federal government property across Route 5, south of LL2mw-271.
Unconsolidated Aquifer	
FWG-UNCONS1	Assess the potential presence of naphthalene leaching from soil to groundwater above regulatory screening levels at Electrical Substation No. 3. Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS2	Assess the potential presence of naphthalene leaching from soil to groundwater above regulatory screening levels at Electrical Substation No. 3. Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS3	Assess the potential presence of naphthalene leaching from soil to groundwater above regulatory screening levels at Electrical Substation No. 3. Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS4	Assess the potential presence of leaching from soil to groundwater above regulatory screening levels at the Sand Creek Landfill/Dump for the following constituents: • 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene; Determine a localized direction of flow in the Unconsolidated Aquifer.

Monitored Aquifer/Preliminary Well ID	Purpose/Location
FWG-UNCONS5	Assess the potential presence of leaching from soil to groundwater above regulatory screening levels at the Sand Creek Landfill/Dump for the following constituents: • 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene; Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS6	Assess the potential presence of leaching from soil to groundwater above regulatory screening levels at the Sand Creek Landfill/Dump for the following constituents: • 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene; Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS7	Assess the potential presence of 2,4,6-trinitrotoluene leaching from soil to groundwater above regulatory screening levels at ODA1. Determine a localized direction of flow in the Unconsolidated Aquifer.

Table 3-2
Summary of Monitoring Well Sampling – FWGW Monitoring Program and RI Phase

Existing Wells				
Unconsolidated FWGW/RI	**Homewood* FWGW/RI**	**Basal Sharon FWGW/RI**	**Sharon Shale FWGW/RI**	**Upper Sharon Sandstone FWGW/RI**
20/66	3/22	2/3	0/3	21/30
New Wells to be Installed and Sampled				
Unconsolidated	**Homewood**	**Basal Sharon**	**Sharon Shale**	**Upper Sharon Sandstone**
7	None	3	0	8

*Homewood wells include locations currently under review for monitored formation interval.

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Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite							
							VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Atlas Scrap Yard	ASYmw-004	Sharon Sandstone	960.10	950.10		X[1]						X[1]		pending[3,9]
Atlas Scrap Yard	ASYmw-005	Sharon Sandstone	963.60	953.60		X[1]				X[1]		X[1]		pending[3,9]
Atlas Scrap Yard	ASYmw-010	Unconsolidated	961.20	951.20		X[1]				X[1]		X[1]		pending[3,9]
Building 1200	B12mw-011	Sharon Sandstone	989.76	979.76		X[1]		X[1]						pending[3]
Building 1200	B12mw-012	Sharon Sandstone	991.43	981.43		X[1]		X[1]			X[1]			pending[3]
Background	BKGmw-004	Unconsolidated	955.96	945.96		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Background	BKGmw-005	Unconsolidated	1141.24	1131.24		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-006	Sharon Sandstone	1001.68	991.68		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-008	Sharon Sandstone	955.70	945.70		X[1], Background Study[2]	X[1]	X[1]	X[1]	X[1]		X[1]	Anions, Cations, Alkalinity	X[2]
Background	BKGmw-015	Sharon Sandstone	1007.80	987.80		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-016	Unconsolidated	1090.02	1079.92		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-017	Unconsolidated	1109.60	1099.50		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-018	Sharon Sandstone	1028.56	1018.56		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-021	Unconsolidated	964.46	954.36		Background Study[2]							Anions, Cations, Alkalinity	X[2]
C-Block Quarry	CBLmw-001	Homewood	1139.50	1129.50		X[1]		X[1]	X[1]					pending[3]
C-Block Quarry	CBLmw-002	Homewood	1138.00	1128.00		X[1]		X[1]	X[1]					pending[3]
C-Block Quarry	CBLmw-003	Homewood	1139.22	1129.22		X[1]		X[1]	X[1]					pending[3]
C-Block Quarry	CBLmw-004	Homewood	1138.08	1128.08		X[1]		X[1]	X[1]					pending[3]
Central Burn Pits	CBPmw-001	Unconsolidated	950.91	940.91		X[1]			X[1]	X[1]		X[1]		pending[3]
Central Burn Pits	CBPmw-002	Unconsolidated	947.83	937.83		X[1]			X[1]	X[1]		X[1]		pending[3]
Central Burn Pits	CBPmw-004	Unconsolidated	951.58	941.58		X[1]			X[1]	X[1]		X[1]		pending[3]
Central Burn Pits	CBPmw-006	Unconsolidated	952.51	942.51		X[1]		X[1]				X[1]		pending[3]
Central Burn Pits	CBPmw-008	Unconsolidated	955.57	945.57		X[1]		X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Central Burn Pits	CBPmw-009	Sharon Sandstone	915.90	905.90				X[1]	X[1]	X[1]		X[1]		pending[3]
Demolition Area 2	DA2mw-104	Unconsolidated	1054.52	1044.52		X[1]		X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Demolition Area 2	DA2mw-105	Unconsolidated	1034.36	1029.36		X[1]				X[1]				pending[3]
Demolition Area 2	DA2mw-107	Unconsolidated	1030.38	1025.38					X[1]					

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Demolition Area 2	DA2mw-108	Unconsolidated	1020.62	1015.62		X[1]				X[1]	X[1]			pending[3]
Demolition Area 2	DA2mw-115	Sharon Sandstone	1001.65	991.65	**X**	**X**		**X[4]**	X[1]	**X**		X[1]		**X**
Demolition Area 2	DET-003	Unconsolidated	1028.81	1023.81	**X**	**X**	**X**	**X[4,5,6,7]**	**X**	**X**	**X**	**X**		**X**
Demolition Area 2	DET-004	Unconsolidated	1031.68	1026.68	**X**	**X**	**X**	**X[4,5,6,7]**	**X**	**X**	**X**	**X**		**X**
Erie Burning Grounds	EBGmw-123	Unconsolidated	924.59	914.59		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-125	Unconsolidated	933.55	923.55		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-126	Unconsolidated	923.00	913.00		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-128	Unconsolidated	927.47	917.47		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-131	Sharon Sandstone	887.00	877.00		X[1]				X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-166	Unconsolidated	1099.37	1089.37		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-167	Unconsolidated	1107.05	1097.05		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-168	Homewood	1122.27	1112.27		X[1]	X[1]			X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-171	Homewood	1122.49	1112.49		X[1]	X[1]			X[1]		X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Fuze and Booster Quarry	FBQmw-172	Homewood	1125.71	1115.71		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-173	Homewood	1132.93	1112.93		X[1]	X[1]			X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-174	Homewood	1123.78	1113.78	**X**	**X**	X[1]	**X[4]**		**X**	**X**	X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Fuze and Booster Quarry	FBQmw-175	Homewood	1125.16	1115.16		X[1]						X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Fuze and Booster Quarry	FBQmw-176	Unconsolidated	1118.57	1108.57		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Facility-Wide	FWGmw-002	Unconsolidated	913.60	903.60	**X[8]**	**X[8], X[1]**		X[1]	X[1]	X[1]			**Alkalinity**	pending[3]
Facility-Wide	FWGmw-004	Unconsolidated	1025.00	1015.00	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]		**X**
Facility-Wide	FWGmw-005	Homewood	1148.25	1138.25		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Facility-Wide	FWGmw-007	Unconsolidated	1053.30	1043.30	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]		**X**
Facility-Wide	FWGmw-010	Unconsolidated	953.50	943.50		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Facility-Wide	FWGmw-011	Unconsolidated	933.00	923.00	**X**	**X**		**X[4]**	X[1]	**X**				**X**
Facility-Wide	FWGmw-012	Sharon Sandstone	909.40	899.40	**X**	**X**		**X[4]**	X[1]	**X**				**X**
Facility-Wide	FWGmw-013	Sharon Sandstone	1033.10	1023.10		X[1]						X[1]		pending[3]
Facility-Wide	FWGmw-015	Unconsolidated	998.60	988.60	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]		**X**
Facility-Wide	FWGmw-016	Sharon Sandstone	957.40	947.40	**X**	**X**		**X[4]**	X[1]	**X**				**X**

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Load Line 1	LL1mw-063	Sharon Sandstone	975.10	965.10		X[1]				X[1]	X[1]	X[1]		pending[3]
Load Line 1	LL1mw-064	Unconsolidated	924.32	914.32	X	X		X[4]	X[1]	X		X[1]		X
Load Line 1	LL1mw-065	Unconsolidated	931.33	921.33	X	X		X[4]	X[1]	X		X[1]		X
Load Line 1	LL1mw-080	Sharon Sandstone	984.20	974.70		X[1]				X[1]		X[1]		pending[3]
Load Line 1	LL1mw-081	Sharon Sandstone	967.00	957.50		X[1]				X[1]		X[1]		pending[3]
Load Line 1	LL1mw-083	Sharon Sandstone	963.70	954.20	X	X		X[4]	X[1]	X	X	X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Load Line 1	LL1mw-084	Sharon Sandstone	969.70	960.10	X	X		X[4]	X[1]	X	X	X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Load Line 1	LL1mw-086	Unconsolidated	873.50	863.50	X	X		X[4]	X[1]	X		X[1]	Alkalinity	X
Load Line 1	LL1mw-087	Unconsolidated	934.80	924.80	X	X		X[4]	X[1]	X		X[1]		X
Load Line 1	LL1mw-088	Unconsolidated	922.40	912.40	X	X		X[4]	X[1]	X	X	X[1]	Alkalinity	X
Load Line 2	LL2mw-059	Sharon Sandstone	955.03	945.23	X	X		X[4]	X[1]	X		X[1]		X
Load Line 2	LL2mw-060	Sharon Sandstone	950.83	941.03	X	X		X[4]	X[1]	X		X[1]		X
Load Line 2	LL2mw-261	Sharon Sandstone	999.75	989.75		X[1]			X[1]	X[1]		X[1]		pending[3]
Load Line 2	LL2mw-264	Sharon Sandstone	1000.30	990.30		X[1]		X[4]	X[1]	X[1]		X[1]		pending[3]
Load Line 2	LL2mw-267	Sharon Sandstone	1003.01	993.01	X	X		X[4]	X[1]	X		X[1]		X
Load Line 3	LL2mw-268	Sharon Sandstone	998.17	988.17		X[1]	X[1]			X[1]				pending[3]
Load Line 2	LL2mw-269	Sharon Sandstone	992.39	982.39		X[1]		X[4]	X[1]	X[1]		X[1]		pending[3]
Load Line 2	LL2mw-270	Sharon Sandstone	1000.13	990.13		X[1]			X[1]	X[1]	X[1]	X[1]		pending[3]
Load Line 2	LL2mw-271	Sharon Sandstone	944.10	934.10	X	X		X[4]	X[1]	X		X[1]	**Perchlorate**	X
Load Line 3	LL3mw-234	Sharon Sandstone	994.67	984.67		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Load Line 3	LL3mw-236	Sharon Sandstone	995.14	985.14		X[1]	X[1]			X[1]		X[1]		pending[3]
Load Line 3	LL3mw-237	Sharon Sandstone	990.87	980.87		X[1]	X[1]			X[1]		X[1]		pending[3]
Load Line 3	LL3mw-238	Sharon Sandstone	994.25	984.25	X	X	X[1]	X[4]	X[1]	X	X	X[1]		X
Load Line 3	LL3mw-239	Sharon Sandstone	976.80	966.80		X[1]				X[1]				pending[3]
Load Line 3	LL3mw-241	Sharon Sandstone	979.71	969.71	X	X	X[1]	X[4]	X[1]	X	X	X[1]		X
Load Line 3	LL3mw-243	Sharon Sandstone	975.56	965.56		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Load Line 3	LL3mw-244	Sharon Sandstone	951.70	941.70	X	X	X[1]	X[4]	X[1]	X	X	X[1]		**X + Cr(VI)**
Load Line 3	LL3mw-246	Sharon Sandstone	953.70	943.70	X	X	X[1]	X[4]	X[1]	X		X[1]	**Perchlorate**	X
Load Line 4	LL4mw-193	Unconsolidated	969.58	959.58		X[1]	X[1]	X[1]		X[1]	X[1]	X[1]		pending[3,9]
Load Line 4	LL4mw-194	Unconsolidated	970.57	960.57		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3,9]
Load Line 4	LL4mw-197	Unconsolidated	972.99	962.99		X[1]				X[1]		X[1]		pending[3,9]
Load Line 4	LL4mw-199	Unconsolidated	964.90	954.90		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3,9]

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Load Line 4	LL4mw-200	Unconsolidated	973.37	963.37		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3,9]
Load Line 4	LL4mw-201	Sharon Sandstone	919.40	909.40		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3,9]
Load Line 5	LL5mw-001	Homewood	1111.00	1101.00		X[1]	X[1]		X[1]					pending[3]
Load Line 5	LL5mw-002	Homewood	1110.80	1100.80		X[1]	X[1]		X[1]			X[1]		pending[3]
Load Line 5	LL5mw-006	Homewood	1111.10	1101.10		X[1]	X[1]		X[1]			X[1]		pending[3]
Load Line 6	LL6mw-001	Unconsolidated	N/A	N/A		X[1]		X[1]				X[1]		pending[3]
Load Line 6	LL6mw-002	Unconsolidated	N/A	N/A		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-003	Homewood	N/A	N/A		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-006	Unconsolidated	N/A	N/A		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-007	Homewood	N/A	N/A		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-008	Unconsolidated	1114.10	1104.10		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 7	LL7mw-001	Homewood	1107.40	1097.40	**X**	**X**	**X**	**X[4]**		**X**		X[1]		**X**
Load Line 7	LL7mw-005	Homewood	1115.30	1105.30		X[1]				X[1]		X[1]		pending[3]
Load Line 7	LL7mw-006	Homewood	1103.20	1093.20		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Load Line 8	LL8mw-001	Unconsolidated	1104.69	1094.69		X[1]						X[1]		pending[3]
Load Line 9	LL9mw-003	Homewood	N/A	N/A		X[1]		X[1]		X[1]				pending[3]
Load Line 9	LL9mw-004	Homewood	N/A	N/A		X[1]		X[1]		X[1]				pending[3]
Load Line 9	LL9mw-005	Homewood	N/A	N/A		X[1]		X[1]		X[1]				pending[3]
Load Line 9	LL9mw-007	Homewood	N/A	N/A		X[1]		X[1]		X[1]	X[1]			pending[3]
Load Line 10	LL10mw-001	Homewood	1113.00	1103.00		X[1]	X[1]			X[1]		X[1]		pending[3]
Load Line 10	LL10mw-003	Homewood	1111.40	1101.40	**X**	**X**	**X**	**X[4,5]**		X[1]		X[1]		**X**
Load Line 10	LL10mw-006	Unconsolidated	1107.70	1097.70		X[1]						X[1]		pending[3]
Load Line 11	LL11mw-001	Unconsolidated	1086.06	1076.06				X[1]						pending[3]
Load Line 11	LL11mw-002	Unconsolidated	1073.99	1063.99		X[1]		X[1]		X[1]	X[1]	X[1]		pending[3]
Load Line 11	LL11mw-003	Unconsolidated	1082.55	1072.55		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 11	LL11mw-005	Unconsolidated	1073.40	1063.40		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 11	LL11mw-006	Unconsolidated	1081.01	1071.01		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 11	LL11mw-010	Unconsolidated	1069.32	1059.32		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 12	LL12mw-107	Unconsolidated	957.33	947.33		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-153	Unconsolidated	963.04	953.04				X[1]						pending[3]
Load Line 12	LL12mw-154	Unconsolidated	960.60	950.60		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-182	Unconsolidated	957.00	947.00		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-183	Sharon Shale	957.29	947.05		X[1]		X[1]			X[1]			pending[3]
Load Line 12	LL12mw-185	Unconsolidated	968.29	958.29	**X**	**X**	X[1]	X[1]	X[1]	X[1]		X[1]	**Nitrate**	**Arsenic**
Load Line 12	LL12mw-186	Sharon Shale	967.54	957.54		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Load Line 12	LL12mw-187	Unconsolidated	960.70	950.70	**X**	**X, X[1]**	X[1]	**X[4], X[1]**	X[1]	**X**		X[1]	**Nitrate, Hydrazine[1]**	**X**
Load Line 12	LL12mw-188	Unconsolidated	968.66	958.66		X[1]				X[1]	X[1]			pending[3]
Load Line 12	LL12mw-189	Sharon Shale	968.67	958.67		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Load Line 12	LL12mw-242	Unconsolidated	962.90	952.90	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]	**Nitrate**	**X**
Load Line 12	LL12mw-243	Unconsolidated	965.10	955.10		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Load Line 12	LL12mw-244	Unconsolidated	958.60	948.60		X[1]	X[1]				X[1]		Hydrazine[1]	pending[3]
Load Line 12	LL12mw-245	Unconsolidated	959.50	949.50	**X**	**X**	X[1]	**X[4]**	X[1]	**X**	X[1]	X[1]	**Nitrate**	**X**
Load Line 12	LL12mw-247	Unconsolidated	971.30	961.30	**X**	**X**		**X[4]**	X[1]	**X**	X[1]	X[1]	**Nitrate**	**X + Cr(VI)**
Landfill North of Winklepeck	LNWmw-025	Unconsolidated	1019.20	1009.20		X[1]		X[1]		X[1]		X[1]		pending[3]
Landfill North of Winklepeck	LNWmw-026	Unconsolidated	1012.00	1002.00		X[1]		X[1]		X[1]		X[1]		pending[3]
Suspected Mustard Agent Burial Site	MBS-004	Unconsolidated	1064.85	1055.15		X[1]				X[1]		X[1]		pending[3]
Suspected Mustard Agent Burial Site	MBS-006	Unconsolidated	1063.79	1053.79		X[1]				X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-109	Unconsolidated	1068.89	1058.89		X[1]			X[1]					pending[3]
NACA Test Area	NTAmw-113	Unconsolidated	1055.61	1045.61		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
NACA Test Area	NTAmw-114	Unconsolidated	1066.11	1056.11		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-115	Unconsolidated	1074.41	1064.41		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-116	Unconsolidated	1081.68	1071.68		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-117	Unconsolidated	1077.17	1067.17		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-118	Unconsolidated	1066.86	1056.86		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-119	Unconsolidated	987.40	977.40	**X**	**X**	**X**	**X[4,5,6]**	X[1]	**X**		X[1]		**X**
Ramsdell Quarry Landfill	RQLmw-007	Sharon Sandstone	957.86	947.86	**X**	**X**	**X**	**X[4,6,7]**	**X**	**X**	**X**	**X**	Phosphorus[1]	**X**
Ramsdell Quarry Landfill	RQLmw-008	Sharon Sandstone	957.82	947.82	**X**	**X**	**X**	**X[4,6,7]**	**X**	**X**	**X**	**X**		**X**
Ramsdell Quarry Landfill	RQLmw-009	Sharon Sandstone	956.70	946.70	**X**	**X**	**X**	**X[4,6,7]**	**X**	**X**	**X**	**X**		**X**
Ramsdell Quarry Landfill	RQLmw-011	Sharon Sandstone	962.20	942.20	**X[8]**	**X[8]**	X[1]	X[1]	X[1]	X[1]		X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Ramsdell Quarry Landfill	RQLmw-012	Sharon Sandstone	955.32	945.32	**X[8]**	**X[8]**	X[1]	X[1]	X[1]	X[1]		X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Ramsdell Quarry Landfill	RQLmw-013	Sharon Sandstone	954.34	944.34	**X[8]**	**X[8]**	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Ramsdell Quarry Landfill	RQLmw-014	Sharon Sandstone	952.23	942.23		X[1]				X[1]			Sulfate/ Sulfide, Nitrate/ Nitrite, Alkalinity	X[1] (Cr[VI]), pending[3]
Ramsdell Quarry Landfill	RQLmw-015	Sharon Sandstone	959.99	949.99		X[1]			X[1]					pending[3]
Ramsdell Quarry Landfill	RQLmw-016	Sharon Sandstone	965.52	955.52		X[1]						X[1]		pending[3]
Ramsdell Quarry Landfill	RQLmw-017	Sharon Sandstone	968.89	958.89		X[1]			X[1]					pending[3]

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite: VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Sharon Conglomerate	SCFmw-001	Basal Sharon Cong.	917.53	907.53		X[1]	X[1]	X	X[1]	X[1]		X[1]		pending[3]
Sharon Conglomerate	SCFmw-002	Basal Sharon Cong.	845.28	835.28	**X**	**X**	X[1]	**X[4]**	X[1]	**X**	**X**	X[1]		**X + Cr(VI)**
Sharon Conglomerate	SCFmw-003	Basal Sharon Cong.	830.64	820.64		X[1]	X[1]	X	X[1]	X[1]		X[1]		pending[3]
Sharon Conglomerate	SCFmw-004	Basal Sharon Cong.	841.87	831.87	**X**	**X**	X[1]	**X[4]**	X[1]	**X**	**X**	X[1]		**X**
Sharon Conglomerate	SCFmw-006	Basal Sharon Cong.	887.69	877.69		X[1], Background Study[2]	X[1]	X[1]	X[1]	X[1]		X[1]	Anions, Cations, Alkalinity	X[2]
Upper and Lower Cobbs Pond	ULCPmw-001	Unconsolidated	950.91	940.91		X[1]				X[1]				pending[3]
Upper and Lower Cobbs Pond	ULCPmw-003	Unconsolidated	957.54	947.54		X[1]						X[1]		pending[3]
Upper and Lower Cobbs Pond	ULCPmw-006	Unconsolidated	952.51	942.51		X[1]		X[6]						pending[3]
Winklepeck Burning Grounds	OBG-1	Unconsolidated	N/A	N/A		X[1]	X[1]			X[1]		X[1]		pending[3]
Winklepeck Burning Grounds	OBG-4	N/A	N/A	N/A		X[1]				X[1]				pending[3]
Winklepeck Burning Grounds	WBGmw-006	Unconsolidated	1004.56	994.56	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]		**X**
Winklepeck Burning Grounds	WBGmw-007	Unconsolidated	984.59	974.59		X[1]	X[1]			X[1]		X[1]		pending[3]
Winklepeck Burning Grounds	WBGmw-009	Unconsolidated	1033.63	1023.63	**X**	**X**	X[1]	**X[4]**		**X**		X[1]		**X**
Winklepeck Burning Grounds	WBGmw-014	Unconsolidated	982.10	972.10		X[1]				X[1]				pending[3]
Winklepeck Burning Grounds	WBGmw-018	Unconsolidated	977.00	967.00		X[1]				X[1]				pending[3]
Winklepeck Burning Grounds	WBGmw-019	Sharon Sandstone	949.75	939.75		X[1]	X[1]			X[1]		X[1]		pending[3]
Winklepeck Burning Grounds	WBGmw-020	Sharon Sandstone	1010.50	1000.50	**X**	**X**		**X[4]**	X[1]	**X**				**X**
Winklepeck Burning Grounds	WBGmw-021	Sharon Sandstone	978.00	968.00	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]		**X**

Notes:
AMSL = above mean sea level
FWGMP = Facility-Wide Groundwater Monitoring Program
X - indicates well or constituent to be sampled as part of the 2016 FWGWMP or during the RI characterization sampling
Bold and shaded cells indicate content associated with the 2016 FWGWMP
[1] Indicates monitoring well or constituents to be sampled as part of the RI characterization effort only (not part of the FWGWMP). All RI Wells will be sampled at least once in association with the Fall 2016 FWGMP event. Additional rounds of sampling for select wells and constituents will be conducted based on the initial RI testing results. Wells/constituents confirmed with stable or decreasing concentrations will generally only be sampled once for the purposes of the RI.
[2] Background study wells will be sampled for a minimum of three consecutive quarters in order to obtain a base representative sample set of 12 per aquifer
[3] Metals to be characterized for the RI will be selected based on a comparison of historical sampling results to individual constituent upper-bound value concentrations in the pending metals background study following approval by Ohio EPA.
[4] SVOCs: phthalates
[5] SVOCs: nitroaromatics
[6] SVOCs: polycyclic aromatic hydrocarbons
[7] SVOCs: phenols
[8] Indicates FWGMP well identified for alkalinity testing only
[9] Pending metals evaluation will include hexavalent chromium

Table 4-1
Summary of New Well Installations within 500 feet of Surface Water

Monitoring Well ID	Nearest Surface Water Body or Wetland Within 500 ft	Distance and Direction to Proposed Well
FWBKG-HSS1	Freshwater/Forested Shrub Wetland per National Registry	~360 ft to the NW of proposed well
FWBKG-HSS2	Pond	~350 ft NE of proposed well
FWBKG-SCON1	Freshwater/Forested Shrub Wetland per National Registry	~250 ft SW of proposed well
FWBKG-SCON2	Stream or Creek Bed	~300 ft N of proposed well
FWBKG-SCON5	Freshwater/Forested Shrub Wetland per National Registry	~500 ft NW of proposed well
FWG-SS/C1	Freshwater/Forested Shrub Wetland per National Registry	~250 ft N of proposed well
FWG-SS/C4	Freshwater/Forested Shrub Wetland per National Registry	~300 ft NW of proposed well
FWG-SS/C7	Freshwater Emergent Wetland per National Registry	~400 ft N of proposed well
FWG-UNCONS1	Stream/Creek	~220 ft SE of proposed well
FWG-UNCONS2	Stream/Creek	~220 ft SE of proposed well
FWG-UNCONS3	Stream/Creek	~280 ft SE of proposed well
FWG-UNCONS4	Sand Creek	~50 ft NW of proposed well
FWG-UNCONS5	Sand Creek	~40 ft NW of proposed well
FWG-UNCONS6	Sand Creek	~140 ft NW of proposed well
FWG-UNCONS7	Freshwater Emergent Wetland per National Registry	~100 ft SW of proposed well

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FIGURES

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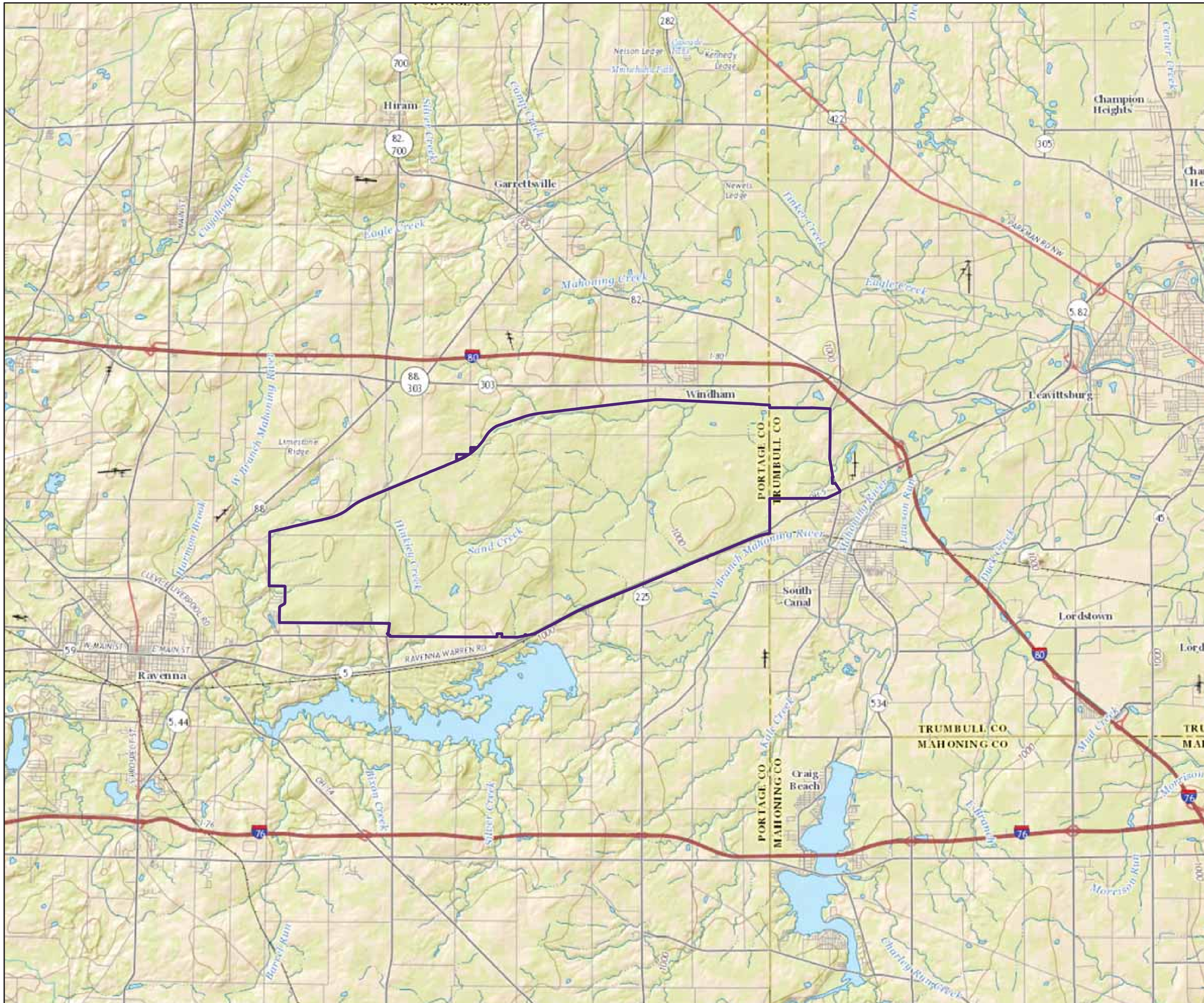

Overview Map

Legend

Camp Ravenna Property Line

Notes:
- Basemap Source: ESRI Map Service - USGSTopo

N

0 1 2 3 4 Miles

1:126,720
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

SITE LOCATION MAP

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-1

FINAL

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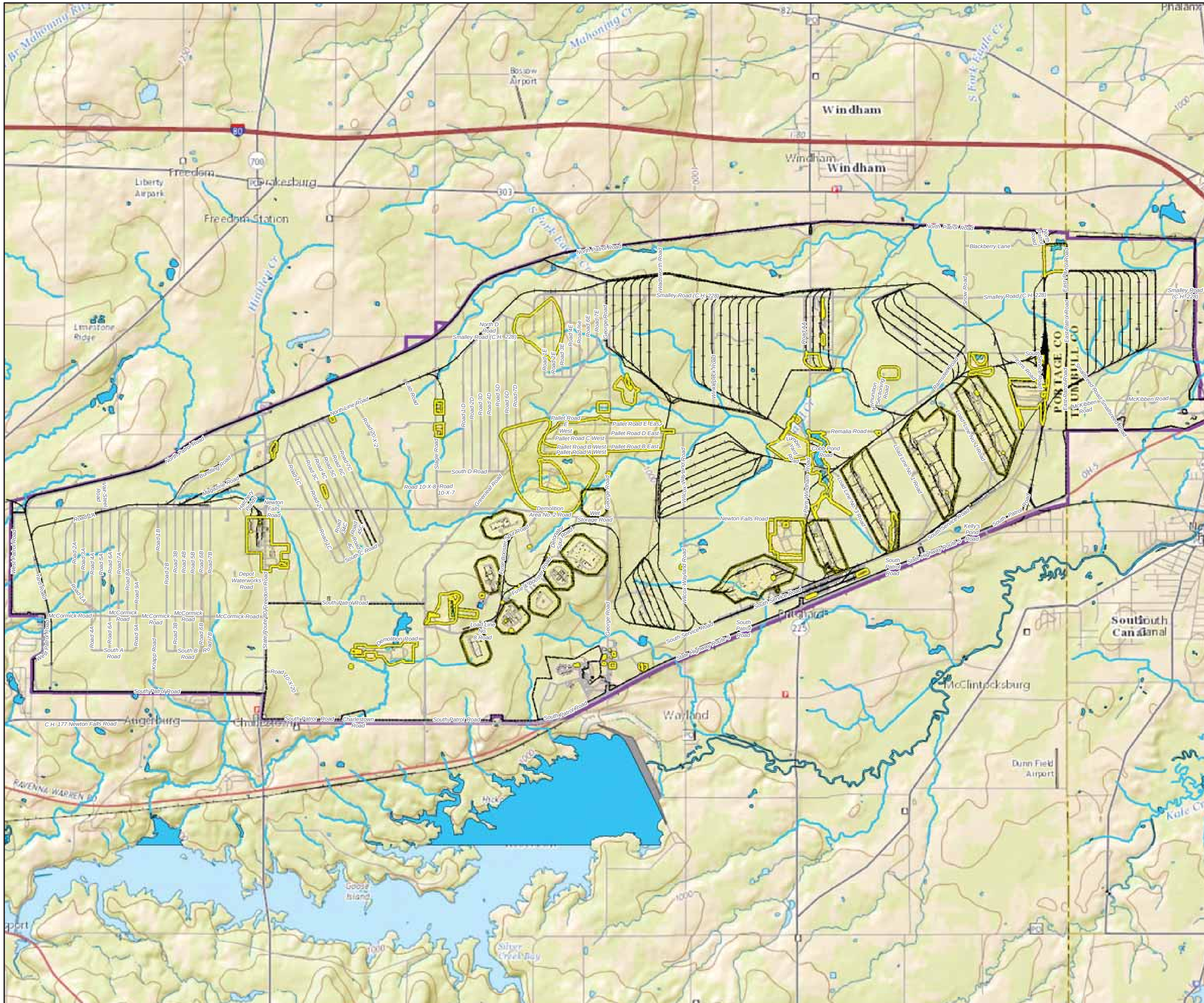

Legend

- Fenceline
- Roads
- Railroad
- Streams
- Water Bodies
- Buildings
- AOCs
- Camp Ravenna Property Line

Notes:
- Basemap Source: ESRI Map Sservice - USGSTopo

N

0 2,500 5,000 7,500 10,000 Feet

1:60,000
NAD83 UTM Zone 17N

Cardno TEC WESTON TEC-Weston Joint Venture

SITE LAYOUT

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-2

FINAL

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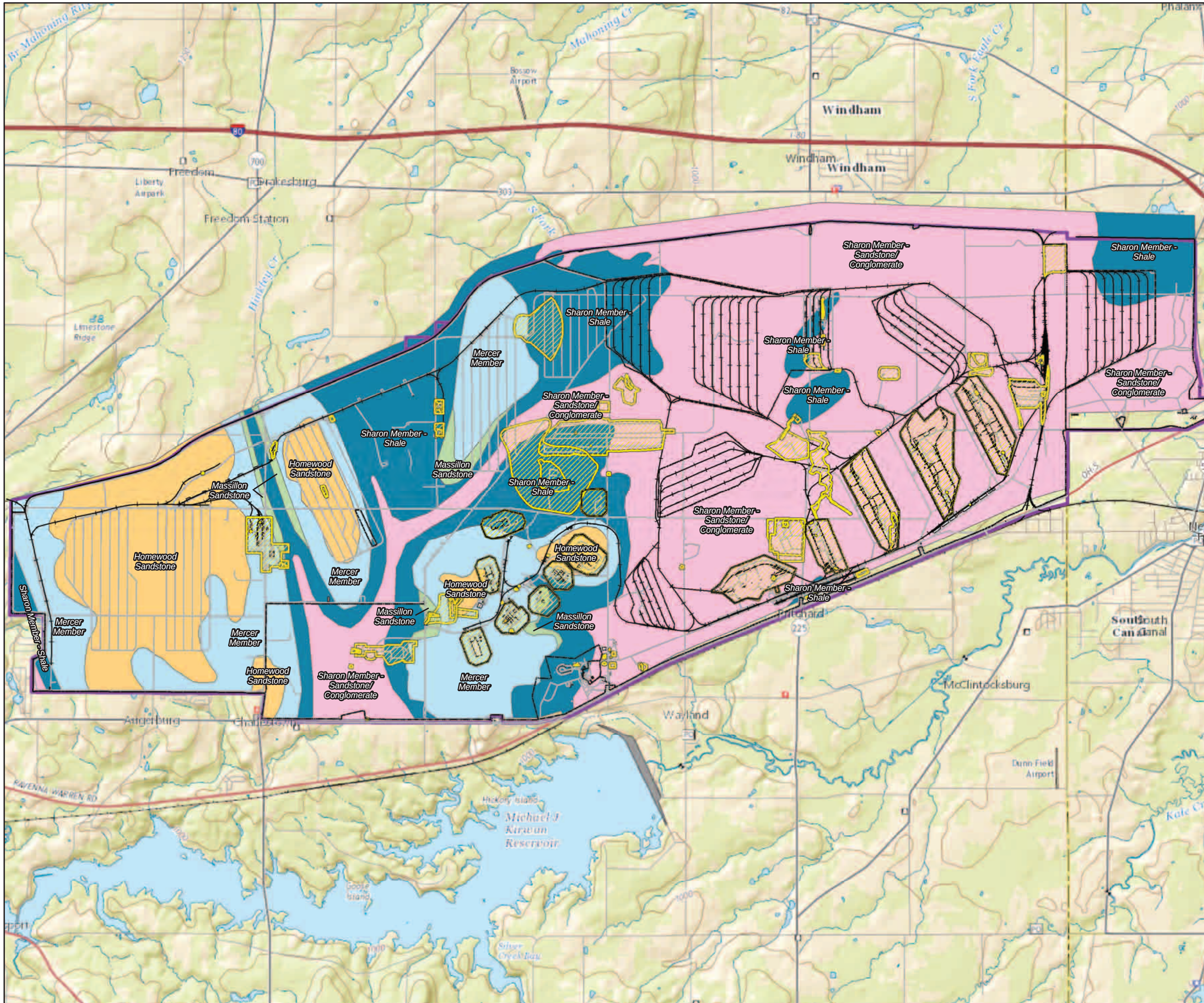

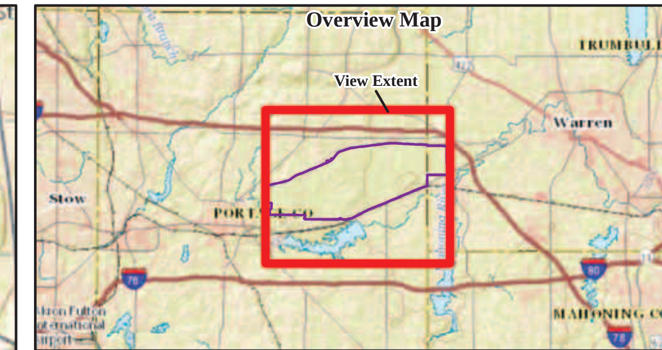

Legend

Geology Formation

- Homewood Sandstone
- Mercer Member
- Massillon Sandstone
- Sharon Member - Shale
- Sharon Member - Sandstone/Conglomerate
- Fenceline
- Roads
- Railroad
- Buildings
- AOCs
- Camp Ravenna Property Line

Notes:
- Basemap Source: ESRI Map Sservice - USGSTopo

N

0 2,500 5,000 7,500 10,000 Feet

1:60,000
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

SURFACE GEOLOGY MAP

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-3

FINAL

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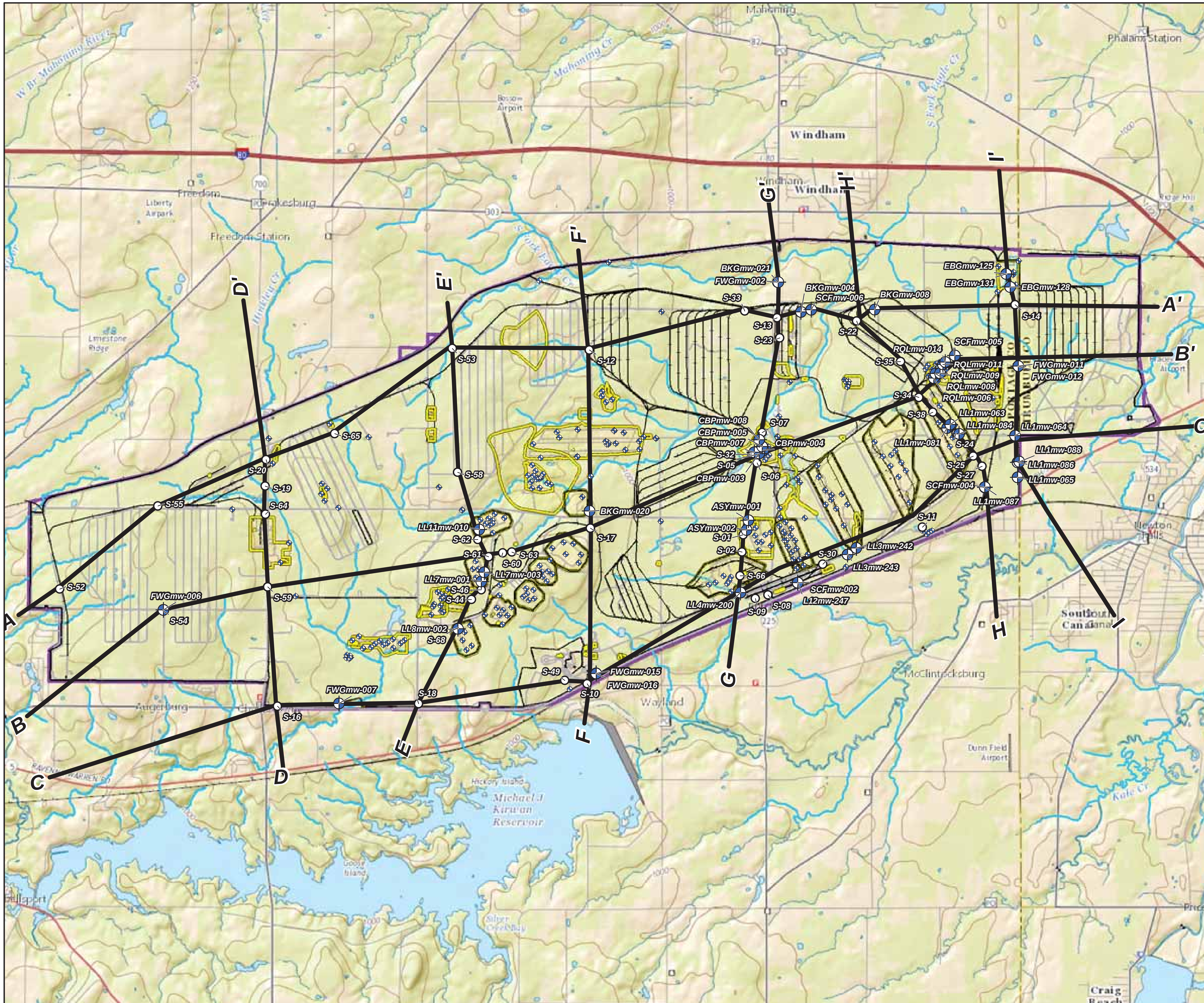

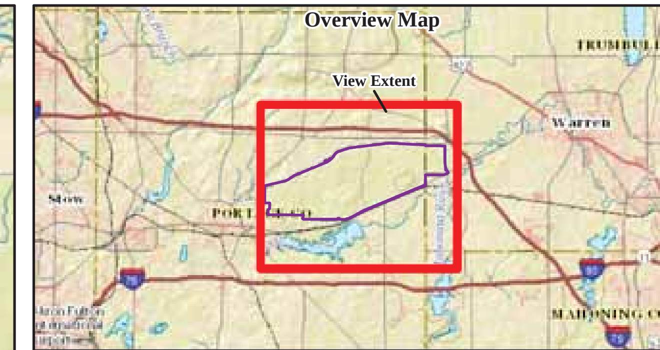

Legend

- Line of Section
- Monitor Well Location Used in Cross-
- Other Input Used for Cross
- Other Monitor Well Location
- AOCs
- Camp Ravenna Property Line
- Fenceline
- Roads
- Railroad
- Streams

Notes:
- Basemap Source: ESRI Map Sservice - USGSTopo

N

0 2,500 5,000 7,500 10,000 Feet

1:64,000
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

LINE OF SECTION MAP

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-4

FINAL

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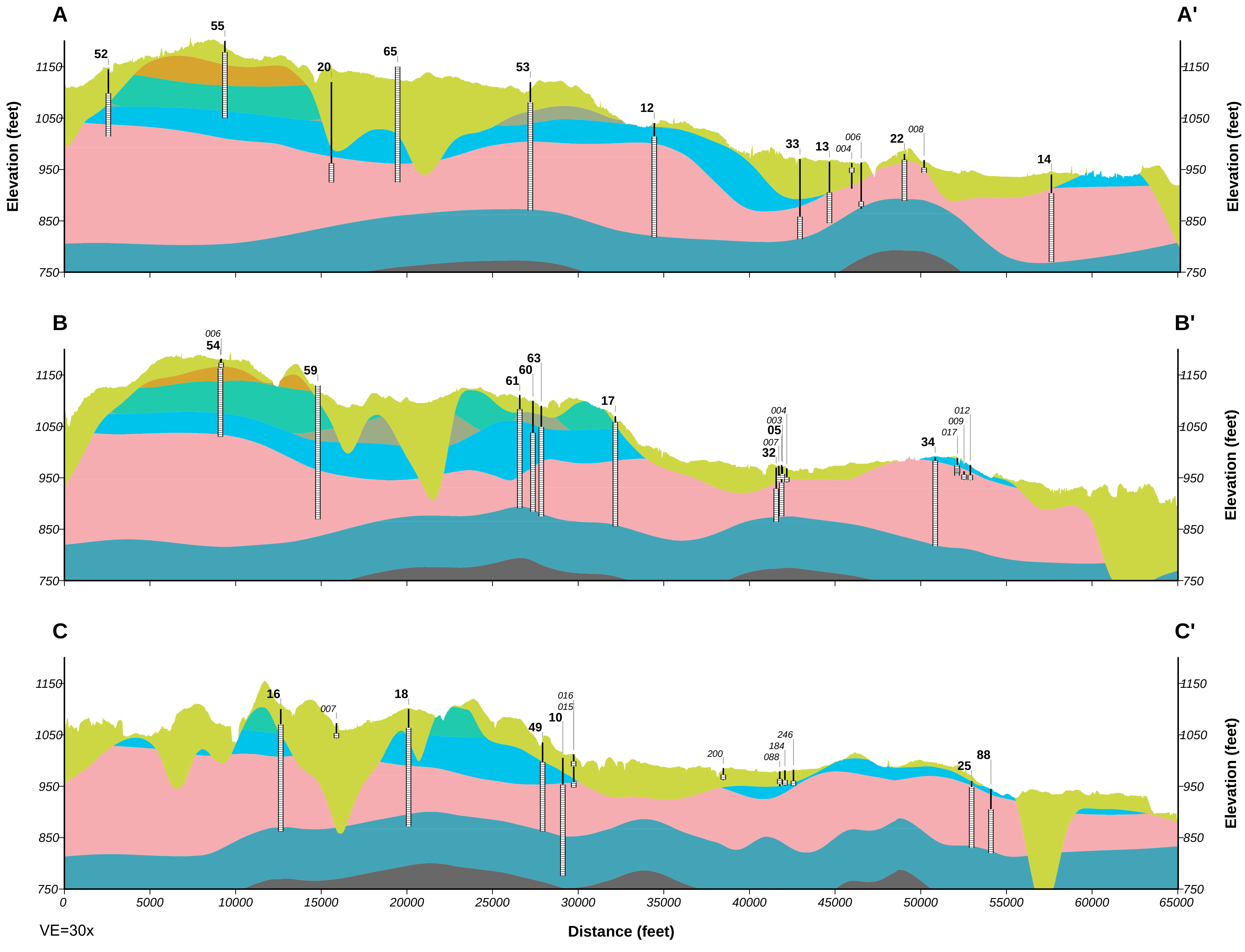

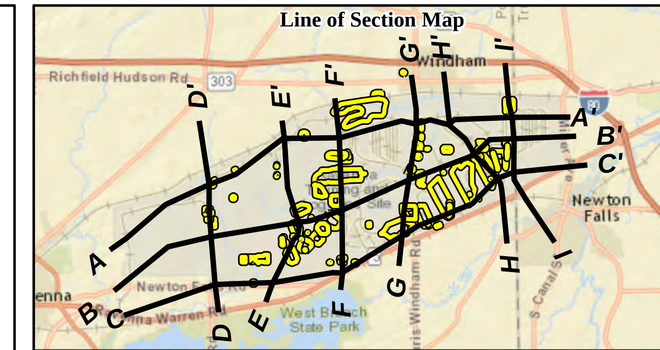

Legend

- AOC boundary
- Lines of Section

Site Wells

- Leader
- Casing
- Screen

Geology

- Unconsolidated
- Homewood Sandstone Member
- Mercer Member
- Massillon Sandstone Member
- Sharon Member, Shale Unit
- Sharon Member, Sandstone/Conglomerate Unit
- Cuyahoga Group
- Berea Sandstone

Pottsville Formation (Homewood Sandstone Member through Sharon Member, Sandstone/Conglomerate Unit)

Notes:
- Former production well IDs are **bold**
- Site wells are *italicized* and have had the AOC prefix removed for clarity

TEC-Weston Joint Venture

EAST-WEST CROSS SECTIONS (A-C)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-5

FINAL

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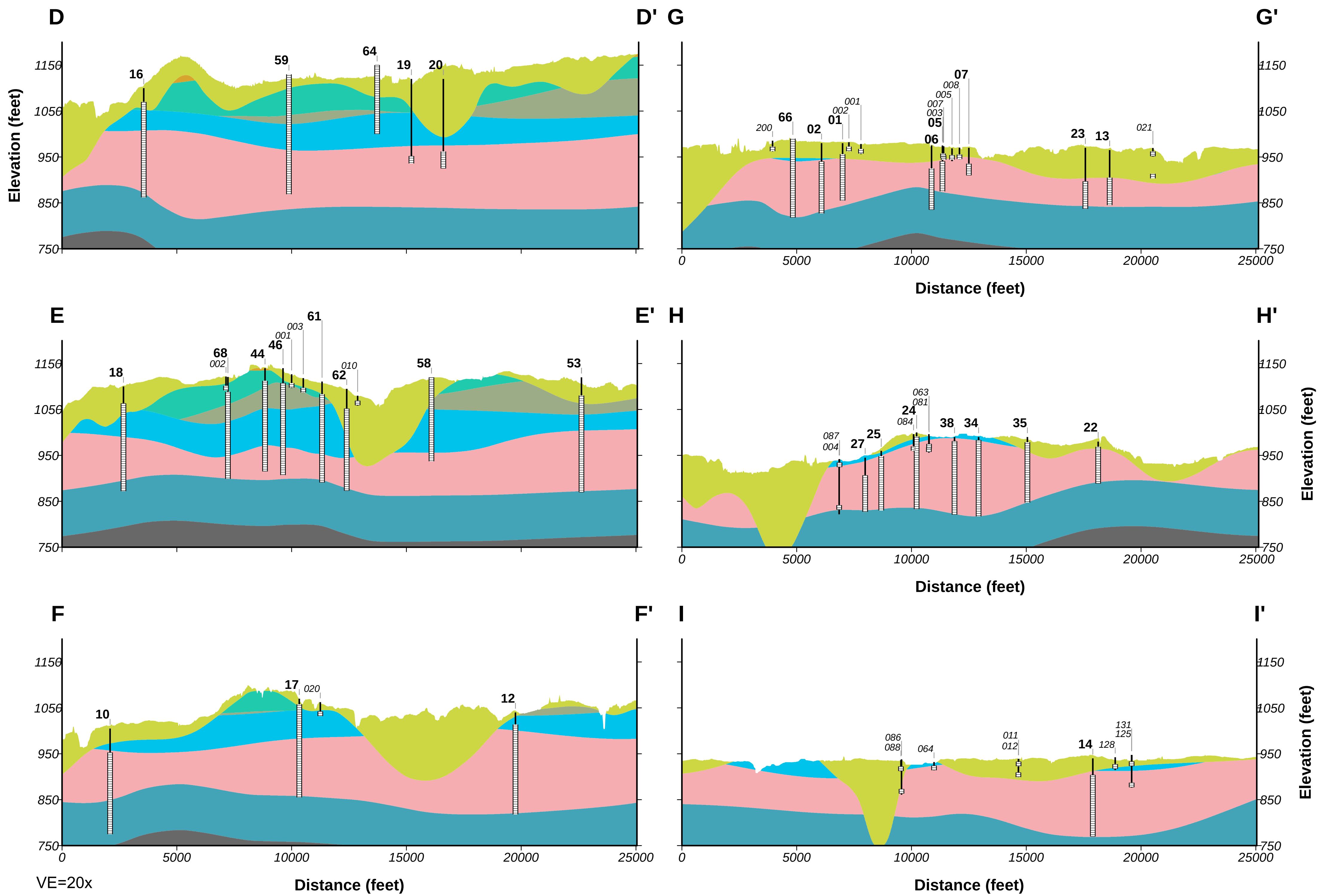

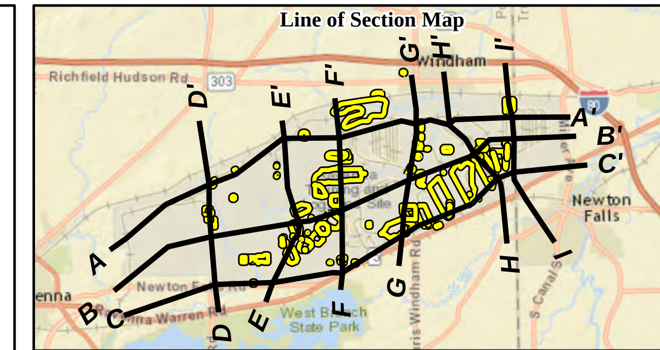

Legend

AOC boundary

Lines of Section

Site Wells

Leader

Casing

Screen

Geology

Unconsolidated

Homewood Sandstone Member

Mercer Member

Massillon Sandstone Member

Sharon Member, Shale Unit

Sharon Member, Sandstone/Conglomerate Unit

Cuyahoga Group

Berea Sandstone

Pottsville Formation

Notes:
- Former production well IDs are **bold**
- Site wells are *italicized* and have had the AOC prefix removed for clarity

TEC-Weston Joint Venture

NORTH-SOUTH CROSS SECTIONS (D-I)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-6

FINAL

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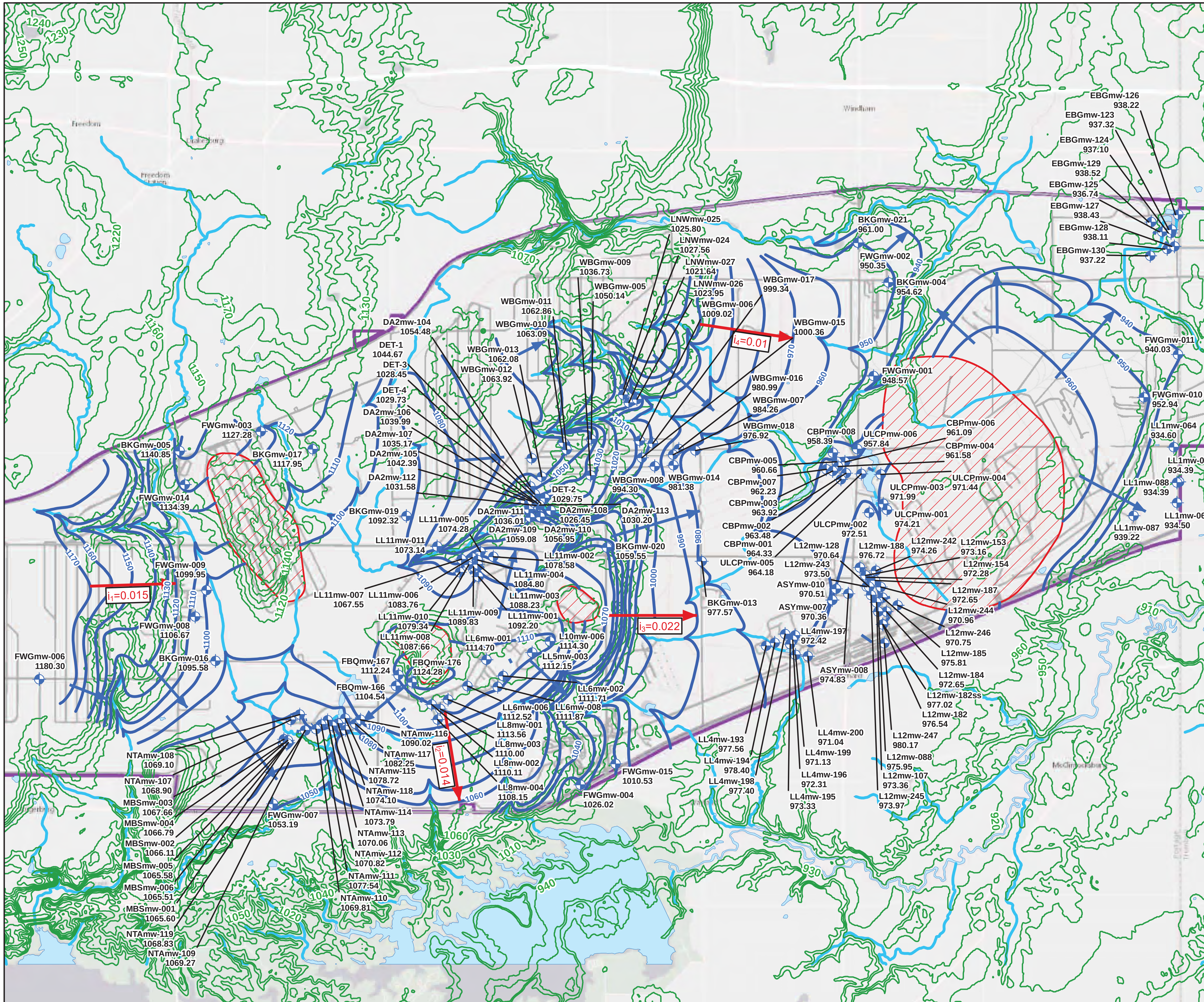

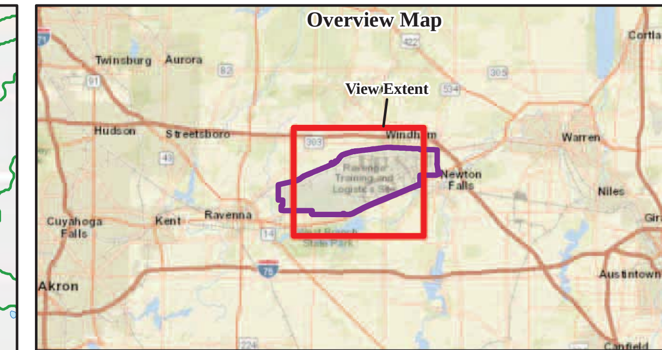

Legend

- Unconsolidated Well Location
- Unconsolidated Contours - 10ft Interval
- Direction Of Flow
- i1 = Hydraulic Gradient (ft/ft)
- Roads
- Creeks and Streams
- Elevation Contours (Feet)
- Unconsolidated Aquifer Missing (See Notes Below)
- Camp Ravenna Property Line

Notes:
- Potentiometric Surfaces based on data collected in July 2015
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map
- Unconsolidated Aquifer indicated to not be present, based on the most recent Facility Wide Groundwater Monitoring Program Report on the January 2014 Sampling Event

N

0 4,000 8,000 Feet

1:48,000
NAD83 UTM Zone 17N

Cardno TEC WESTON
TEC-Weston Joint Venture

POTENTIOMETRIC SURFACE MAP
UNCONSOLIDATED AQUIFER

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-7

FINAL

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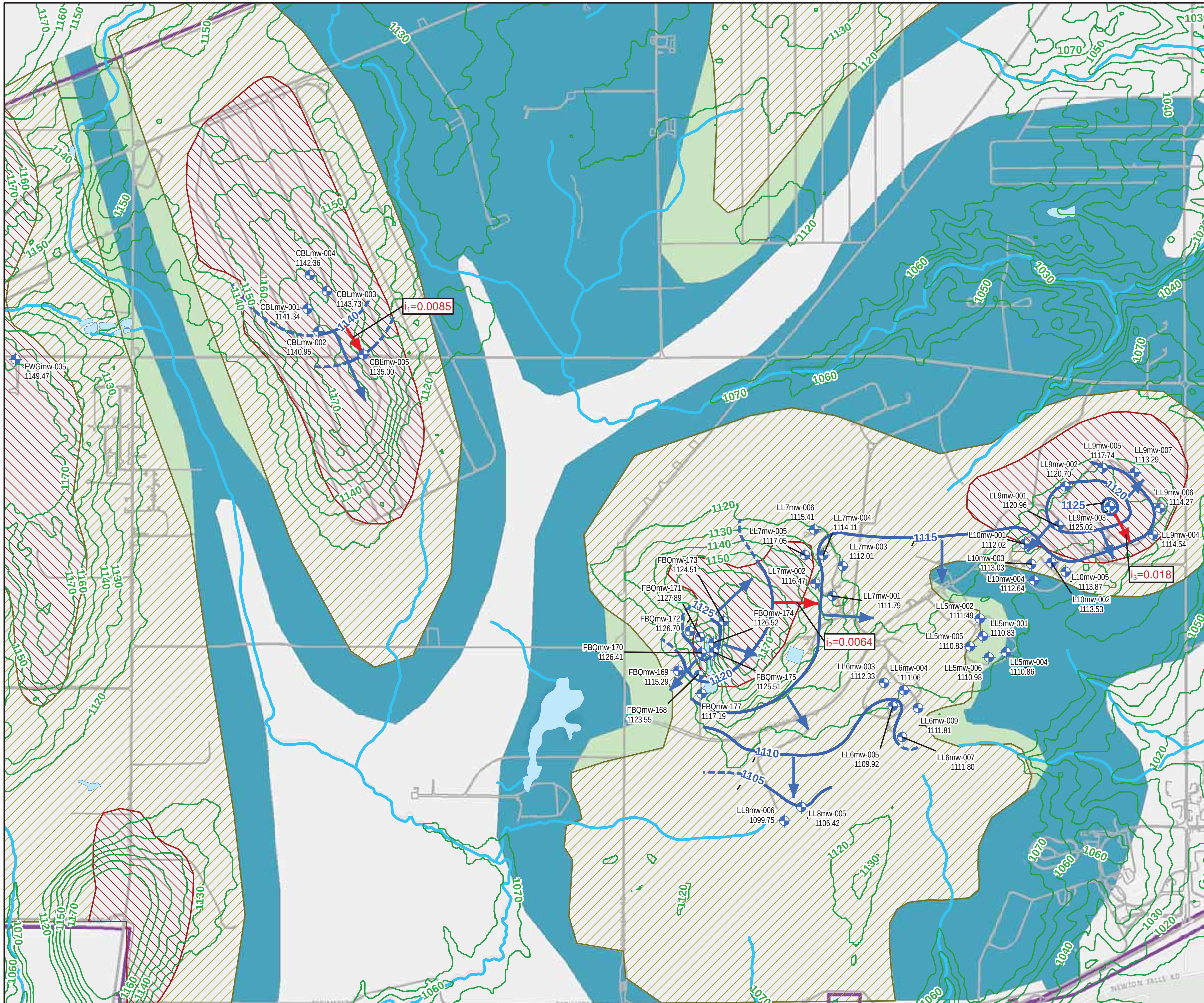

Legend

- Homewood or Mercer Well Locations
- Homewood and Mercer Contour Intervals
- Inferred Homewood and Mercer Contour Intervals
- Direction Of Flow
- i1 = Hydraulic Gradient (ft/ft)
- Roads
- Creeks and Streams
- Elevation Contours (Feet)
- Camp Ravenna Property Line

Geology Formation

- Homewood Sandstone Member
- Mercer Member
- Massillon Sandstone
- Sharon Member - Shale

Notes:
- Potentiometric Surfaces based on data collected in July 2015
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map
- Surface Elevation Contours - USDA

N

0 1,625 3,250 Feet

1:19,500

NAD83 UTM Zone 17N

TEC-Weston Joint Venture

POTENTIOMETRIC SURFACE MAP
HOMEWOOD SANDSTONE AQUIFER

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-8

FINAL

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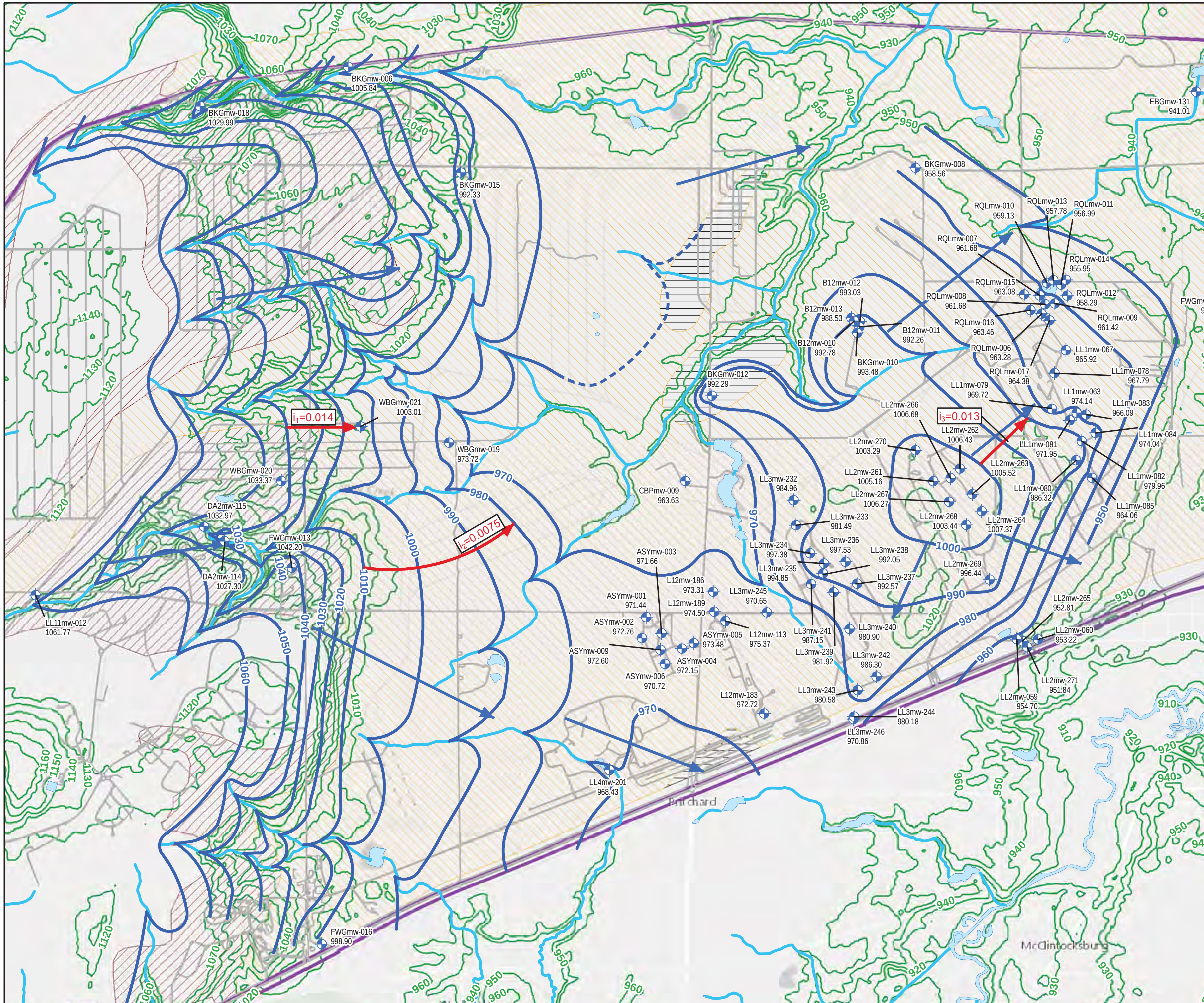

Legend

- Upper Sharon Well Location
- Upper Sharon Contour Intervals
- Upper Sharon Inferred Contour Intervals
- Direction Of Flow
- i1 = Hydraulic Gradient (ft/ft)
- Creeks and Streams
- Roads
- Camp Ravenna Property Line
- Sharon Conglomerate Shale Lens
- Sharon Member
- Sharon Sandstone - Conglomerate Unit

Notes:
- Potentiometric Surfaces based on data collected July 14-20, 2015
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map
- Surface Elevation Contours - USDA

N

0 2,500 5,000 Feet

1:30,000

NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS

TEC-Weston Joint Venture

POTENTIOMETRIC SURFACE MAP
UPPER SHARON AQUIFER

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-9

FINAL

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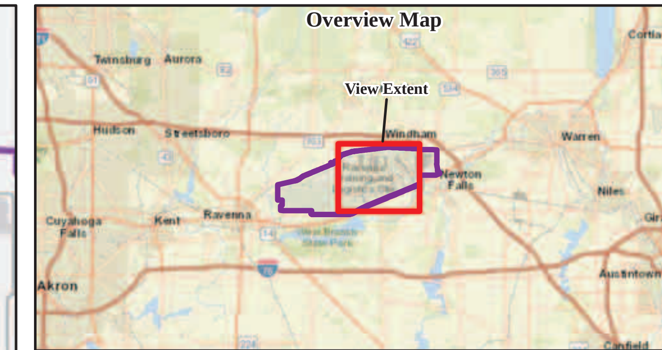

Legend

- Basal Sharon Conglomerate Well Location
- Basal Sharon Conglomerate Contours - 10ft Interval
- Direction Of Flow
- i1 = Hydraulic Gradient (ft/ft)
- Roads
- Camp Ravenna Property Line

Notes:
- Potentiometric Surfaces based on data collected in July 2015
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map
- Surface Elevation Contours - USDA

N

0 3,000 6,000 Feet

1:30,000
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

POTENTIOMETRIC SURFACE MAP
BASAL SHARON CONGLOMERATE AQUIFER
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-10

FINAL

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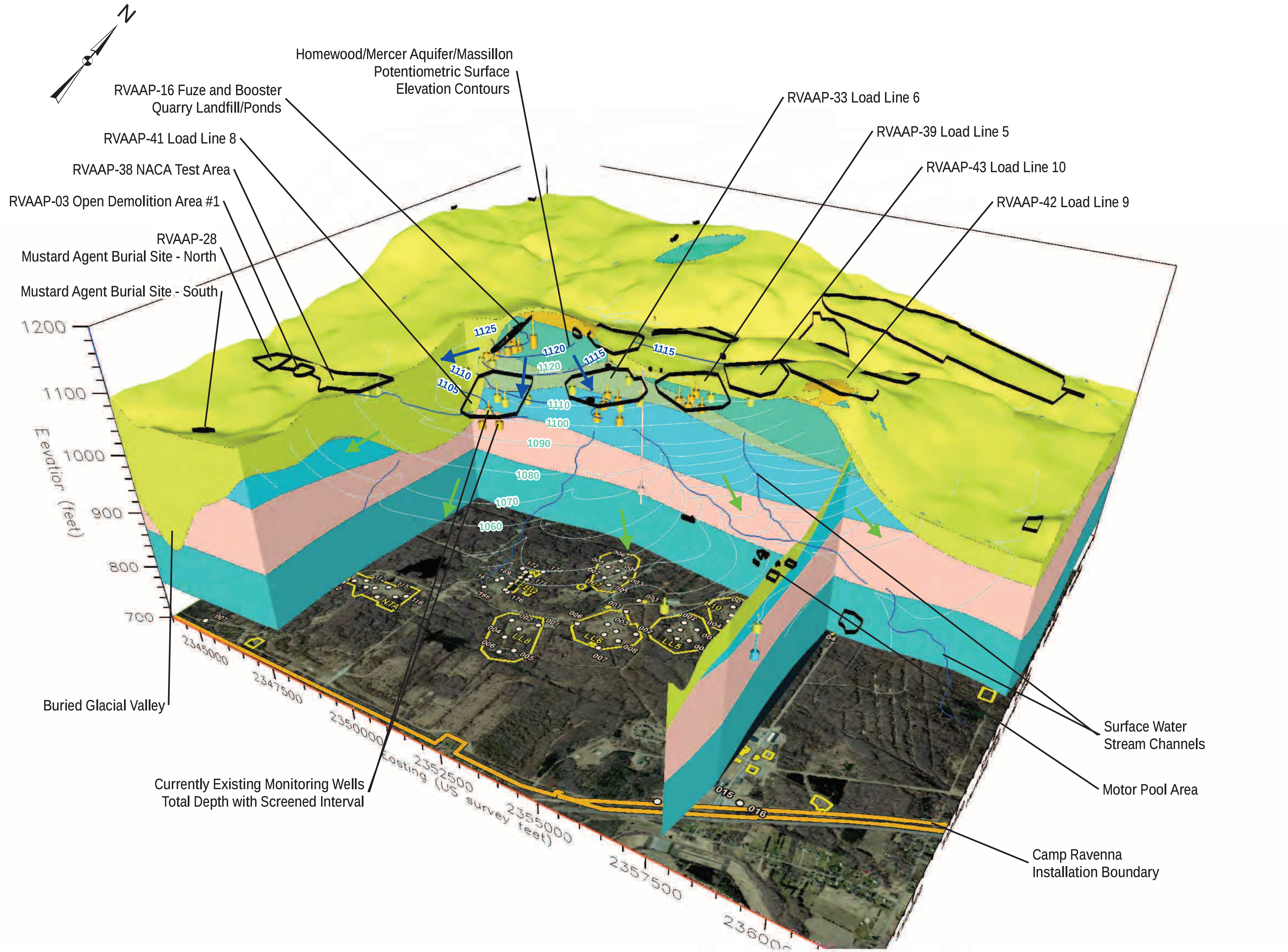

Legend

- AOC Physical Location Boundaries
- Unconsolidated Aquifer Potentiometric Surface Elevation Contours
- Homewood/Mercer/Massillon Aquifer Potentiometric Surface Elevation Contours
- Surface Water Stream Channels
- Unconsolidated Aquifer Flow Direction
- Homewood/Mercer/Massillon Aquifer Flow Direction
- Homewood Well
- Overburden Well
- Basal Sharon Conglomerate Well
- Sharon Member Shale Unit Well

Geology

- Unconsolidated
- Homewood Sandstone Member
- Mercer Member
- Massillon Sandstone Member
- Sharon Member, Shale Unit
- Sharon Member, Sandstone/Conglomerate Unit
- Cuyahoga Group

Pottsville Formation (Homewood Sandstone Member through Sharon Member, Sandstone/Conglomerate Unit)

Notes:
This illustration is a preliminary draft intended for discussion purposes only. Figure is not to scale.

TEC-Weston Joint Venture

FUZE AND BOOSTER QUARRY AREA KEY HYDROGEOLOGY DYNAMICS

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-11

FINAL

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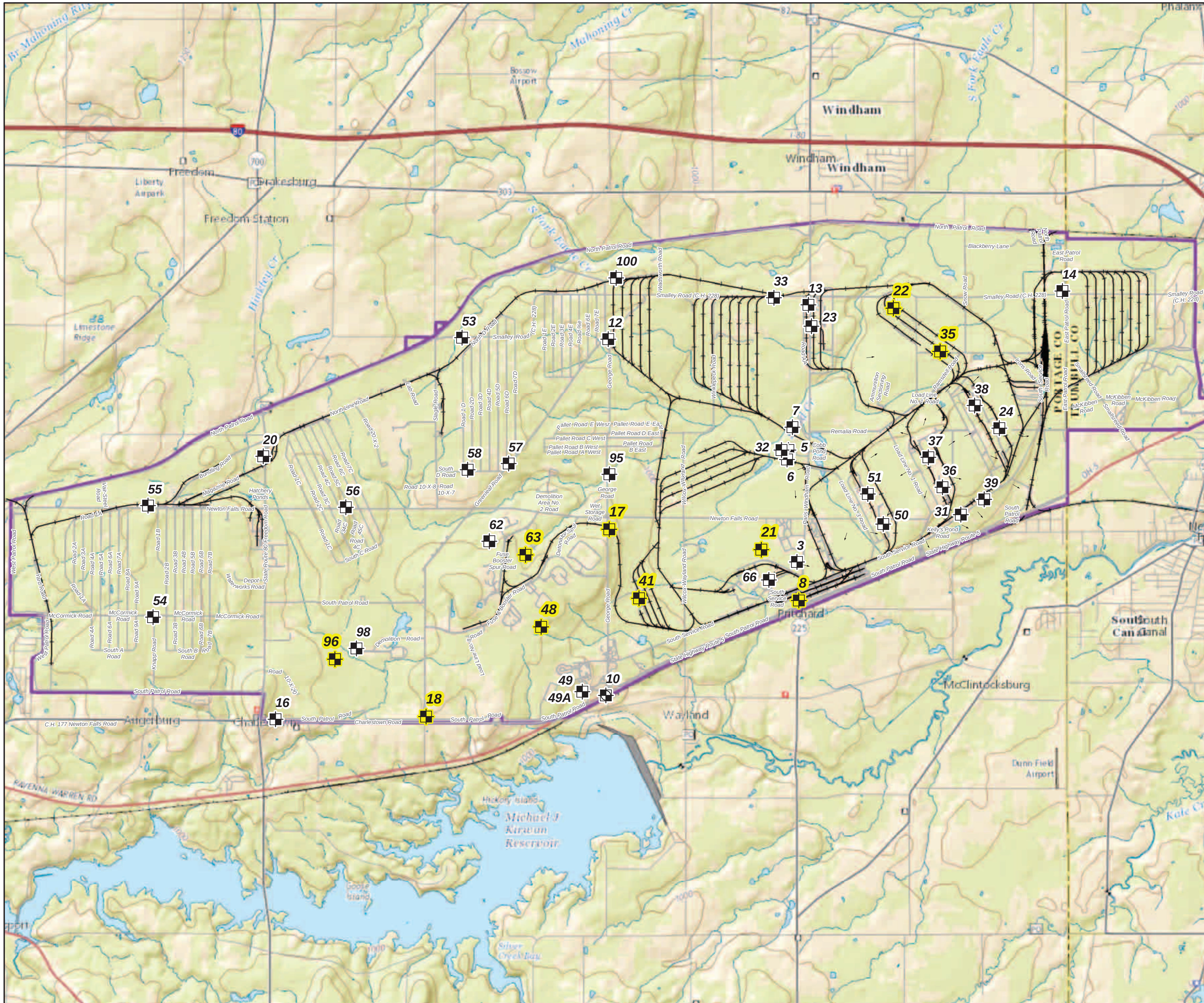

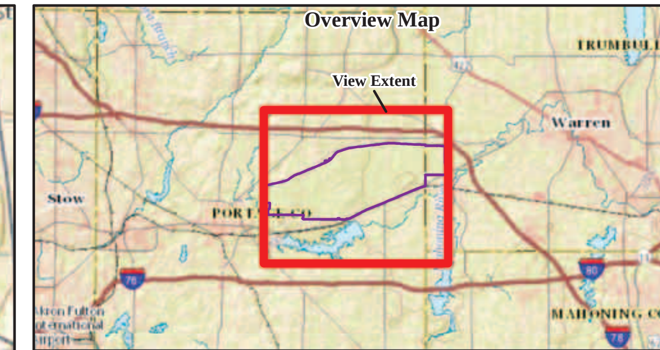

Legend

- Former Groundwater Production Well to be Abandoned by JV Team
- Former Groundwater Production Well to be Abandoned by Others
- Roads
- Railroad
- Camp Ravenna Property Line

Notes:
- Basemap Source: ESRI Map Sservice - USGSTopo

N

0 2,500 5,000 7,500 10,000 Feet

1:60,000

NAD83 UTM Zone 17N

Cardno TEC WESTON

TEC-Weston Joint Venture

HISTORICAL PRODUCTION WELL LOCATIONS

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-12

FINAL

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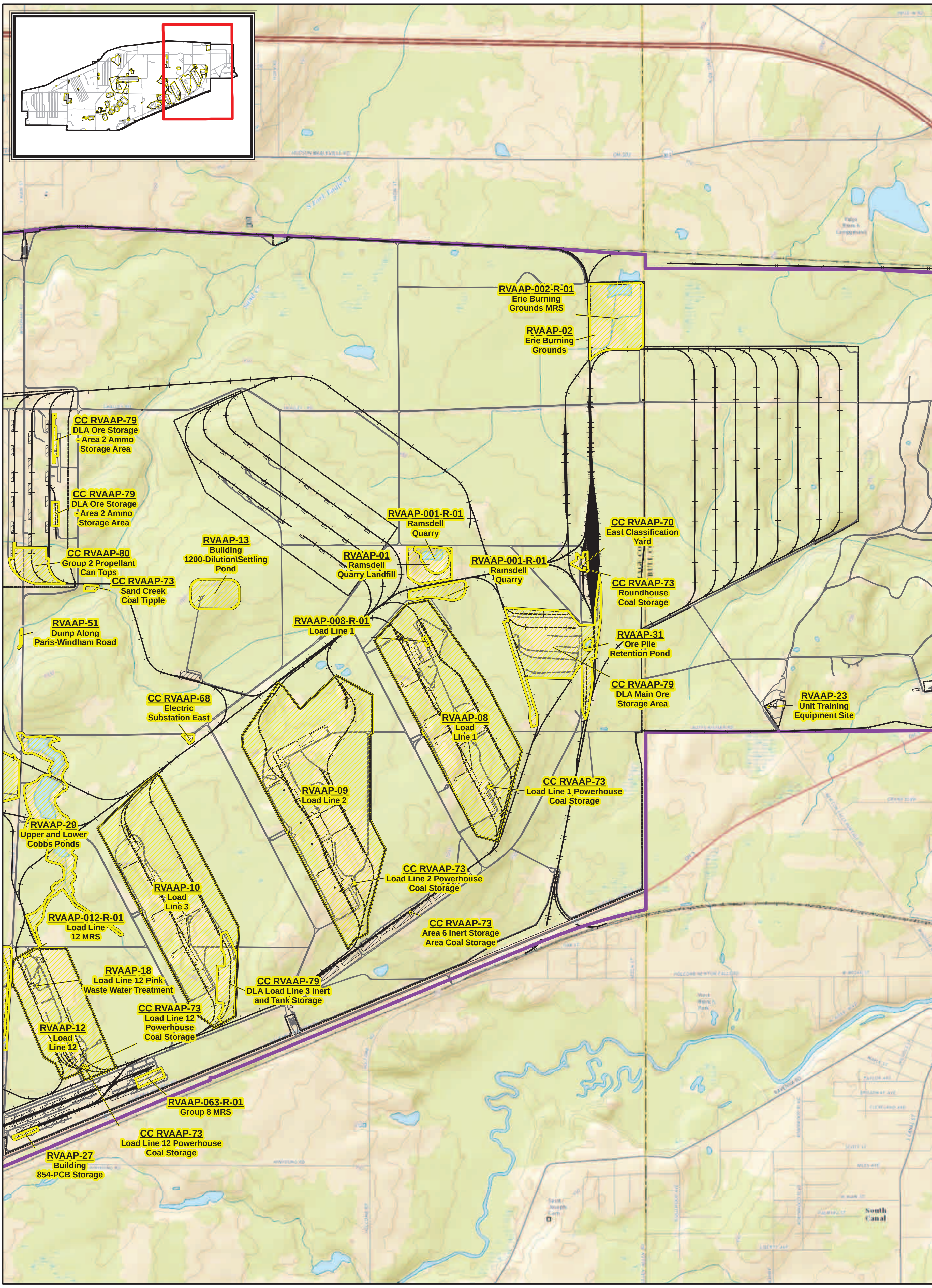

Legend

- Fenceline
- Camp Ravenna Property Line
- AOCs
- Railroad
- Roads
- Buildings

N

0 1,000 2,000 3,000 4,000 Feet

1 " = 2,000 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

AOC LOCATION MAP
EAST
Groundwater and Environmental Investigation
Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-13

FINAL

Notes:
Basemap Image Source: ESRI Map Service - USGS National Map

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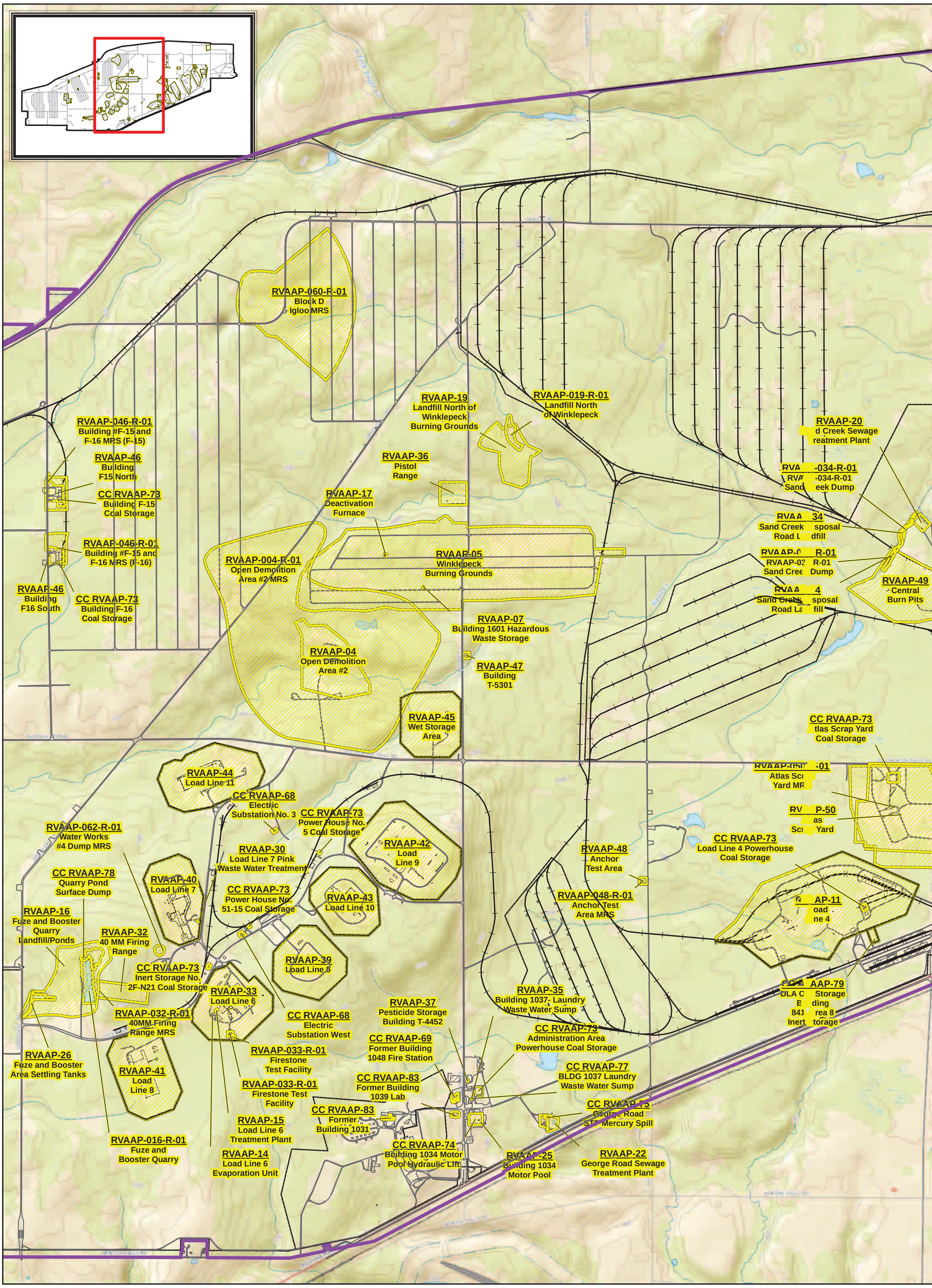

Legend

- Fenceline
- Camp Ravenna Property Line
- AOCs
- Railroad
- Roads
- Buildings

N

0 1,000 2,000 3,000 4,000 Feet

1 " = 2,000 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

AOC LOCATION MAP
CENTRAL
Groundwater and Environmental Investigation
Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-14

FINAL

Notes:
Basemap Image Source: ESRI Map Service - USGS National Map

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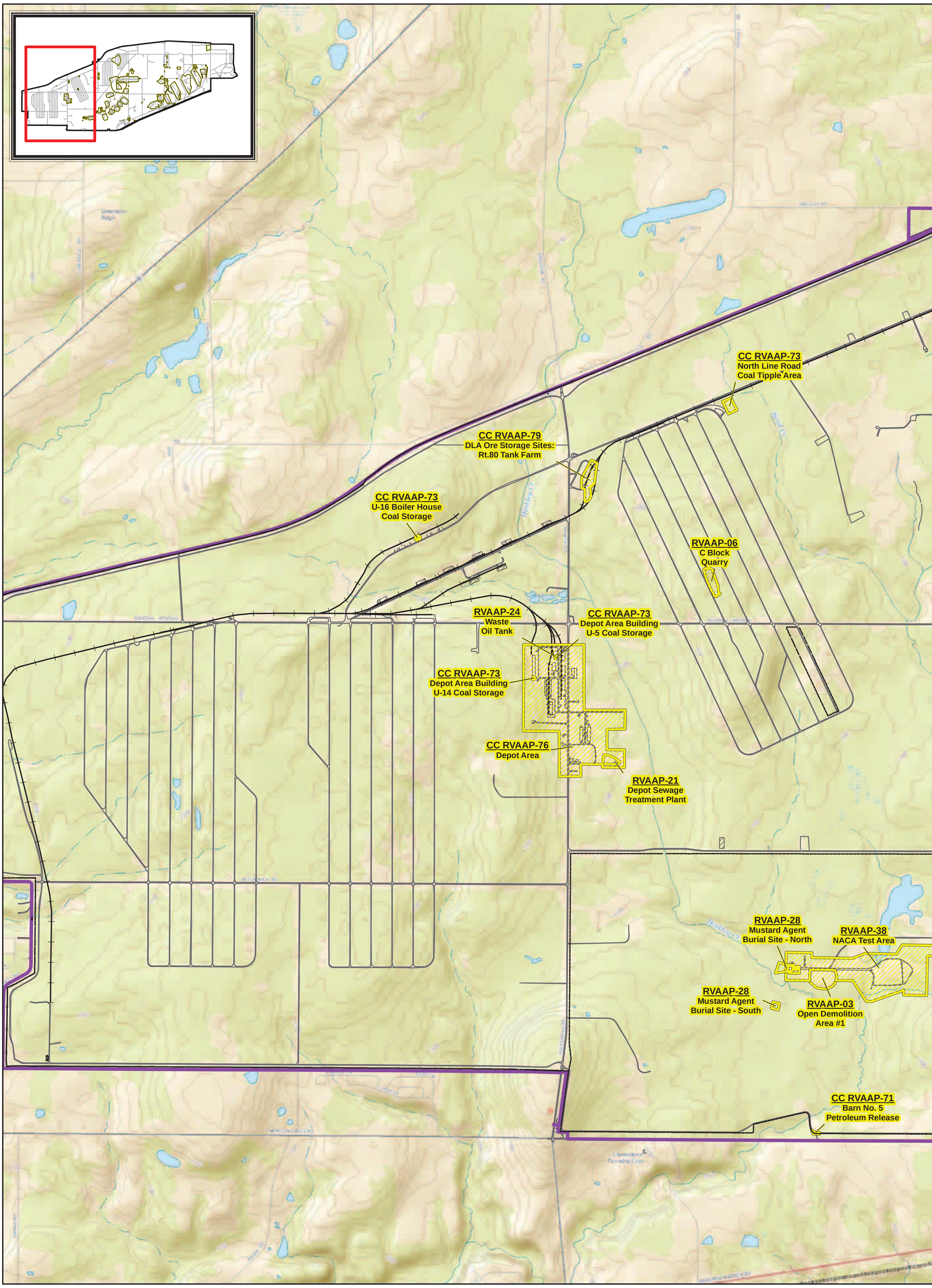

Legend

- Fenceline
- Camp Ravenna Property Line
- AOCs
- Railroad
- Roads
- Buildings

N

0 1,000 2,000 3,000 4,000 Feet

1 " = 2,000 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

AOC LOCATION MAP
WEST
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-15

FINAL

Notes:
Basemap Image Source: ESRI Map Service - USGS National Map

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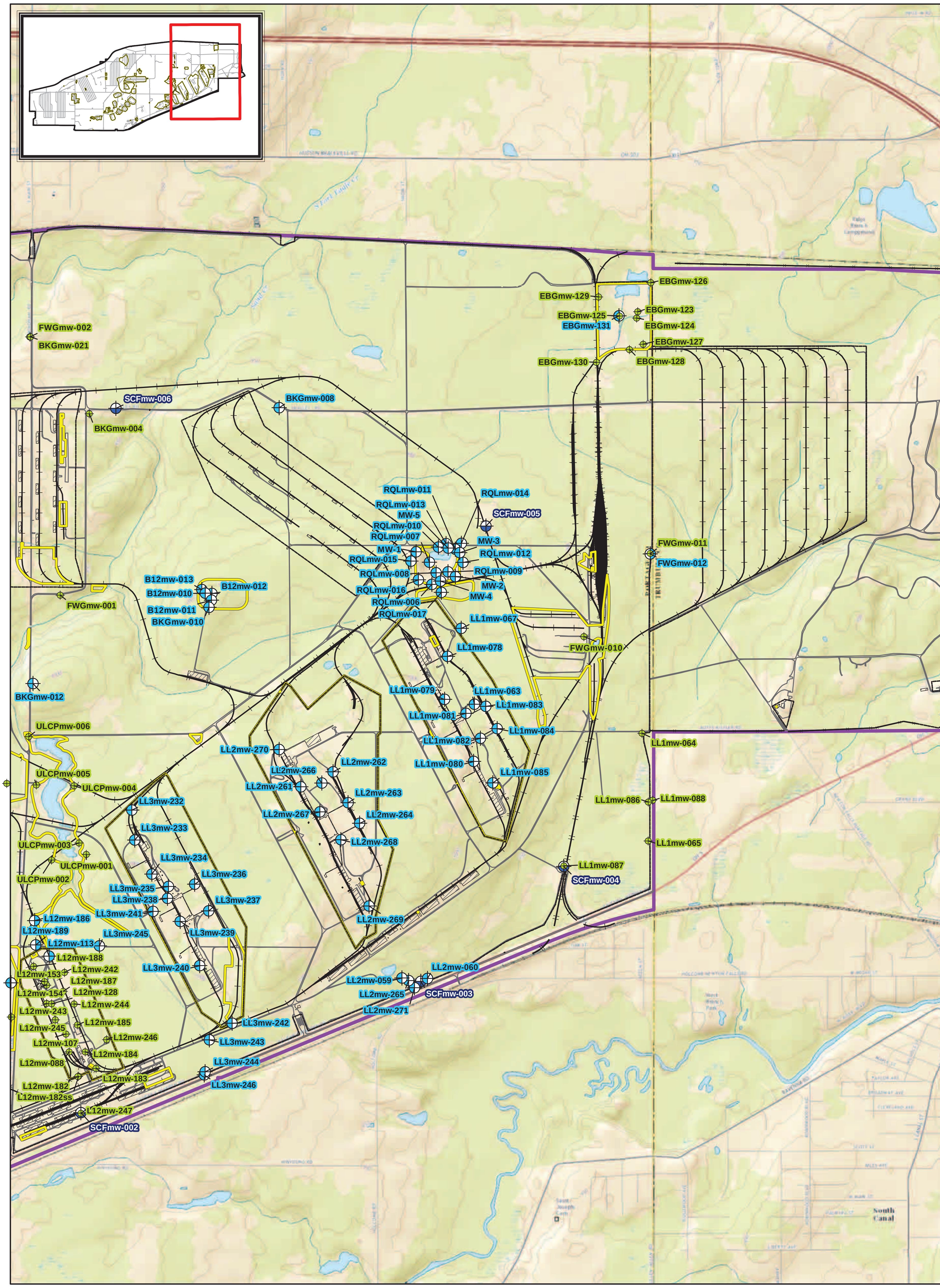

Legend

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- Fenceline
- AOCs
- Railroad
- Roads
- Buildings
- Camp Ravenna Property Line

N

0 1,000 2,000 3,000 4,000 Feet

1 " = 2,000 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

MONITORING WELL LOCATIONS
EAST
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-16

FINAL

Notes:
Basemap Image Source: ESRI Map Service - USGS National Map

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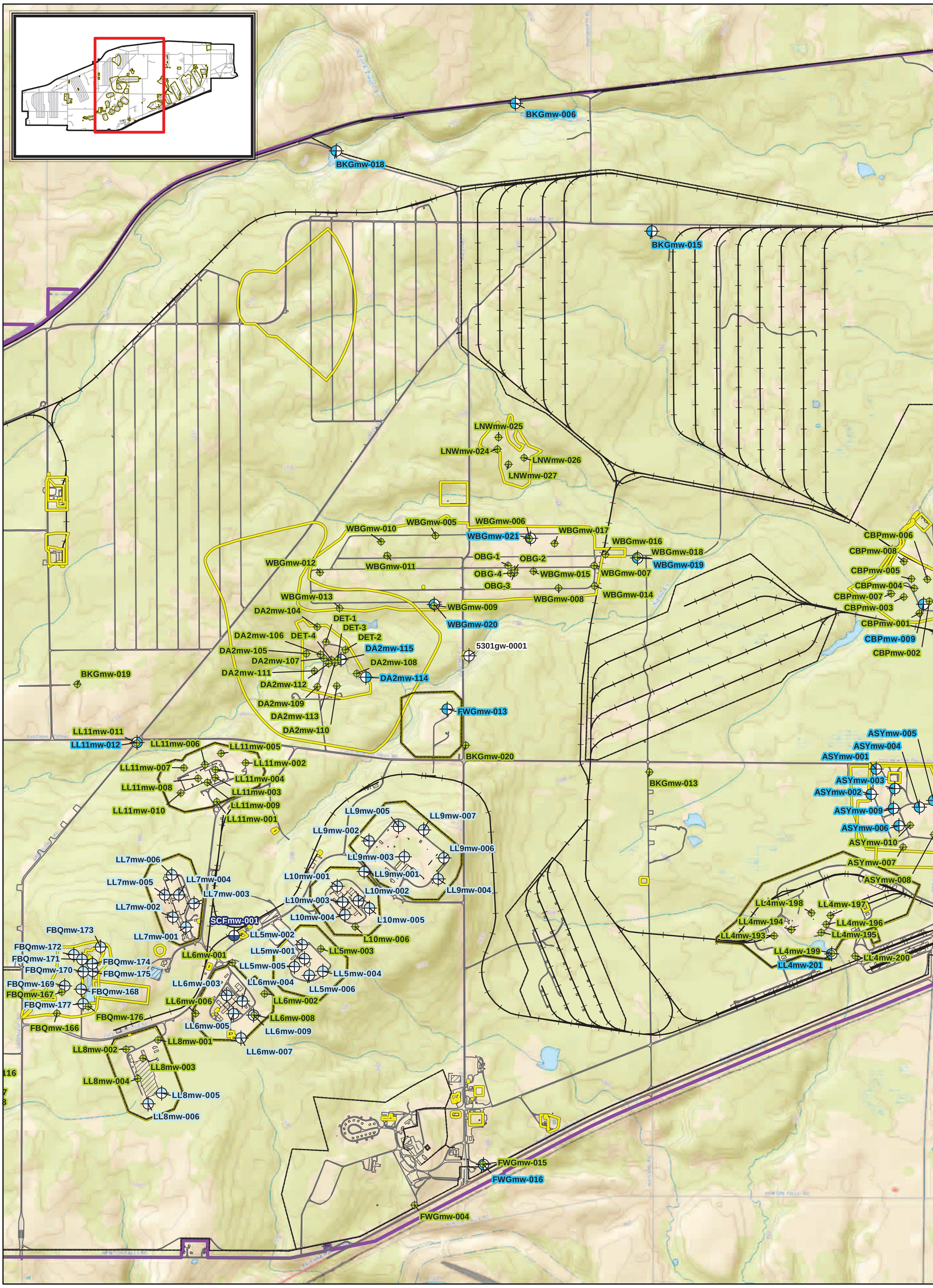

Legend

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- Fenceline
- AOCs
- Railroad
- Roads
- Buildings
- Camp Ravenna Property Line

N

0 1,000 2,000 3,000 4,000 Feet

1 " = 2,000 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

MONITORING WELL LOCATIONS CENTRAL

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-17

FINAL

Notes:
Basemap Image Source: ESRI Map Service - USGS National Map

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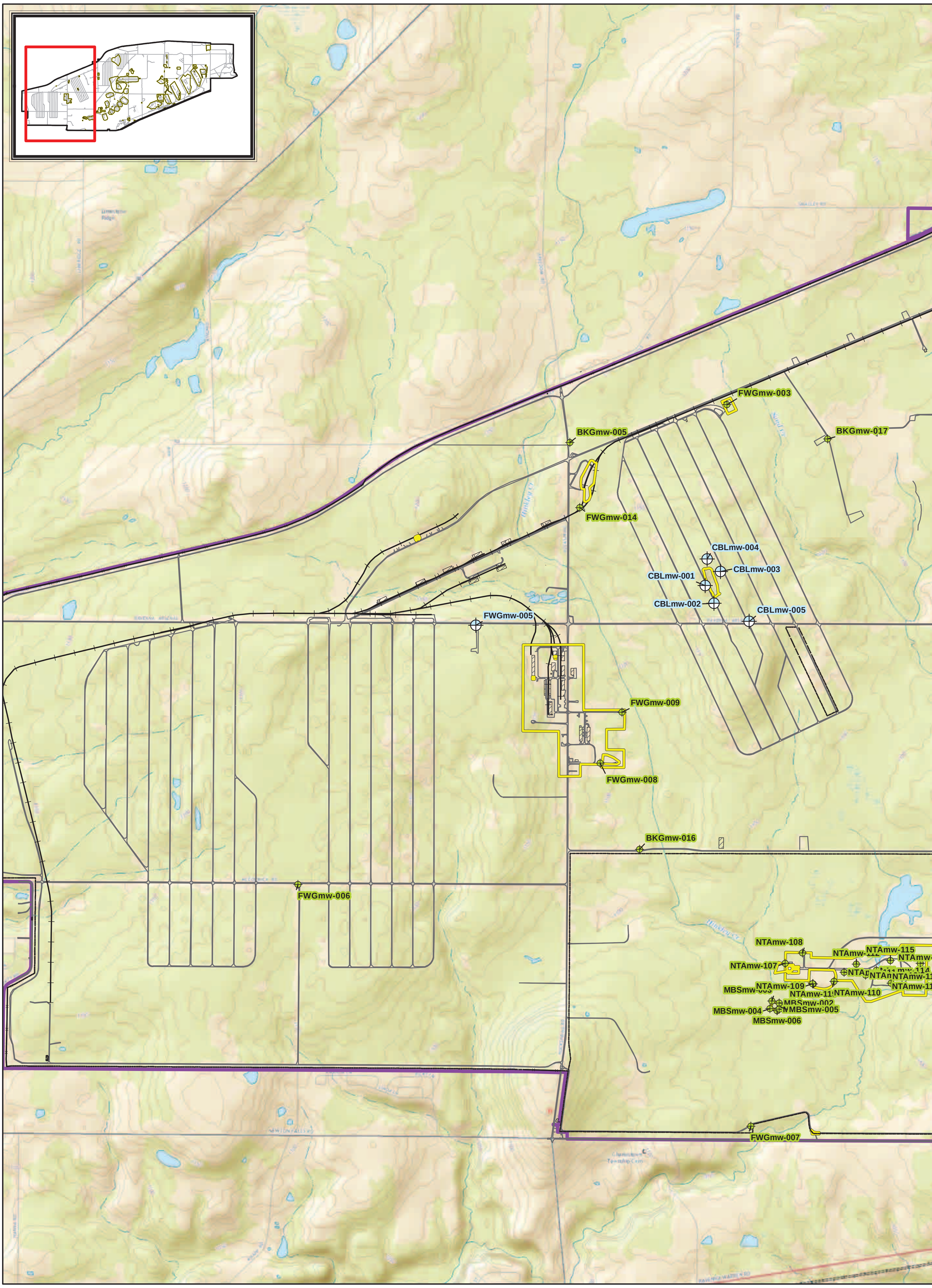

Legend

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- Fenceline
- AOCs
- Railroad
- Roads
- Buildings
- Camp Ravenna Property Line

N

0 1,000 2,000 3,000 4,000 Feet

1 " = 2,000 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

MONITORING WELL LOCATIONS
WEST
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-18

FINAL

Notes:
Basemap Image Source: ESRI Map Service - USGS National Map

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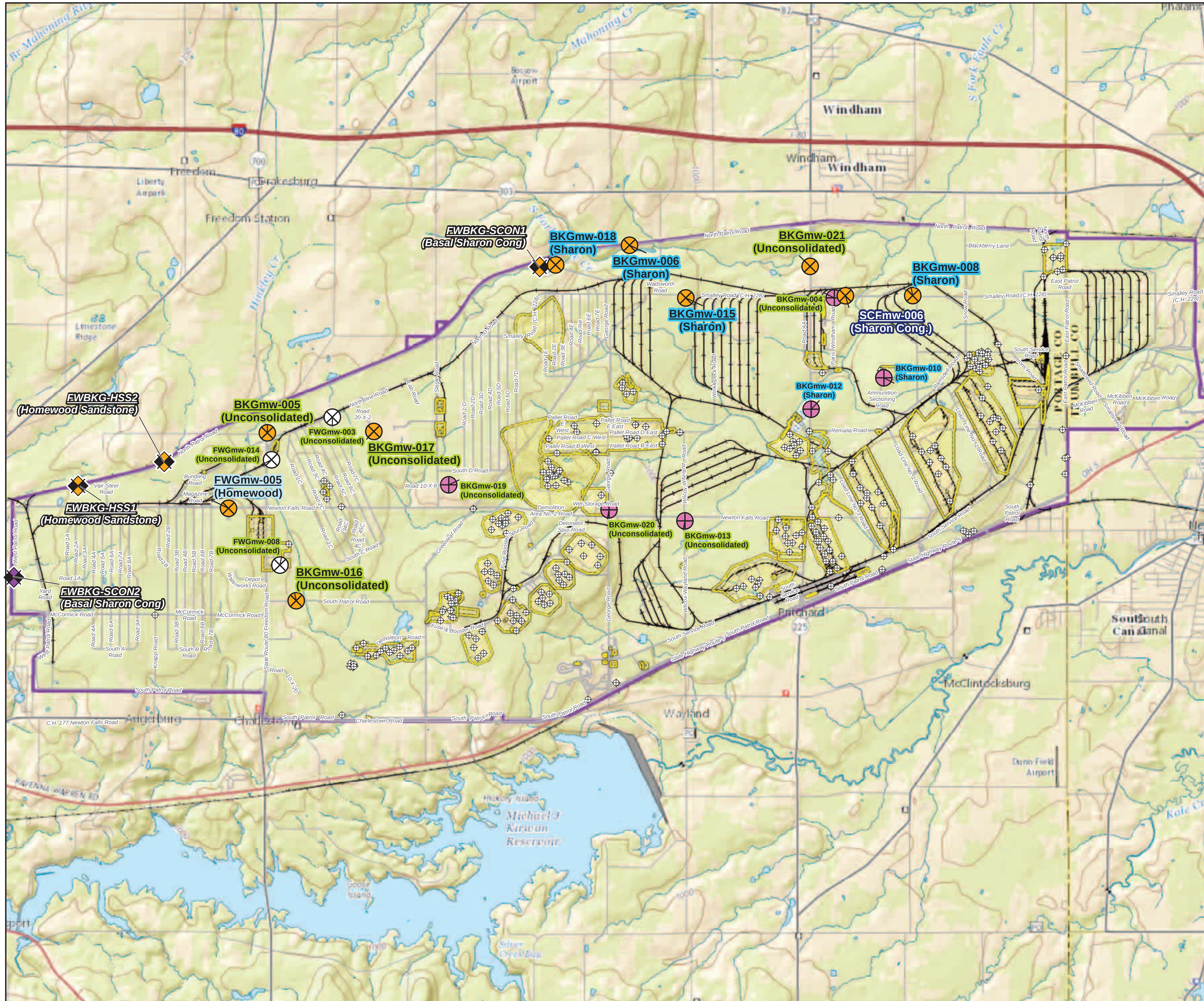

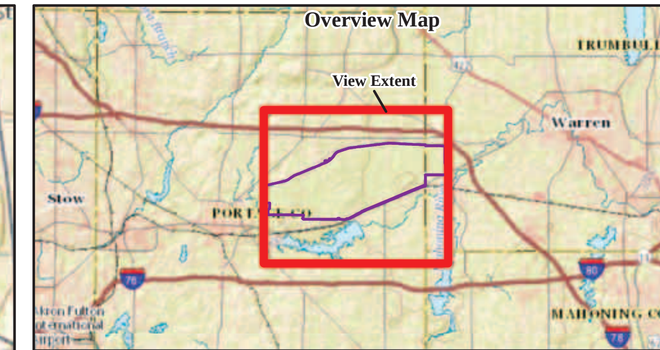

Legend

- Background Monitoring Well Approved by OEPA for Use in Background Study
- Background Monitoring Well Approved by OEPA for Use in Background Study but not Planned for Sampling
- Other Historical Background Monitoring Well
- Proposed Inorganic Constituent Background Study Well - New Installation
- Revised Proposed Inorganic Constituent Background Study Well - New Installation
- Other Existing Monitoring Well
- Railroad
- Roads
- AOCs
- Camp Ravenna Property Line

Notes:
- Basemap Source: ESRI Map Sservice - USGSTopo

N

0 2,500 5,000 7,500 10,000 Feet

1:60,000
NAD83 UTM Zone 17N

Cardno TEC WESTON
TEC-Weston Joint Venture

BACKGROUND MONITORING WELL LOCATIONS

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-19

FINAL

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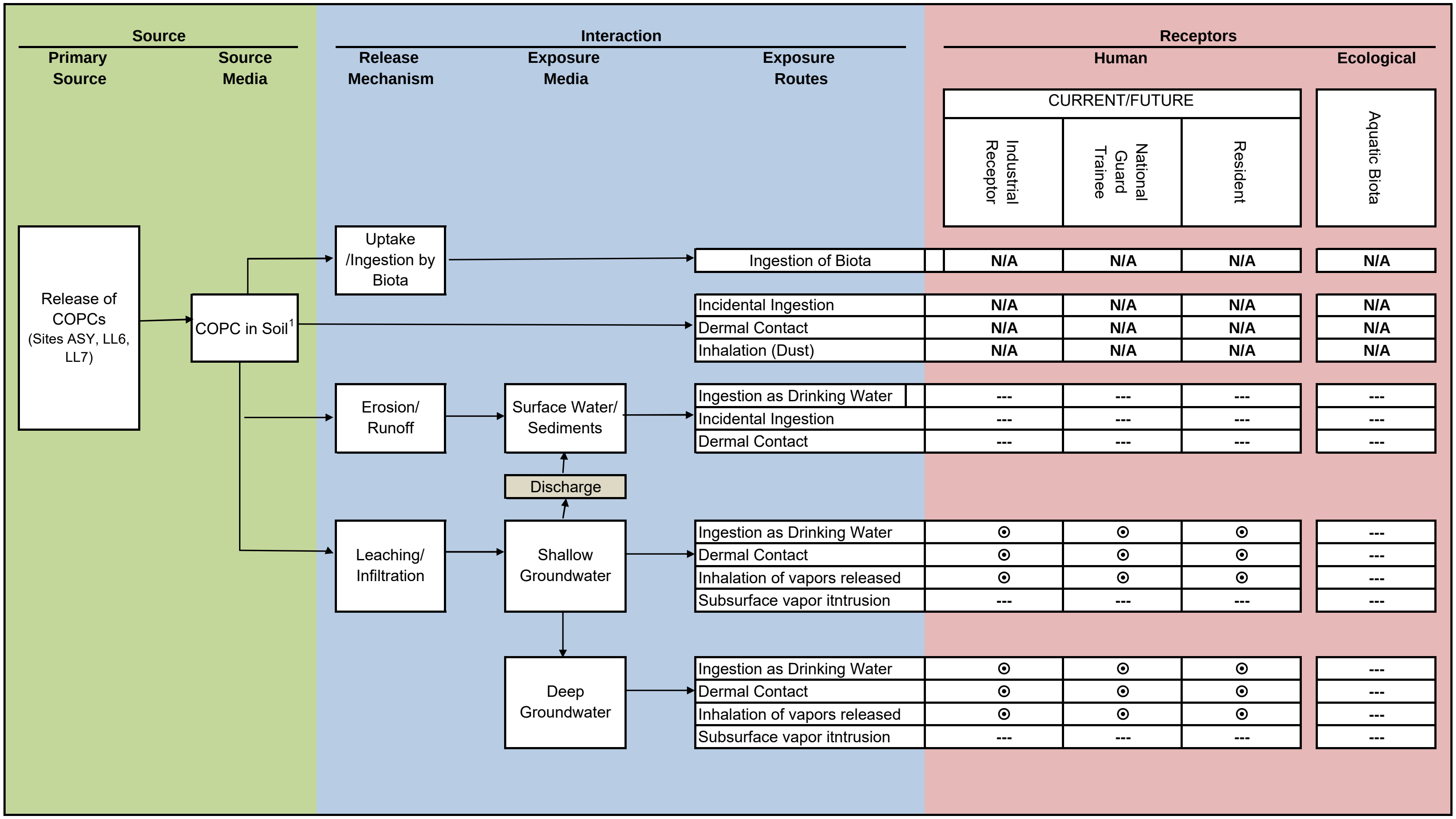
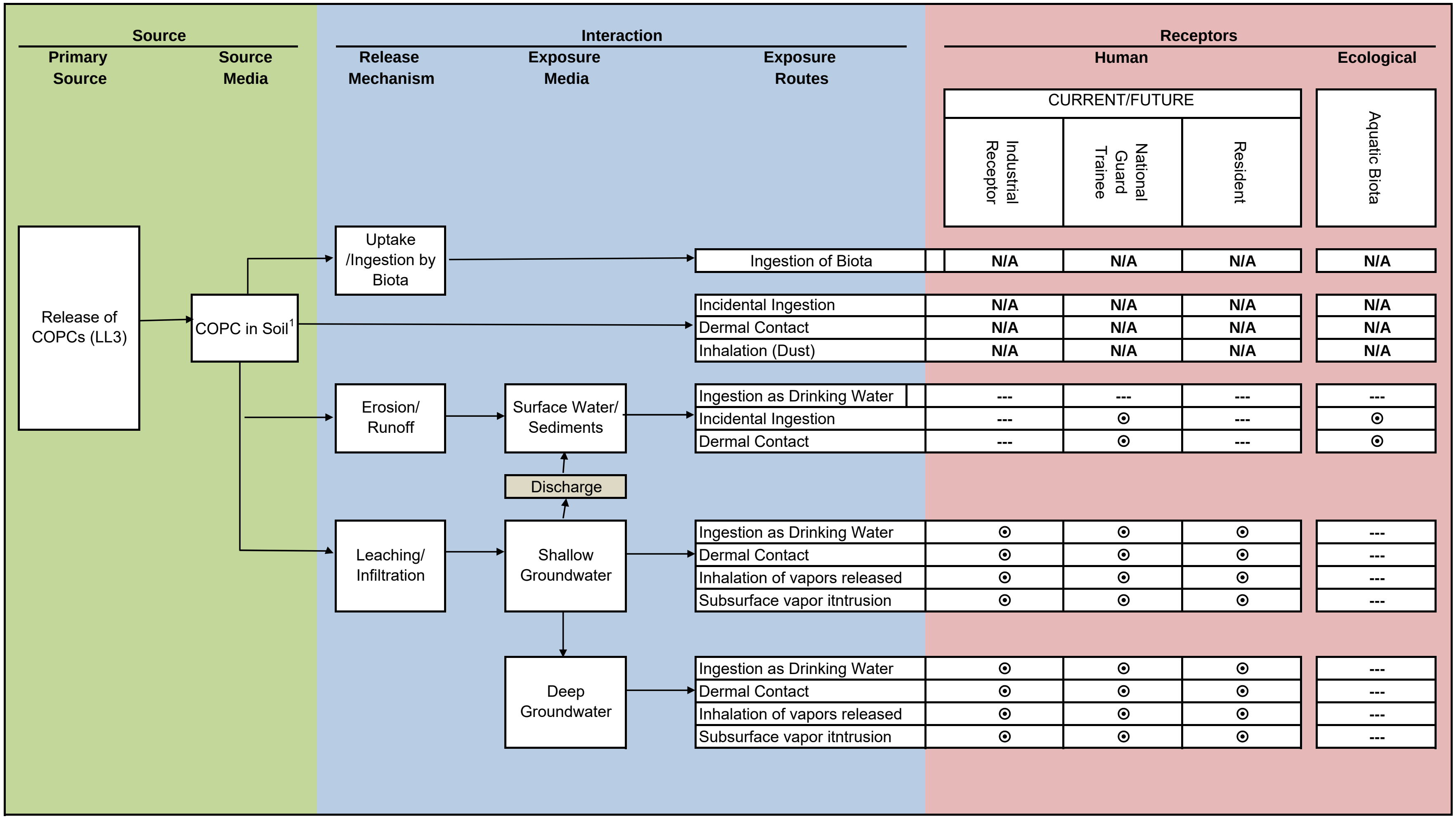


Figure 1-20a Graphical CSM for RVAAP 66 (Facility-Wide Groundwater)

Note:

1 - Potentially complete receptor exposure pathways associated with contaminated environmental media other than groundwater (and surface water potentially affected by discharging groundwater) have been or will be addressed through other CERCLA actions at Camp Ravenna.

●	Complete Receptor Pathway
⊙	Potentially Complete Receptor Pathway
---	Incomplete Receptor Pathway
N/A	Receptor Pathway Not Applicable to RVAAP-66
→ (black arrow)	Potentially Complete Pathway
→ (red arrow)	Incomplete Pathway



Exposure Media	Exposure Routes	Industrial Receptor	National Guard Trainee	Resident	Aquatic Biota
Uptake /Ingestion by Biota	Ingestion of Biota	N/A	N/A	N/A	N/A
COPC in Soil	Incidental Ingestion	N/A	N/A	N/A	N/A
	Dermal Contact	N/A	N/A	N/A	N/A
	Inhalation (Dust)	N/A	N/A	N/A	N/A
Surface Water/ Sediments	Ingestion as Drinking Water	---	---	---	---
	Incidental Ingestion	---	⦿	---	⦿
	Dermal Contact	---	⦿	---	⦿
Shallow Groundwater	Ingestion as Drinking Water	⦿	⦿	⦿	---
	Dermal Contact	⦿	⦿	⦿	---
	Inhalation of vapors released	⦿	⦿	⦿	---
	Subsurface vapor itntrusion	⦿	⦿	⦿	---
Deep Groundwater	Ingestion as Drinking Water	⦿	⦿	⦿	---
	Dermal Contact	⦿	⦿	⦿	---
	Inhalation of vapors released	⦿	⦿	⦿	---
	Subsurface vapor itntrusion	⦿	⦿	⦿	---

Figure 1-20b Graphical CSM for RVAAP 66 (Facility-Wide Groundwater)

Note:

1 - Potentially complete receptor exposure pathways associated with contaminated environmental media other than groundwater (and surface water potentially affected by discharging groundwater) have been or will be addressed through other CERCLA actions at Camp Ravenna.

● Complete Receptor Pathway
⦿ Potentially Complete Receptor Pathway
--- Incomplete Receptor Pathway
N/A Receptor Pathway Not Applicable to RVAAP-66
→ Potentially Complete Pathway
→ Incomplete Pathway

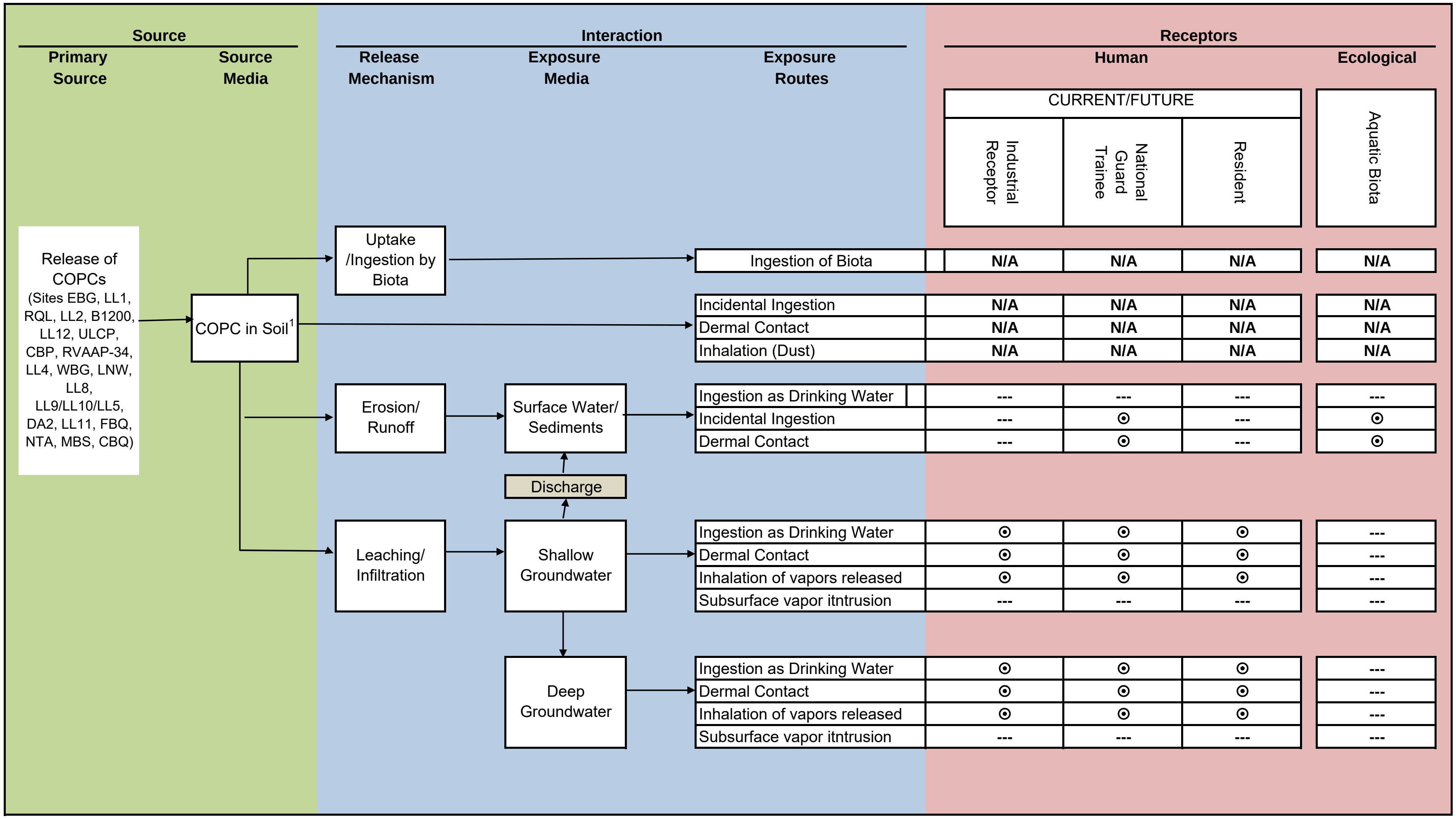


Figure 1-20c Graphical CSM for RVAAP 66 (Facility-Wide Groundwater)

Note:

1 - Potentially complete receptor exposure pathways associated with contaminated environmental media other than groundwater (and surface water potentially affected by discharging groundwater) have been or will be addressed through other CERCLA actions at Camp Ravenna.

●	Complete Receptor Pathway
⦿	Potentially Complete Receptor Pathway
---	Incomplete Receptor Pathway
N/A	Receptor Pathway Not Applicable to RVAAP-66
→	Potentially Complete Pathway
→ (red)	Incomplete Pathway

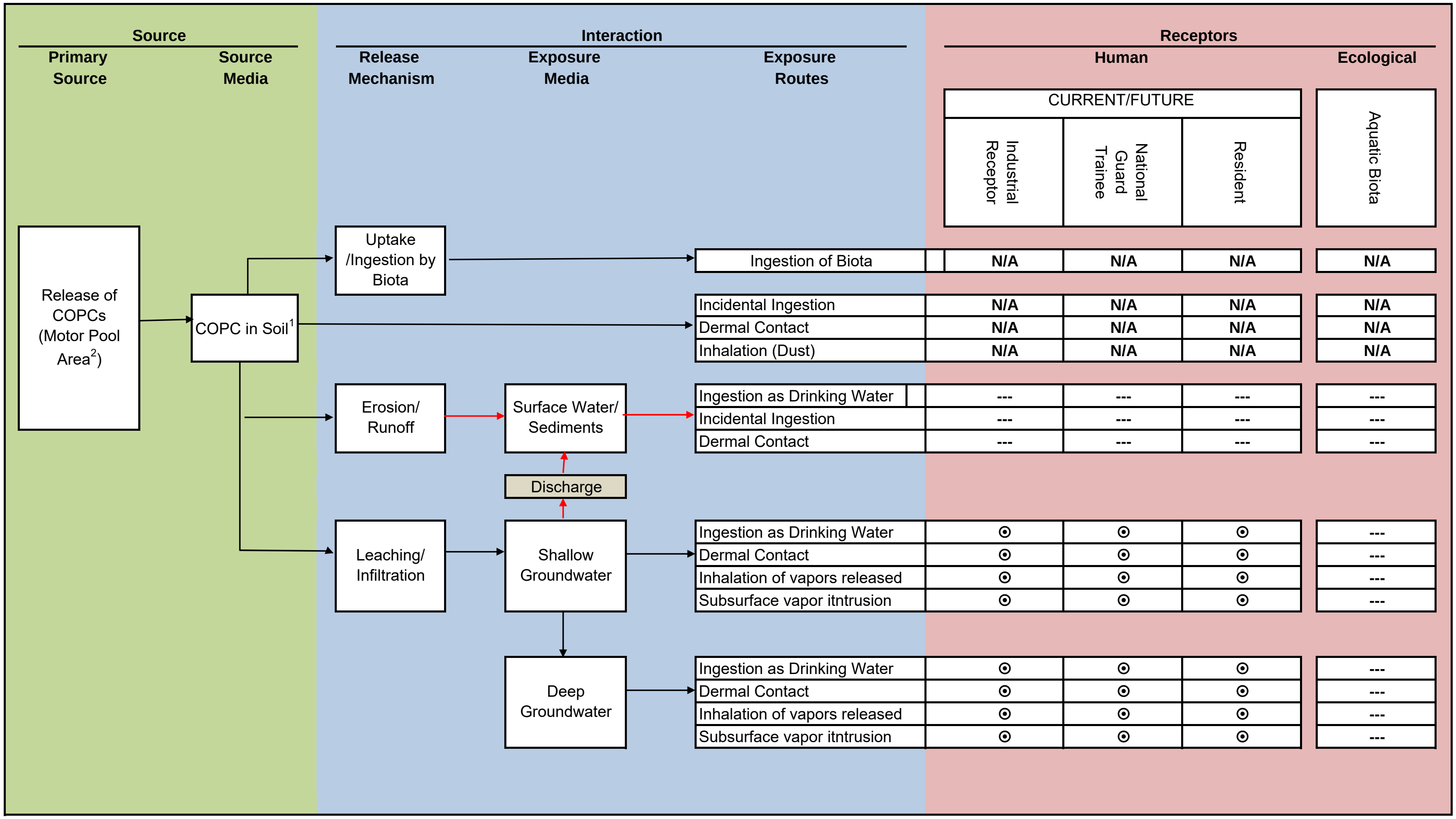


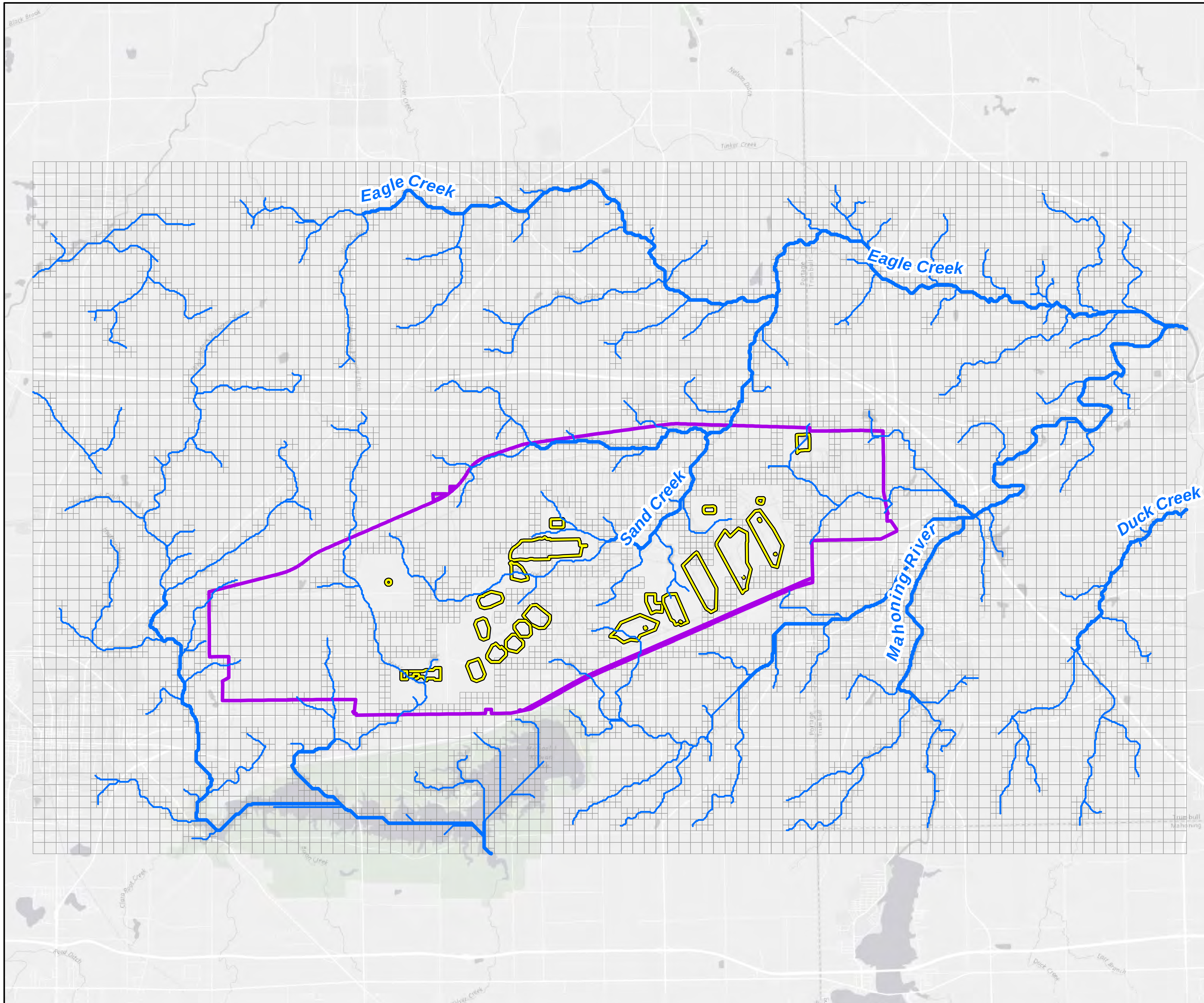
Figure 1-20d Graphical CSM for RVAAP 66 (Facility-Wide Groundwater)

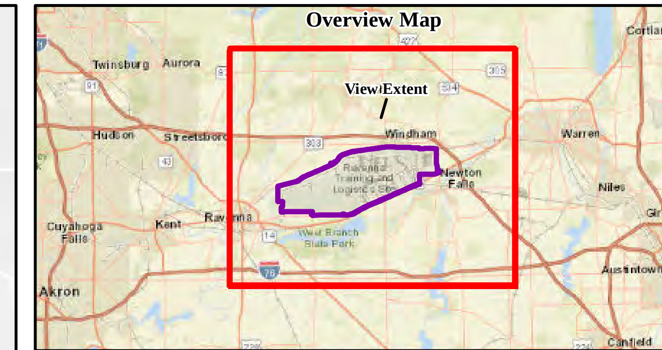
Note:

1 - Potentially complete receptor exposure pathways associated with contaminated environmental media other than groundwater (and surface water potentially affected by discharging groundwater) have been or will be addressed through other CERCLA actions at Camp Ravenna.

2 - Buildings are located in the vicinity; however, no groundwater data is currently available for site

●	Complete Receptor Pathway
⊙	Potentially Complete Receptor Pathway
---	Incomplete Receptor Pathway
N/A	Receptor Pathway Not Applicable to RVAAP-66
→ (black arrow)	Potentially Complete Pathway
→ (red arrow)	Incomplete Pathway





Legend

- Camp Ravenna Property Line
- AOCs with abundant groundwater data
- MODFLOW-USG's Quadtree Grid

Stream Network Used as Boundary Conditions

- Strahler Order 1-2
- Strahler Order 3-5

Notes:
- Model grid resolution ranges from 1000-ft (largest squares) to 500-ft near streams down to 125-ft (squares not shown) in the vicinity of AOCs having abundant groundwater data.
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map

N

0 5,000 10,000 15,000 Feet

1:105,000

NAD83 Ohio State Plane North

TEC-Weston Joint Venture

GROUNDWATER FLOW MODEL DESIGN

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-21

FINAL

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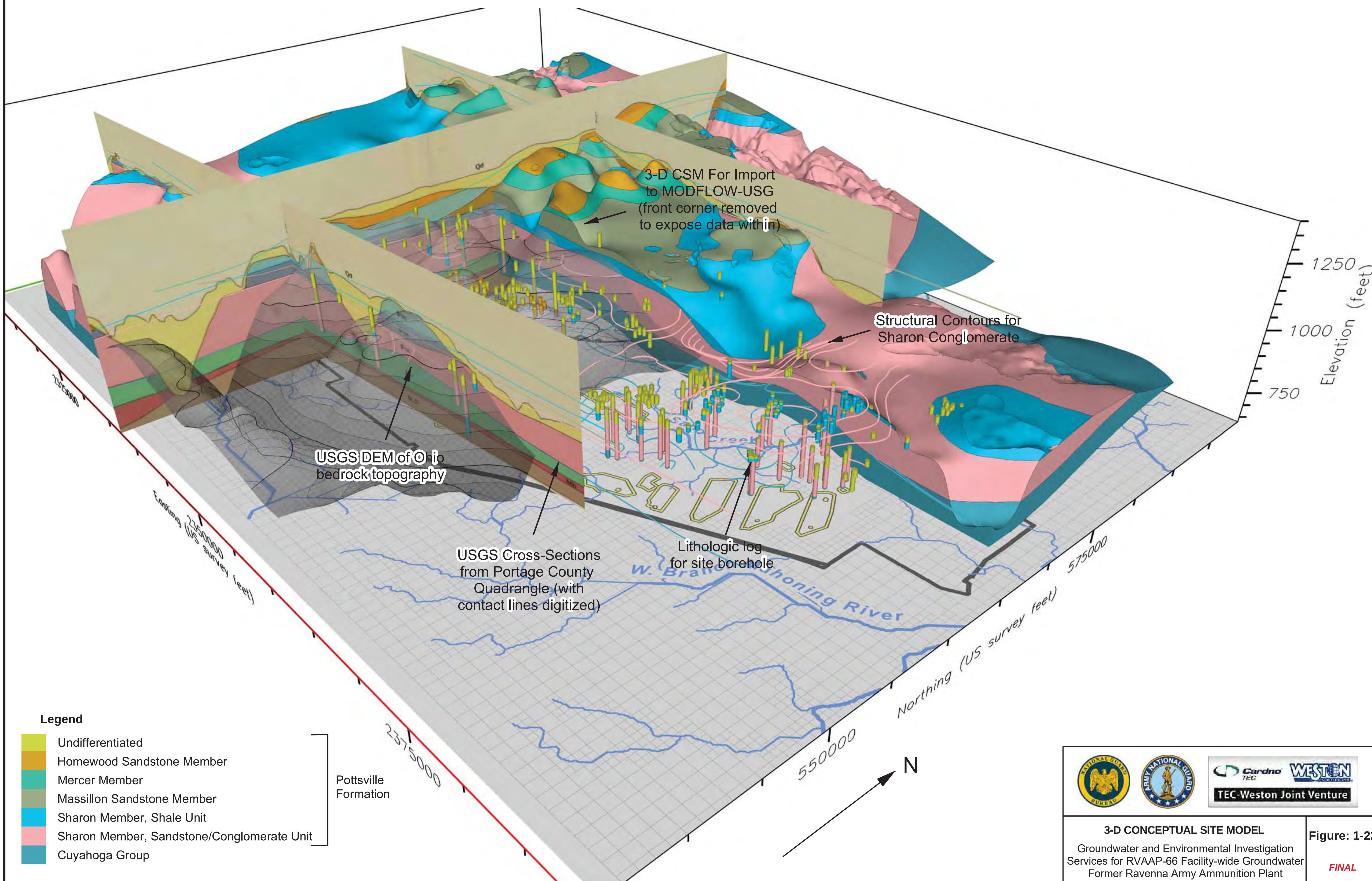

Legend

- Undifferentiated
- Homewood Sandstone Member
- Mercer Member
- Massillon Sandstone Member
- Sharon Member, Shale Unit
- Sharon Member, Sandstone/Conglomerate Unit
- Cuyahoga Group

Pottsville Formation

TEC-Weston Joint Venture

3-D CONCEPTUAL SITE MODEL

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-22

FINAL

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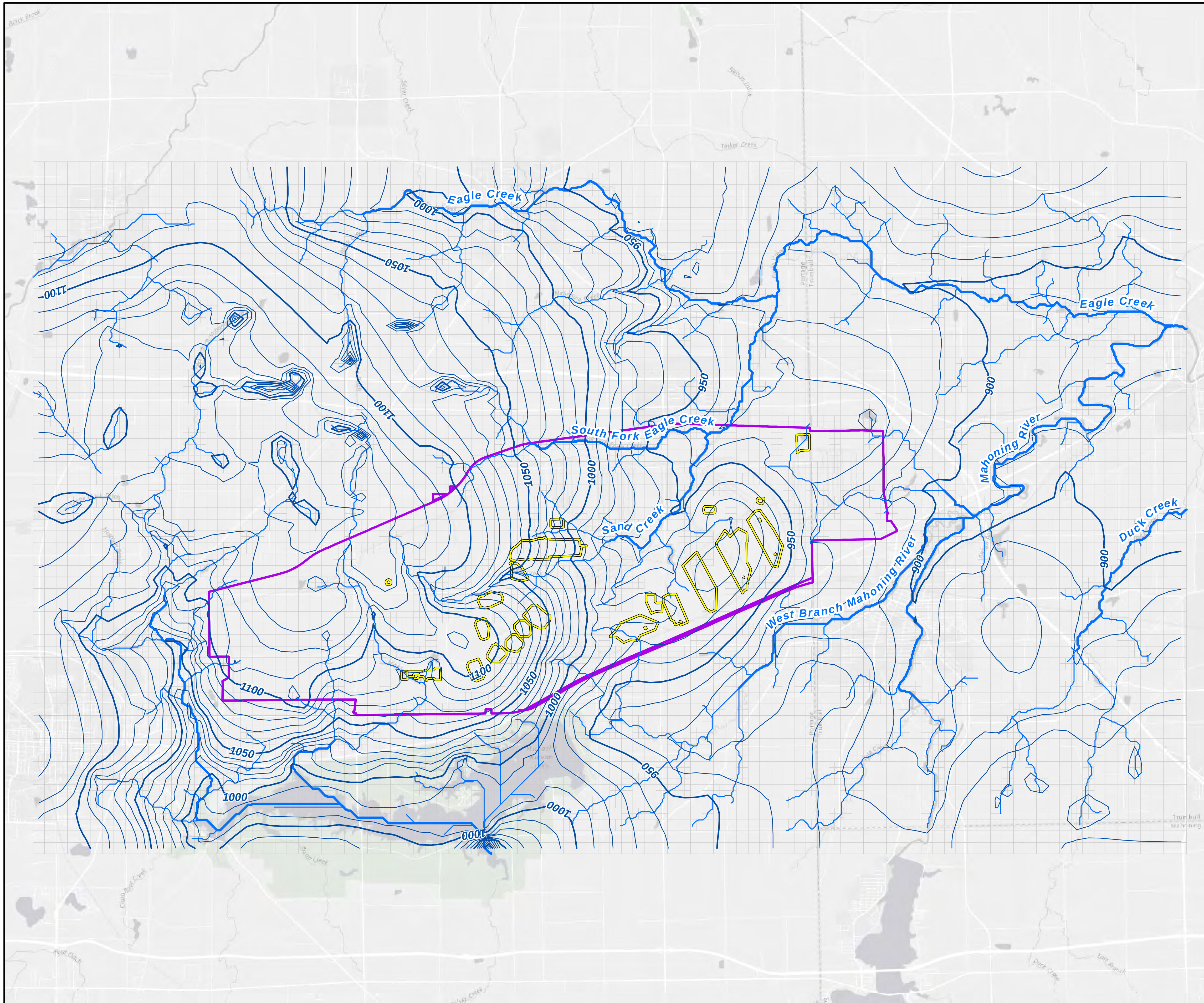
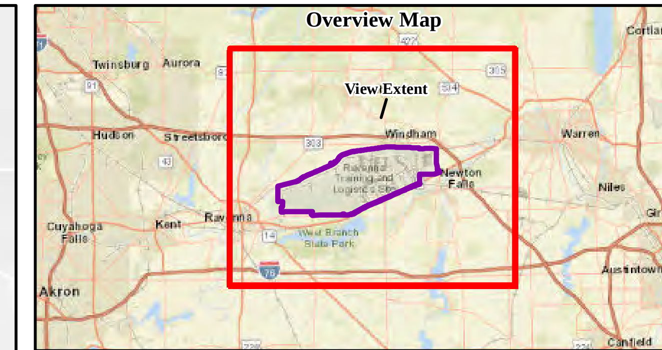




Legend

- Camp Ravenna Property Line
- AOCs with abundant groundwater data
- MODFLOW-USG's Quadtree Grid

Stream Network Used as Boundary Conditions

- Strahler Order 1-2
- Strahler Order 3-5
- Simulated Upper-Most Potentiometric Surface (feet amsl)

Notes:
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map

N

0 5,000 10,000 Feet

1:105,000
NAD83 Ohio State Plane North

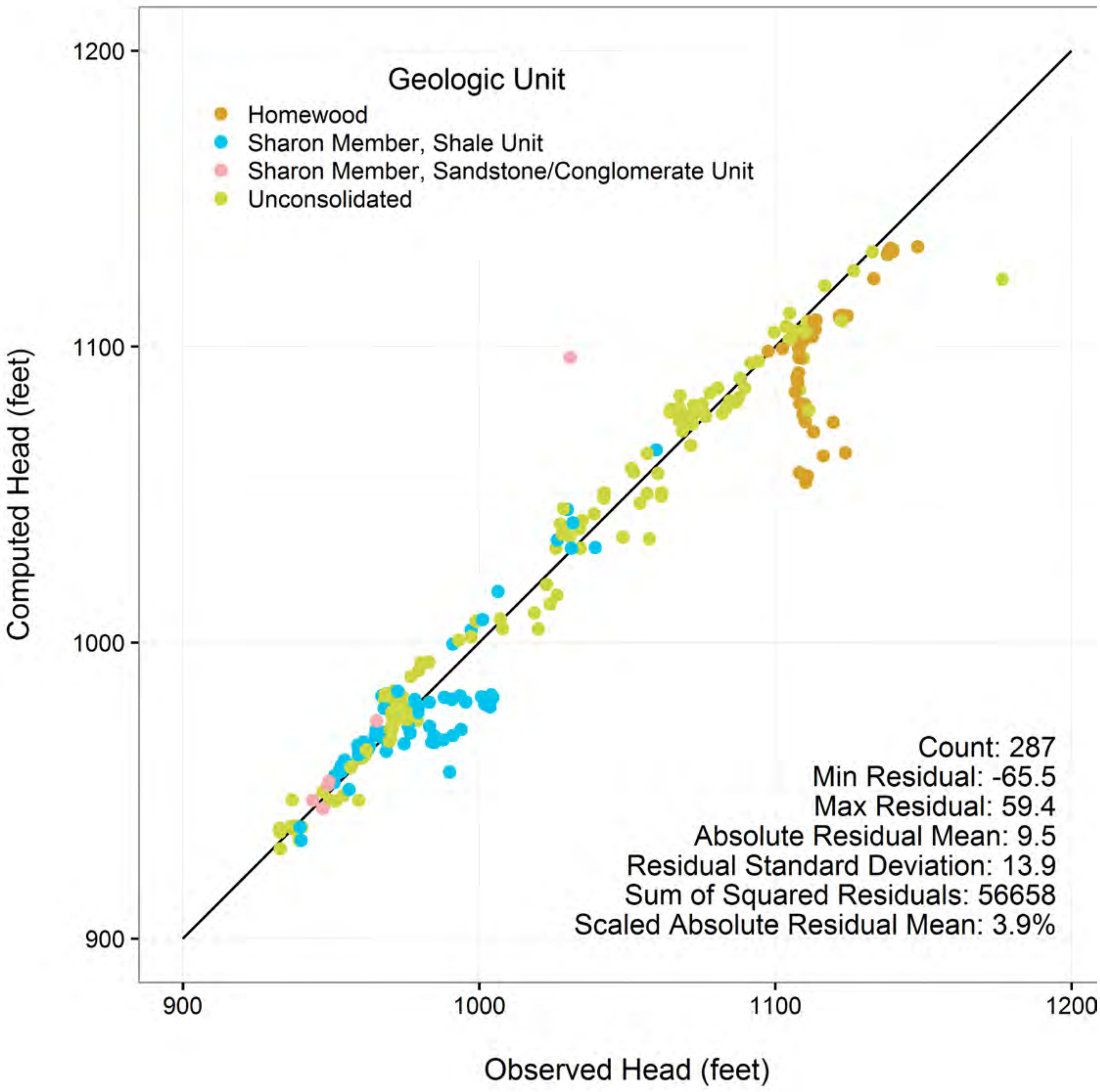
Cardno TEC WESTON
TEC-Weston Joint Venture

SIMULATED UPPER-MOST POTENTIOMETRIC SURFACE

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-23

FINAL



SIMULATED VERSUS OBSERVED HEADS

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

TEC-Weston Joint Venture

Figure: 1-24

FINAL

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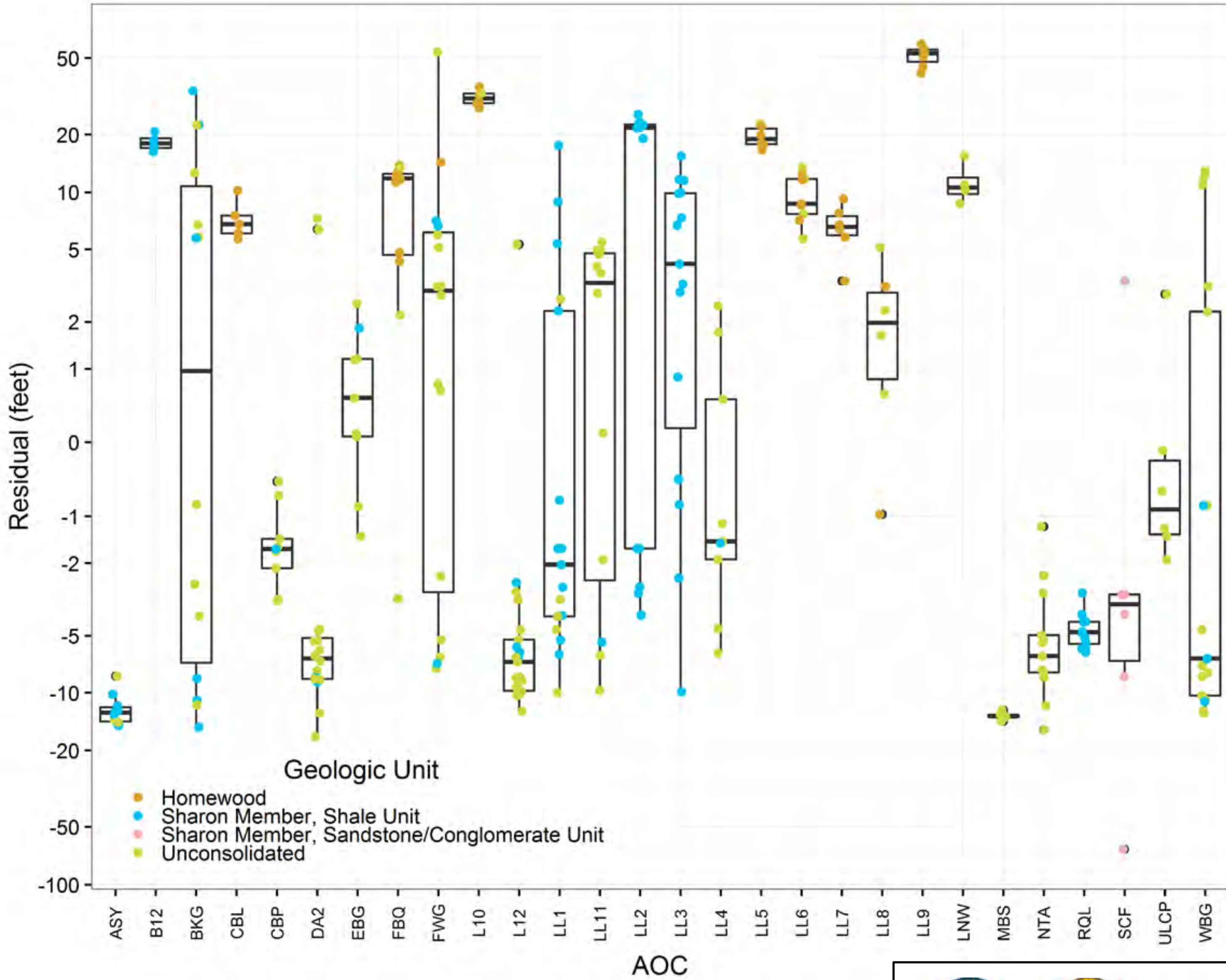

TEC-Weston Joint Venture

MODEL RESIDUALS BY AOC

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-25

FINAL

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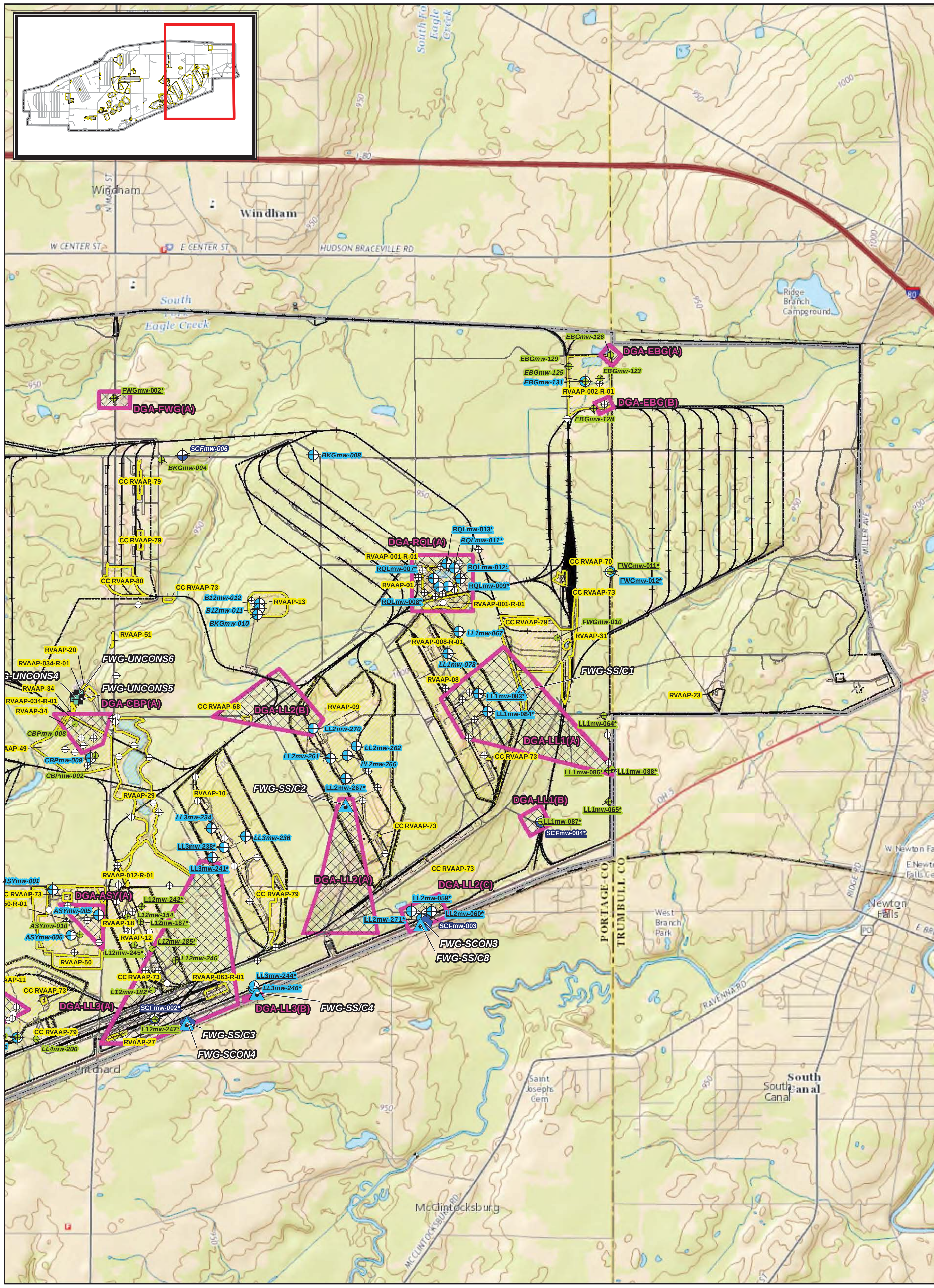

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Existing Groundwater Monitoring Wells to be Sampled During the RI

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- * Wells with underlined labels are Proposed 2016 FWGW Monitoring Program Wells
- Other Existing Monitoring Well - (Not to be sampled during the RI)

Proposed Well Installations

- Proposed Sharon Sandstone / Conglomerate Well Location
- Proposed Basal Sharon Conglomerate Well Location
- Proposed Background Basal Sharon Conglomerate Well
- Proposed Background Homewood Sandstone Well Location
- Proposed Unconsolidated Well Location
- AOCs
- Horizontal and Vertical Data Gap Area
- Camp Ravenna Boundary

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,500 ft
NAD83 UTM Zone 17N

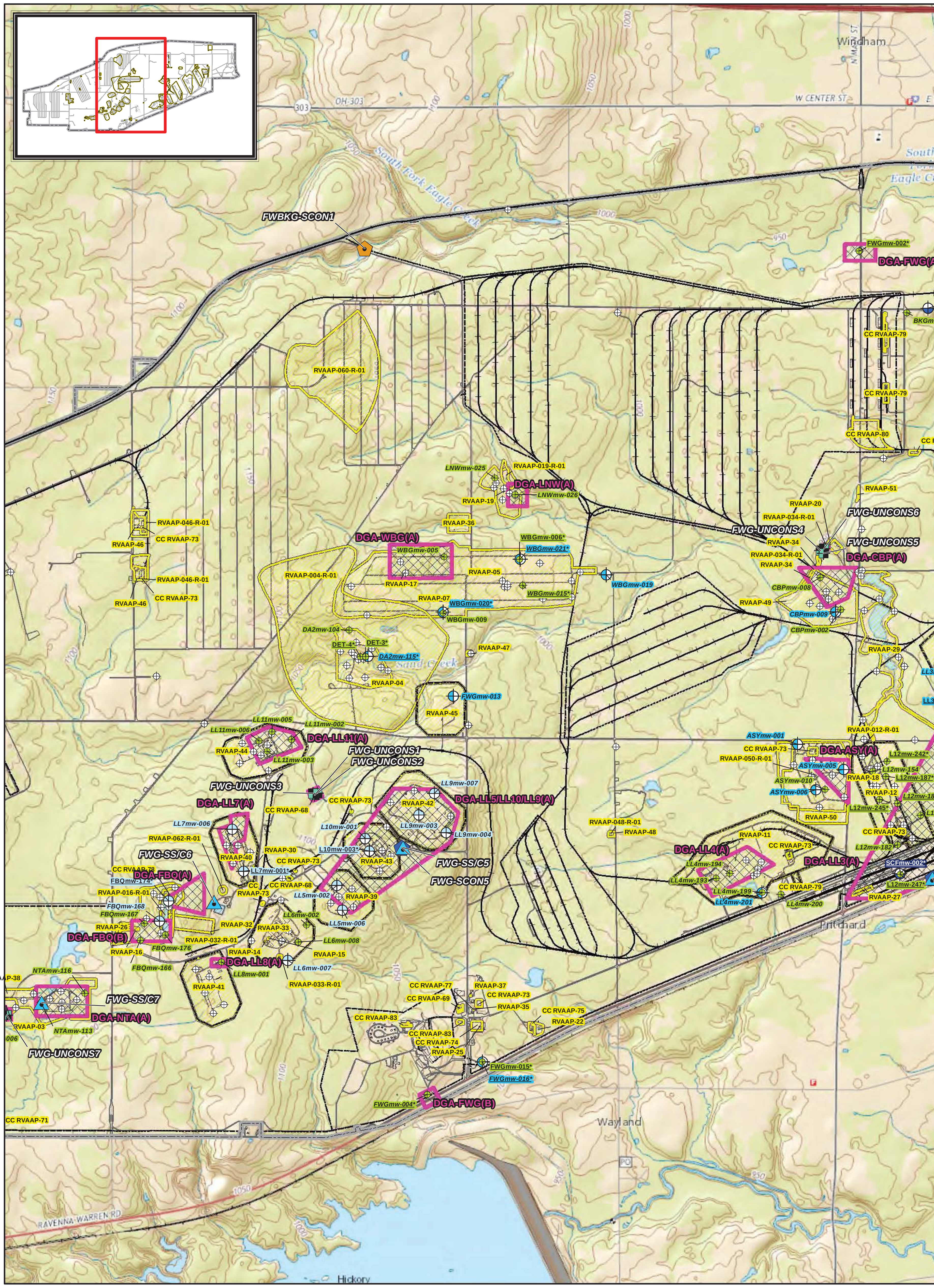
TEC-Weston Joint Venture

RI SAMPLE AND NEW GROUNDWATER MONITORING WELL LOCATIONS - EAST

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-1

FINAL



Existing Groundwater Monitoring Wells to be Sampled During the RI

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- * Wells with underlined labels are Proposed 2016 FWGW Monitoring Program Wells
- Other Existing Monitoring Well - (Not to be sampled during the RI)

Proposed Well Installations

- Proposed Sharon Sandstone / Conglomerate Well Location
- Proposed Basal Sharon Conglomerate Well Location
- Proposed Background Basal Sharon Conglomerate Well
- Proposed Background Homewood Sandstone Well Location
- Proposed Unconsolidated Well Location
- AOCs
- Horizontal and Vertical Data Gap Area
- Camp Ravenna Boundary

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,490 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

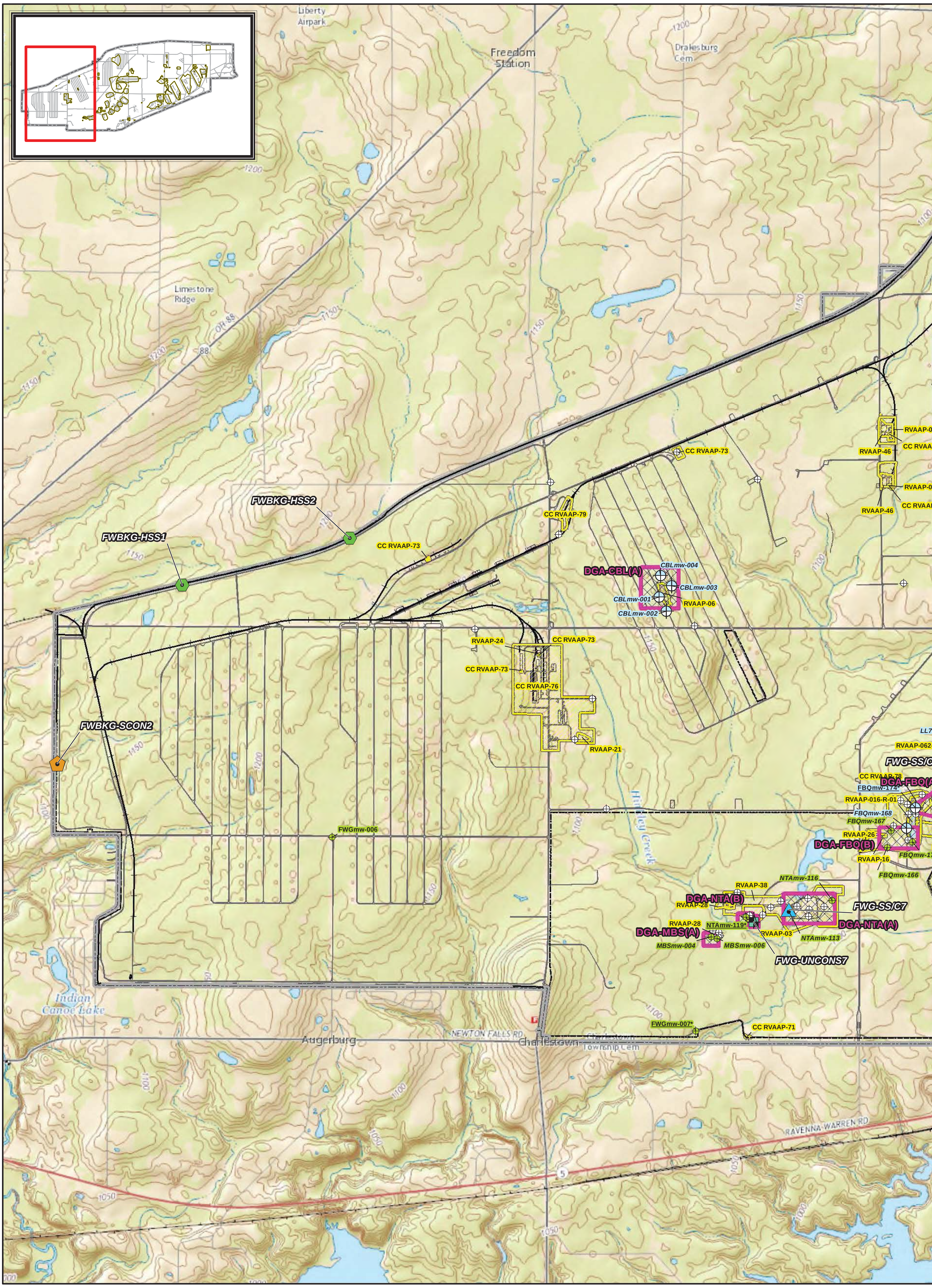
RI SAMPLE AND NEW GROUNDWATER MONITORING WELL LOCATIONS - CENTRAL

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-2

FINAL

Path: I:\GIS Project Files\15363_Cardno Weston Services\Ravenna\GIS\MXDs\Work_Plans\RI_WP_FINAL\Fig_3_1-2-3_RI_Sample_Locations_v20160603.mxd, 10/12/2016 9:27:59 AM, herrinm



Existing Groundwater Monitoring Wells to be Sampled During the RI

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- * Wells with underlined labels are Proposed 2016 FWGW Monitoring Program Wells
- Other Existing Monitoring Well - (Not to be sampled during the RI)

Proposed Well Installations

- Proposed Sharon Sandstone / Conglomerate Well Location
- Proposed Basal Sharon Conglomerate Well Location
- Proposed Background Basal Sharon Conglomerate Well
- Proposed Background Homewood Sandstone Well Location
- Proposed Unconsolidated Well Location
- AOCs
- Horizontal and Vertical Data Gap Area
- Camp Ravenna Boundary

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,490 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RI SAMPLE AND NEW GROUNDWATER MONITORING WELL LOCATIONS - WEST

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-3

FINAL

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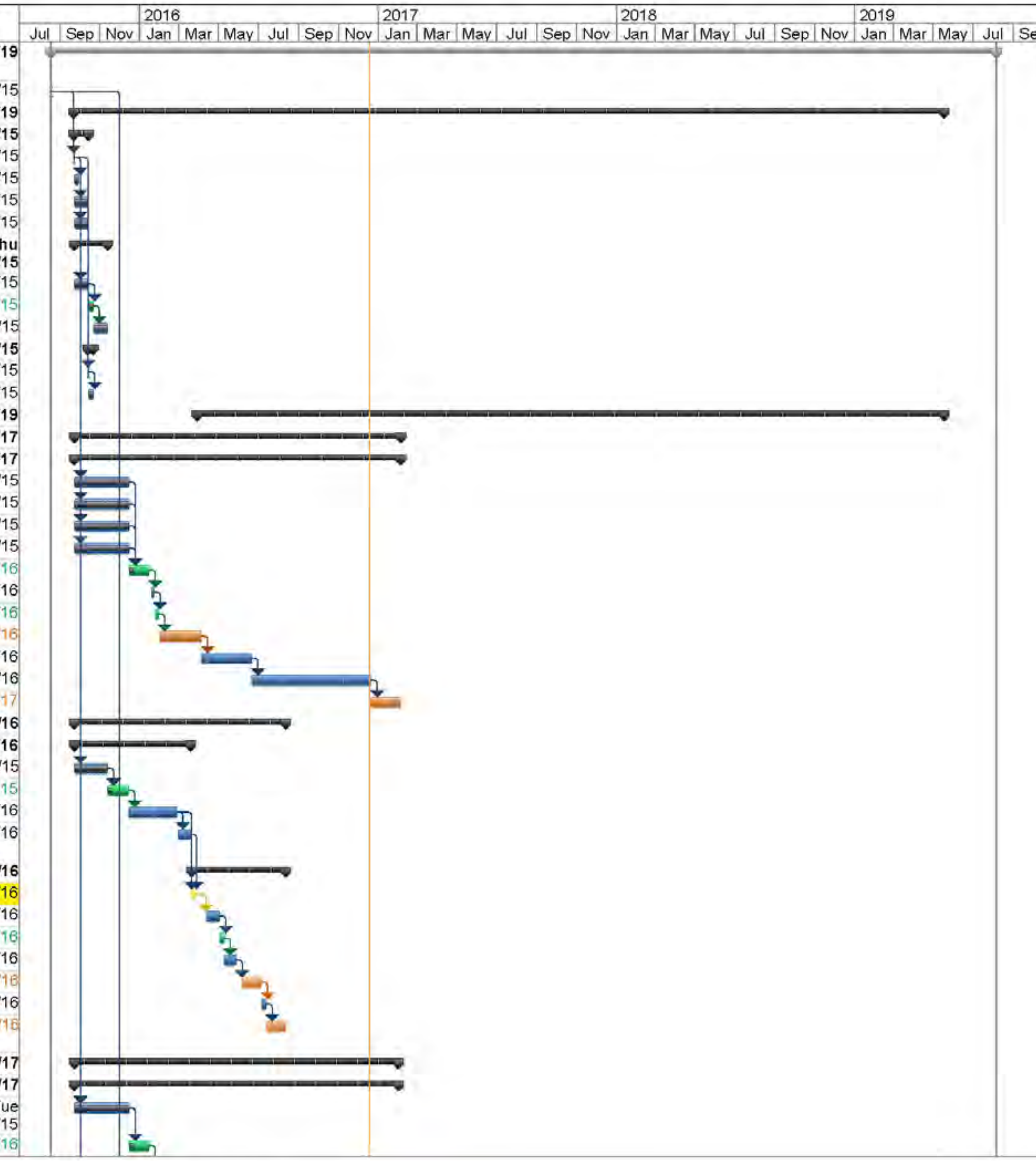
ID	Task	Task Name	Calendar Days	Start	Finish
0		**Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna**	**1449 days**	**Tue 8/18/15**	**Mon 8/5/19**
1		Contract Award	1 day	Tue 8/18/15	Tue 8/18/15
2	**1**	**Project Management Plan**	**1334 days**	**Tue 9/22/15**	**Fri 5/17/19**
3	**1.01**	**Kickoff Meeting**	**23 days**	**Tue 9/22/15**	**Ved 10/14/15**
4	1.01	Project Kickoff Meeting	1 day	Tue 9/22/15	Tue 9/22/15
5	1.01	Prepare Project Kickoff Meeting Minutes	7 days	Wed 9/23/15	Tue 9/29/15
6	1.01	Initial Personnel Security/Access Training	22 days	Wed 9/23/15	Ved 10/14/15
7	1.01	Written Notification of PM and APM	22 days	Wed 9/23/15	Ved 10/14/15
8	**1.02**	**Project Management Plan (PMP) and Quality Control Plan (QCP)**	**51 days**	**Wed 9/23/15**	**Thu 11/12/15**
9	1.02	Prepare Preliminary Draft PMP and QCP	22 days	Wed 9/23/15	Ved 10/14/15
10	1.02	ARNG Review and Comment	7 days	Thu 10/15/15	Ved 10/21/15
11	1.02	Prepare Final PMP and QCP for ARNG Approval	22 days	Thu 10/22/15	Thu 11/12/15
12	**1.03**	**Initial Scoping Meeting**	**8 days**	**Ved 10/14/15**	**Ved 10/21/15**
13	1.03	Initial Project Scoping Meeting	1 day	Ved 10/14/15	Ved 10/14/15
14	1.03	Prepare Initial Project Scoping Meeting Minutes (Vista)	7 days	Thu 10/15/15	Ved 10/21/15
15	**1.04**	**RAB Meeting Attendance**	**1145 days**	**Tue 3/29/16**	**Fri 5/17/19**
38	**2**	**Remedial Investigation (RI) Work Plan**	**500 days**	**Wed 9/23/15**	**Fri 2/3/17**
39	**2.01**	**Remedial Investigation (RI) Work Plan**	**500 days**	**Wed 9/23/15**	**Fri 2/3/17**
40	2.02	Prepare Conceptual Site Model (CSM)	84 days	Wed 9/23/15	Tue 12/15/15
41	2.03	Analyze Well Data and Network	84 days	Wed 9/23/15	Tue 12/15/15
42	2.04	Prepare Background Study	84 days	Wed 9/23/15	Tue 12/15/15
43	2.01	Prepare Preliminary Draft RI Work Plan	84 days	Wed 9/23/15	Tue 12/15/15
44	2.01	ARNG Review and Comment	31 days	Ved 12/16/15	Fri 1/15/16
45	2.01	Prepare RTCs and Draft RI Work Plan	4 days	Tue 1/19/16	Fri 1/22/16
46	2.01	ARNG Review and Comment	5 days	Mon 1/25/16	Fri 1/29/16
47	2.01	Regulator Review Draft RI Work Plan	64 days	Mon 2/1/16	Mon 4/4/16
48	2.01	Prepare RTCs	77 days	Tue 4/5/16	Mon 6/20/16
49	2.01	Prepare Final RI Work Plan	183 days	Tue 6/21/16	Tue 12/20/16
50	2.01	Receive ARNG and Regulatory Approval of RI Work Plan	45 days	Ved 12/21/16	Fri 2/3/17
51	**3**	**Phase I Archaeological Survey**	**324 days**	**Wed 9/23/15**	**Thu 8/11/16**
52	**3.01**	**Phase I Archaeological Survey Work Plan**	**178 days**	**Wed 9/23/15**	**Fri 3/18/16**
53	3.01	Prepare Survey Work Plan	51 days	Wed 9/23/15	Thu 11/12/15
54	3.01	ARNG Review Survey Work Plan	32 days	Fri 11/13/15	Mon 12/14/15
55	3.01	Prepare RTCs and Finalize Survey Work Plan	74 days	Tue 12/15/15	Fri 2/26/16
56	3.01	Receive ARNG and Regulatory Approval of Phase 1 Archaeological Survey Work Plan	19 days	Mon 2/29/16	Fri 3/18/16
57	**3.02**	**Phase I Archaeological Survey Report**	**144 days**	**Mon 3/21/16**	**Thu 8/11/16**
58	3.02	Conduct Phase I Archaeological Survey	4 days	Mon 3/21/16	Thu 3/24/16
59	3.02	Prepare Preliminary Draft Phase I Archaeological Survey Report	21 days	Tue 4/12/16	Mon 5/2/16
60	3.02	ARNG Review and Comment	7 days	Tue 5/3/16	Mon 5/9/16
61	3.02	Prepare RTCs and Draft Phase I Archaeological Survey Report	18 days	Tue 5/10/16	Fri 5/27/16
62	3.02	Regulator Review Draft Phase I Archaeological Survey Report	30 days	Mon 6/6/16	Tue 7/5/16
63	3.02	Prepare RTCs and Final Phase I Archaeological Survey Report	7 days	Wed 7/6/16	Tue 7/12/16
64	3.02	Receive ARNG and Regulatory Approval of Phase 1 Archaeological Survey Report	30 days	Wed 7/13/16	Thu 8/11/16
65	**4**	**Sampling and Analysis Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
66	**4.01**	**Sampling and Analysis Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
67	4.01	Prepare Preliminary Draft Field Sampling Plan (FSP)/UFP-QAPP	84 days	Wed 9/23/15	Tue 12/15/15
68	4.01	ARNG Review and Comment	31 days	Ved 12/16/15	Fri 1/15/16



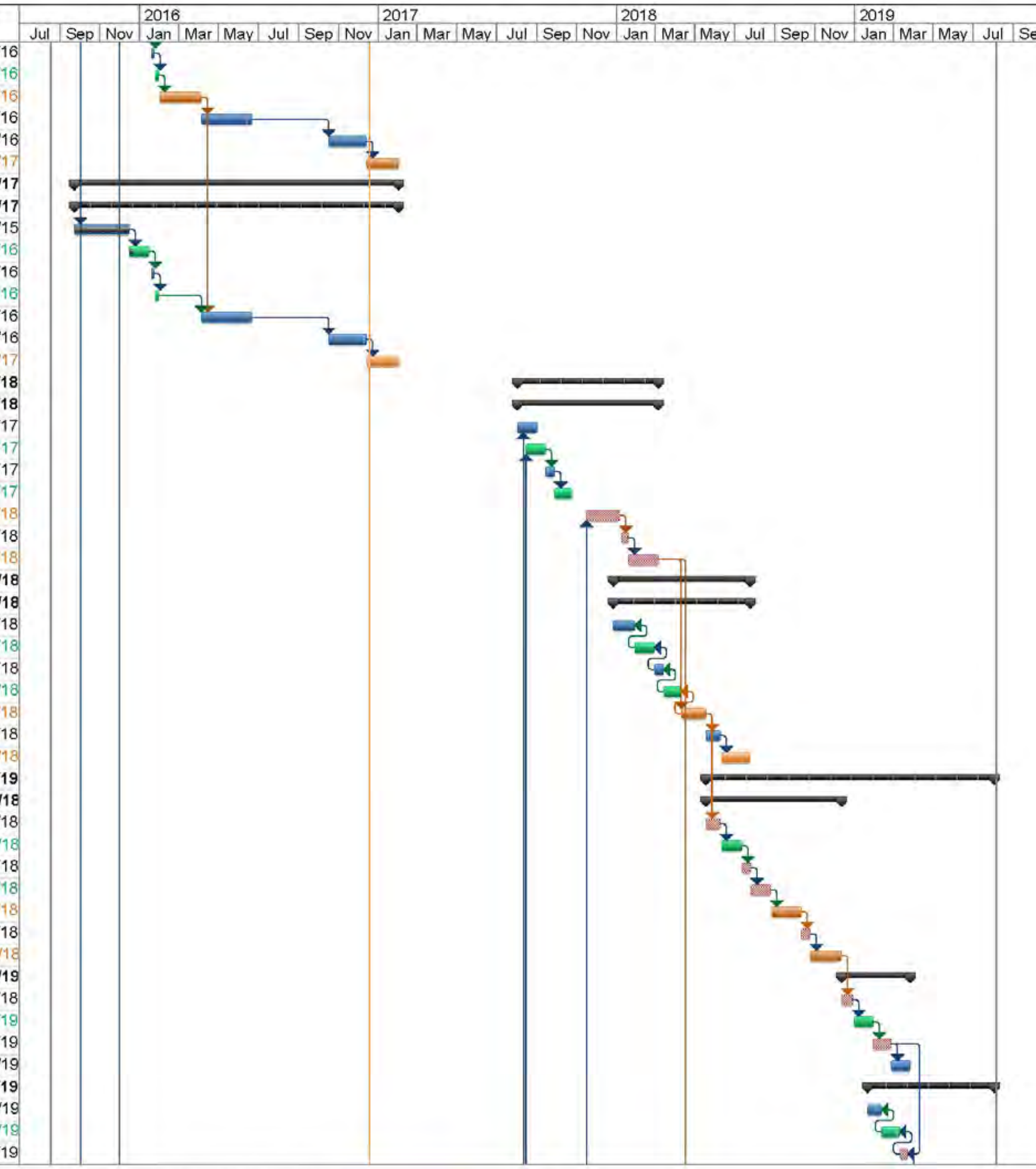
Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Mon 12/19/16

Task | Summary | Field Work Activities (Yellow)
Milestone | Critical | Progress

Page 1

Figure 8-1 Project Schedule

ID	Task	Task Name	Calendar Days	Start	Finish
69	4.01	Prepare RTCs and Draft FSP/UFP-QAPP	4 days	Tue 1/19/16	Fri 1/22/16
70	4.01	ARNG Review and Comment	5 days	Mon 1/25/16	Fri 1/29/16
71	4.01	Regulator Review Draft FSP/UFP-QAPP	64 days	Mon 2/1/16	Mon 4/4/16
72	4.01	Prepare RTCs	77 days	Tue 4/5/16	Mon 6/20/16
73	4.01	Prepare Final FSP/UFP-QAPP	58 days	Mon 10/17/16	Tue 12/13/16
74	4.01	Receive ARNG and Regulatory Approval of FSP/UFP-QAPP	49 days	Wed 12/14/16	Tue 1/31/17
75	**5**	**Health and Safety Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
76	**5.01**	**Health and Safety Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
77	5.01	Prepare Preliminary Draft Health and Safety Plan (HSP)	84 days	Wed 9/23/15	Tue 12/15/15
78	5.01	ARNG Review and Comment	31 days	Wed 12/16/15	Fri 1/15/16
79	5.01	Prepare RTCs and Draft Health and Safety Plan (HSP)	4 days	Tue 1/19/16	Fri 1/22/16
80	5.01	ARNG Review and Comment	5 days	Mon 1/25/16	Fri 1/29/16
81	5.01	Prepare RTCs	77 days	Tue 4/5/16	Mon 6/20/16
82	5.01	Prepare Final HSP for ARNG Approval	58 days	Mon 10/17/16	Tue 12/13/16
83	5.01	Receive ARNG Approval of HSP	49 days	Wed 12/14/16	Tue 1/31/17
84	**6**	**Remedial Investigation Report**	**216 days**	**Wed 8/2/17**	**Mon 3/5/18**
85	**6.01**	**Remedial Investigation (RI) Report**	**216 days**	**Wed 8/2/17**	**Mon 3/5/18**
86	6.01	Prepare Preliminary Draft Report	30 days	Wed 8/2/17	Thu 8/31/17
87	6.01	ARNG Review and Comment	30 days	Tue 8/15/17	Wed 9/13/17
88	6.01	Prepare RTCs and Draft Report	14 days	Thu 9/14/17	Wed 9/27/17
89	6.01	ARNG Review and Comment	26 days	Thu 9/28/17	Mon 10/23/17
90	6.01	Regulator Review Draft Report	51 days	Thu 11/16/17	Fri 1/5/18
91	6.01	Prepare RTCs and Final Report	11 days	Mon 1/8/18	Thu 1/18/18
92	6.01	Receive ARNG and Regulatory Approval of RI Report	46 days	Fri 1/19/18	Mon 3/5/18
93	**7**	**Feasibility Study (FS) Report**	**210 days**	**Wed 12/27/17**	**Tue 7/24/18**
94	**7.01**	**Feasibility Study (FS) Report**	**210 days**	**Wed 12/27/17**	**Tue 7/24/18**
95	7.01	Prepare Preliminary Draft Report	33 days	Wed 12/27/17	Mon 1/29/18
96	7.01	ARNG Review and Comment	30 days	Mon 1/29/18	Wed 2/28/18
97	7.01	Prepare RTCs and Draft Report	14 days	Wed 2/28/18	Wed 3/14/18
98	7.01	ARNG Review and Comment	27 days	Wed 3/14/18	Tue 4/10/18
99	7.01	Regulator Review Draft Report	38 days	Tue 4/10/18	Thu 5/17/18
100	7.01	Prepare RTCs and Final Report	22 days	Fri 5/18/18	Fri 6/8/18
101	7.01	Receive ARNG and Regulatory Approval of FS Report	44 days	Mon 6/11/18	Tue 7/24/18
102	**8**	**Proposed Plan (PP)/Record of Decision (ROD)**	**442 days**	**Fri 5/18/18**	**Fri 8/2/19**
103	**8.01**	**Proposed Plan (PP)**	**208 days**	**Fri 5/18/18**	**Tue 12/11/18**
104	8.01	Prepare Preliminary Draft PP	22 days	Fri 5/18/18	Fri 6/8/18
105	8.01	ARNG Review	31 days	Mon 6/11/18	Wed 7/11/18
106	8.01	Prepare RTCs and Draft PP	14 days	Thu 7/12/18	Wed 7/25/18
107	8.01	ARNG Review	30 days	Thu 7/26/18	Fri 8/24/18
108	8.01	Regulator Review Draft PP	45 days	Mon 8/27/18	Wed 10/10/18
109	8.01	Prepare RTCs and Final PP	14 days	Thu 10/11/18	Wed 10/24/18
110	8.01	Receive Regulatory Approval of PP	48 days	Thu 10/25/18	Tue 12/11/18
111	**8.02**	**Proposed Plan Public Meeting**	**105 days**	**Wed 12/12/18**	**Tue 3/26/19**
112	8.02	Prepare Draft Public Meeting Submittals	17 days	Wed 12/12/18	Fri 12/28/18
113	8.02	ARNG Review & Approve Public Meeting Submittals	29 days	Mon 12/31/18	Mon 1/28/19
114	8.02	Public Meeting and Comment Period	28 days	Tue 1/29/19	Mon 2/25/19
115	8.02	ARNG Review Public Meeting Minutes and Comments	29 days	Tue 2/26/19	Tue 3/26/19
116	**8.03**	**Record of Decision (ROD)**	**194 days**	**Mon 1/21/19**	**Fri 8/2/19**
117	8.03	Prepare Preliminary Draft ROD	21 days	Mon 1/21/19	Mon 2/11/19
118	8.03	ARNG Review	28 days	Mon 2/11/19	Mon 3/11/19
119	8.03	Prepare RTCs and Draft ROD	12 days	Mon 3/11/19	Fri 3/22/19



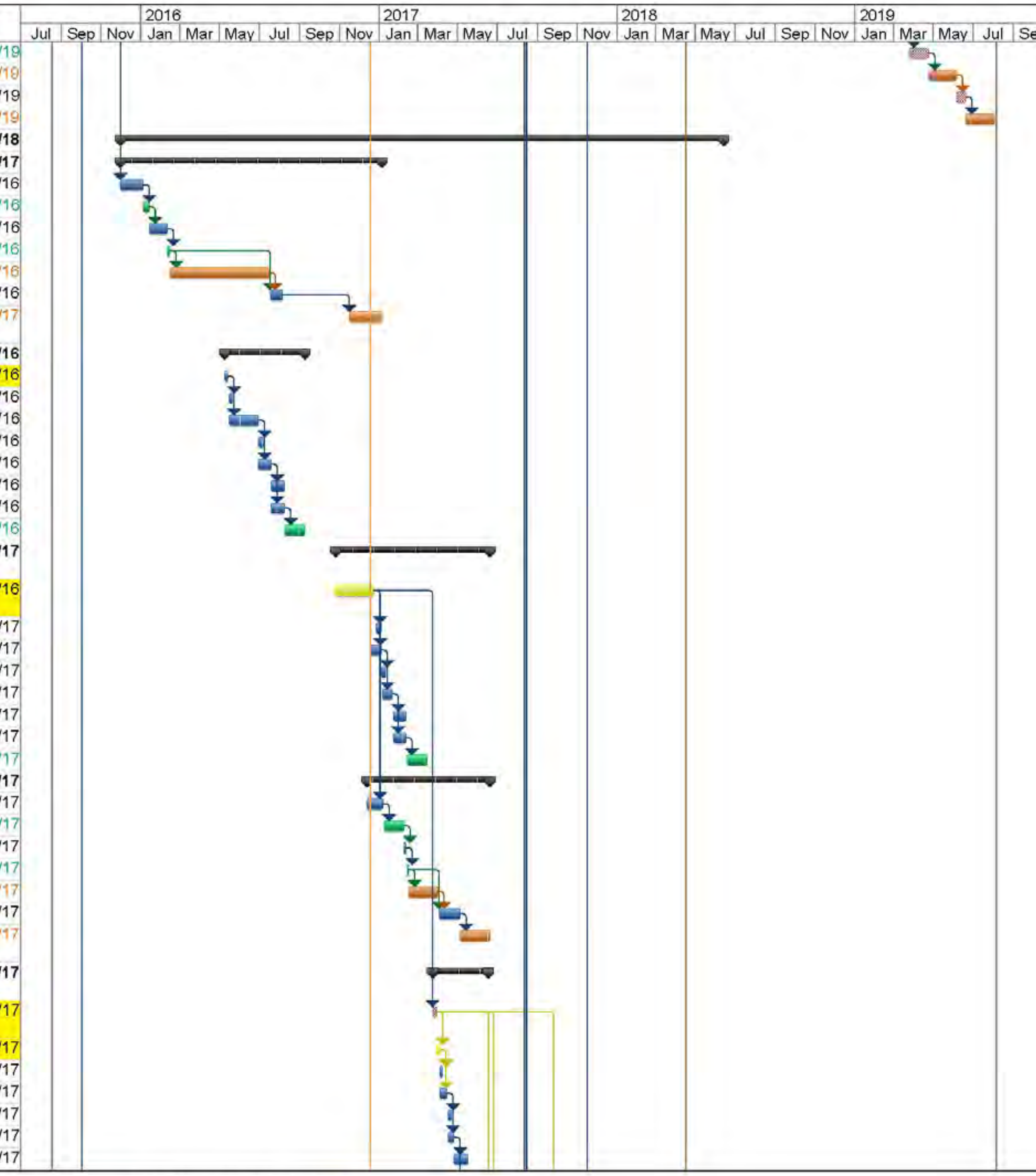
Groundwater and Environmental Investigation Services
at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Mon 12/19/16

Task | Summary | Field Work Activities (Yellow)
Milestone | Critical | Progress

Page 2

Figure 8-1 Project Schedule (Continued)

ID	Task	Task Name	Calendar Days	Start	Finish
120	8.03	ARNG Review	30 days	Mon 3/25/19	Tue 4/23/19
121	8.03	Regulator Review Draft ROD	43 days	Wed 4/24/19	Wed 6/5/19
122	8.03	Prepare RTCs and Final ROD	14 days	Thu 6/6/19	Wed 6/19/19
123	8.03	Receive ARNG and Regulatory Approval of ROD	44 days	Thu 6/20/19	Fri 8/2/19
124	**9**	**Routine Groundwater Sampling**	**926 days**	**Tue 12/1/15**	**Wed 6/13/18**
125	**9.01**	**2015 Annual Groundwater Sampling Report**	**401 days**	**Tue 12/1/15**	**Wed 1/4/17**
126	9.01	Prepare Preliminary Draft Report and IDW Report	35 days	Tue 12/1/15	Mon 1/4/16
127	9.01	ARNG Review and Comment	9 days	Tue 1/5/16	Wed 1/13/16
128	9.01	Prepare RTCs and Draft Report and IDW Report	28 days	Thu 1/14/16	Wed 2/10/16
129	9.01	ARNG Review and Comment	4 days	Thu 2/11/16	Sun 2/14/16
130	9.01	Regulator Review Draft Report	152 days	Mon 2/15/16	Fri 7/15/16
131	9.01	Prepare RTCs and Final Report and IDW Report	19 days	Mon 7/18/16	Fri 8/5/16
132	9.01	Receive ARNG and Regulatory Approval of Groundwater Sampling Report #1 and IDW Report	50 days	Wed 11/16/16	Wed 1/4/17
133	**9.02**	**Semi-Annual Groundwater Sampling #1 (Existing Wells)**	**123 days**	**Mon 5/9/16**	**Thu 9/8/16**
134	9.02	Semi-Annual GW Sampling #1	5 days	Mon 5/9/16	Fri 5/13/16
135	9.02	Field Work Completion Notice	5 days	Mon 5/16/16	Fri 5/20/16
136	9.02	Sample Analysis	45 days	Mon 5/16/16	Wed 6/29/16
137	9.02	Analytical Raw Data Submission	8 days	Thu 6/30/16	Thu 7/7/16
138	9.02	Data Validation	19 days	Thu 6/30/16	Mon 7/18/16
139	9.02	Database Upload	21 days	Tue 7/19/16	Mon 8/8/16
140	9.02	Prepare Sampling Event Tech Memo	21 days	Tue 7/19/16	Mon 8/8/16
141	9.02	ARNG Review and Approve Sampling Event Tech Memo	31 days	Tue 8/9/16	Thu 9/8/16
142	**9.02/9.04**	**Semi-Annual Groundwater Sampling #2 and Quarterly GW Sampling #1 (Existing/New Wells)**	**237 days**	**Wed 10/26/16**	**Mon 6/19/17**
143	9.02/9.04	Semi-Annual Groundwater Sampling #2 and Quarterly GW Sampling #1	59 days	Wed 10/26/16	Fri 12/23/16
144	9.02/9.04	Field Work Completion Notice	8 days	Tue 12/27/16	Tue 1/3/17
145	9.02/9.04	Sample Analysis	16 days	Mon 12/19/16	Tue 1/3/17
146	9.02/9.04	Analytical Raw Data Submission	7 days	Wed 1/4/17	Tue 1/10/17
147	9.02/9.04	Data Validation	15 days	Fri 1/6/17	Fri 1/20/17
148	9.02/9.04	Database Upload	19 days	Mon 1/23/17	Fri 2/10/17
149	9.02/9.04	Prepare Sampling Event Tech Memo	19 days	Mon 1/23/17	Fri 2/10/17
150	9.02/9.04	ARNG Review and Approve Sampling Event Tech Memo	31 days	Mon 2/13/17	Wed 3/15/17
151	**9.05**	**2016 Annual Groundwater Sampling Report**	**189 days**	**Tue 12/13/16**	**Mon 6/19/17**
152	9.05	Prepare Preliminary Draft Report and IDW Report	25 days	Tue 12/13/16	Fri 1/6/17
153	9.05	ARNG Review and Comment	30 days	Mon 1/9/17	Tue 2/7/17
154	9.05	Prepare RTCs and Draft Report and IDW Report	3 days	Wed 2/8/17	Fri 2/10/17
155	9.05	ARNG Review and Comment	2 days	Mon 2/13/17	Tue 2/14/17
156	9.05	Regulator Review Draft Report	45 days	Wed 2/15/17	Fri 3/31/17
157	9.05	Prepare RTCs and Final Report and IDW Report	32 days	Mon 4/3/17	Thu 5/4/17
158	9.05	Receive ARNG and Regulatory Approval of Groundwater Sampling Report #1 and IDW Report	46 days	Fri 5/5/17	Mon 6/19/17
159	**9.04**	**Semi-Annual Groundwater Sampling #3 and Quarterly GW Sampling #2 (New Wells)**	**85 days**	**Fri 3/24/17**	**Fri 6/16/17**
160	9.04/9.07	Semi-Annual Groundwater Sampling #3 and Quarterly GW Sampling #2	6 days	Fri 3/24/17	Wed 3/29/17
161	9.04/9.07	Additional RI Sampling	5 days	Thu 3/30/17	Mon 4/3/17
162	9.04/9.07	Field Work Completion Notice	4 days	Tue 4/4/17	Fri 4/7/17
163	9.04/9.07	Sample Analysis	11 days	Tue 4/4/17	Fri 4/14/17
164	9.04/9.07	Analytical Raw Data Submission	5 days	Mon 4/17/17	Fri 4/21/17
165	9.04/9.07	Data Validation	9 days	Mon 4/17/17	Tue 4/25/17
166	9.04/9.07	Database Upload	21 days	Wed 4/26/17	Tue 5/16/17



Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Mon 12/19/16

Task | Summary | Field Work Activities (Yellow)
Milestone | Critical | Progress

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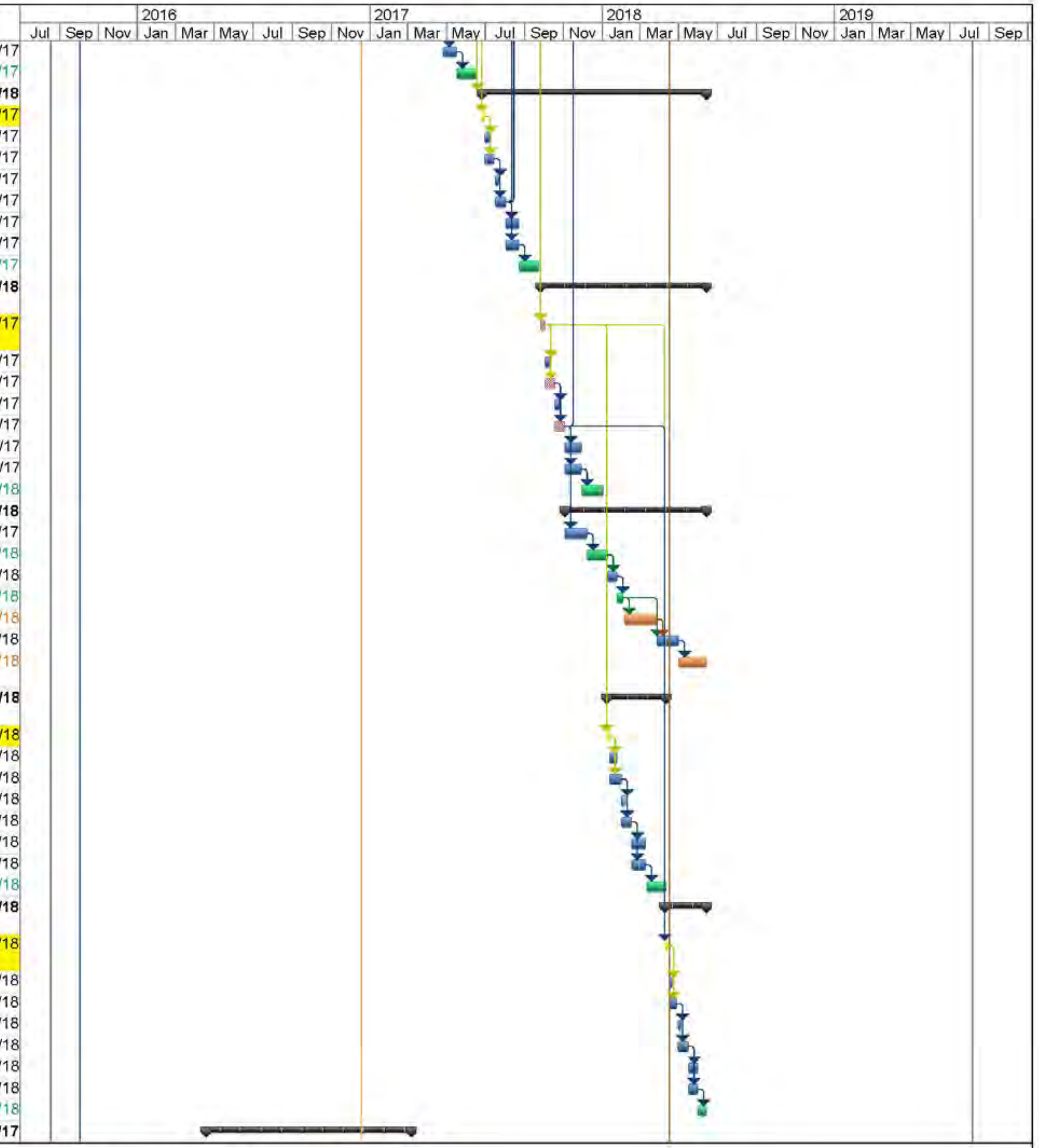
Figure 8-1 Project Schedule (Continued)

ID	Task	Task Name	Calendar Days	Start	Finish
167	9.04/9.07	Prepare Sampling Event Tech Memo	21 days	Wed 4/26/17	Tue 5/16/17
168	9.04/9.07	ARNG Review and Approve Sampling Event Tech Memo	31 days	Wed 5/17/17	Fri 6/16/17
169	**9.06**	**Quarterly Groundwater Sampling #3 (New Wells)**	**353 days**	**Mon 6/26/17**	**Wed 6/13/18**
170	9.06	Quarterly GW Sampling #3	4 days	Mon 6/26/17	Thu 6/29/17
171	9.06	Field Work Completion Notice	8 days	Fri 6/30/17	Fri 7/7/17
172	9.06	Sample Analysis	15 days	Fri 6/30/17	Fri 7/14/17
173	9.06	Analytical Raw Data Submission	5 days	Mon 7/17/17	Fri 7/21/17
174	9.06	Data Validation	16 days	Mon 7/17/17	Tue 8/1/17
175	9.06	Database Upload	21 days	Wed 8/2/17	Tue 8/22/17
176	9.06	Prepare Sampling Event Tech Memo	21 days	Wed 8/2/17	Tue 8/22/17
177	9.06	ARNG Review and Approve Sampling Event Tech Memo	31 days	Wed 8/23/17	Fri 9/22/17
178	**9.09**	**Semi-Annual Groundwater Sampling #4 and Quarterly GW Sampling #4 (New Wells)**	**261 days**	**Tue 9/26/17**	**Wed 6/13/18**
179	9.09	Semi-Annual Groundwater Sampling #4 and Quarterly GW Sampling #4	7 days	Tue 9/26/17	Mon 10/2/17
180	9.09	Field Work Completion Notice	8 days	Tue 10/3/17	Tue 10/10/17
181	9.09	Sample Analysis	15 days	Tue 10/3/17	Tue 10/17/17
182	9.09	Analytical Raw Data Submission	7 days	Wed 10/18/17	Tue 10/24/17
183	9.09	Data Validation	16 days	Wed 10/18/17	Thu 11/2/17
184	9.09	Database Upload	26 days	Fri 11/3/17	Tue 11/28/17
185	9.09	Prepare Sampling Event Tech Memo	26 days	Fri 11/3/17	Tue 11/28/17
186	9.09	ARNG Review and Approve Sampling Event Tech Memo	35 days	Wed 11/29/17	Tue 1/2/18
187	**9.05**	**2017 Annual Groundwater Sampling Report**	**223 days**	**Fri 11/3/17**	**Wed 6/13/18**
188	9.05	Prepare Preliminary Draft Report and IDW Report	35 days	Fri 11/3/17	Thu 12/7/17
189	9.05	ARNG Review and Comment	32 days	Fri 12/8/17	Mon 1/8/18
190	9.05	Prepare RTCs and Draft Report and IDW Report	15 days	Tue 1/9/18	Tue 1/23/18
191	9.05	ARNG Review and Comment	10 days	Wed 1/24/18	Fri 2/2/18
192	9.05	Regulator Review Draft Report	51 days	Mon 2/5/18	Tue 3/27/18
193	9.05	Prepare RTCs and Final Report and IDW Report	34 days	Wed 3/28/18	Mon 4/30/18
194	9.05	Receive ARNG and Regulatory Approval of Groundwater Sampling Report #1 and IDW Report	44 days	Tue 5/1/18	Wed 6/13/18
195	**9.06**	**Quarterly Groundwater Sampling #5 (New Wells)**	**93 days**	**Mon 1/8/18**	**Tue 4/10/18**
196	9.06	Quarterly GW Sampling #5	4 days	Mon 1/8/18	Thu 1/11/18
197	9.06	Field Work Completion Notice	12 days	Fri 1/12/18	Tue 1/23/18
198	9.06	Sample Analysis	19 days	Fri 1/12/18	Tue 1/30/18
199	9.06	Analytical Raw Data Submission	7 days	Wed 1/31/18	Tue 2/6/18
200	9.06	Data Validation	16 days	Wed 1/31/18	Thu 2/15/18
201	9.06	Database Upload	22 days	Fri 2/16/18	Fri 3/9/18
202	9.06	Prepare Sampling Event Tech Memo	22 days	Fri 2/16/18	Fri 3/9/18
203	9.06	ARNG Review and Approve Sampling Event Tech Memo	30 days	Mon 3/12/18	Tue 4/10/18
204	**9.11**	**Semi-Annual Groundwater Sampling #5 (Existing/New Wells) and Quarterly GW Sampling #6**	**66 days**	**Mon 4/9/18**	**Wed 6/13/18**
205	9.11	Semi-Annual GW Sampling #5 and Quarterly GW Sampling #6 (Pending New Wells)	5 days	Mon 4/9/18	Fri 4/13/18
206	9.11	Field Work Completion Notice	5 days	Mon 4/16/18	Fri 4/20/18
207	9.11	Sample Analysis	12 days	Mon 4/16/18	Fri 4/27/18
208	9.11	Analytical Raw Data Submission	5 days	Mon 4/30/18	Fri 5/4/18
209	9.11	Data Validation	16 days	Mon 4/30/18	Tue 5/15/18
210	9.11	Database Upload	15 days	Wed 5/16/18	Wed 5/30/18
211	9.11	Prepare Sampling Event Tech Memo	15 days	Wed 5/16/18	Wed 5/30/18
212	9.11	ARNG Review and Approve Sampling Event Tech Memo	14 days	Thu 5/31/18	Wed 6/13/18
213	**10**	**Well Redevelopment and Reconstruction**	**323 days**	**Mon 4/18/16**	**Mon 3/6/17**



Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Mon 12/19/16

Task | Summary | Field Work Activities (Yellow)
Milestone | Critical | Progress

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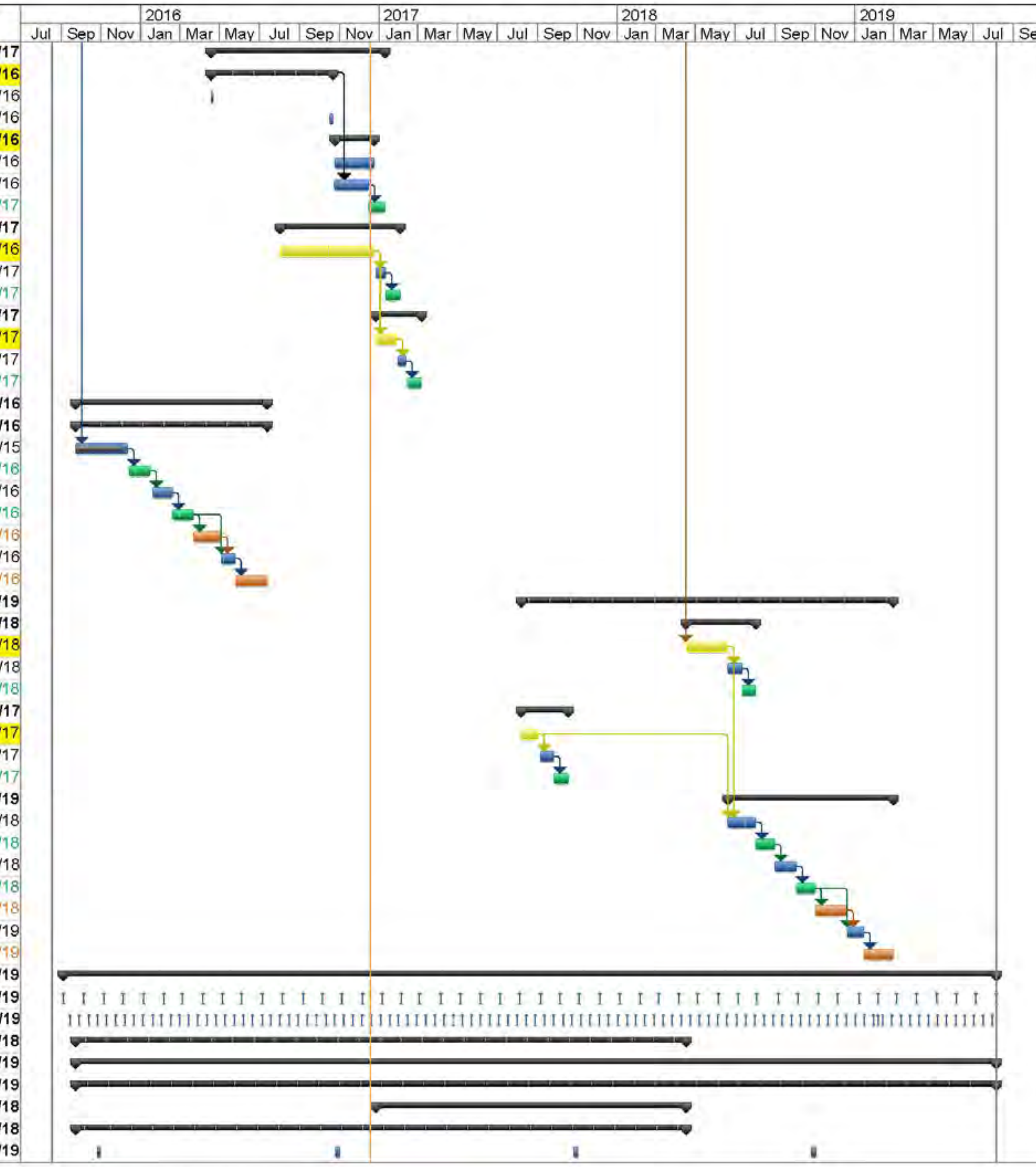
Figure 8-1 Project Schedule (Continued)

ID	Task	Task Name	Calendar Days	Start	Finish
214	**10.01**	**Install Bladder Pumps in Wells**	**267 days**	**Mon 4/18/16**	**Mon 1/9/17**
215	**10.01**	**Install Bladder Pumps in Existing Wells**	**187 days**	**Mon 4/18/16**	**Fri 10/21/16**
216	10.01	May 2016 Sampling Event	3 days	Mon 4/18/16	Wed 4/20/16
217	10.01	October 2016 Sampling Event	5 days	Mon 10/17/16	Fri 10/21/16
218		**Install Bladder Pumps in New Wells**	**60 days**	**Tue 10/25/16**	**Fri 12/23/16**
219	10.01	Quarterly #1 Sampling Event	60 days	Tue 10/25/16	Fri 12/23/16
220	10.01	Prepare Tech Memo	53 days	Mon 10/24/16	Thu 12/15/16
221	10.01	ARNG Approve Tech Memo	25 days	Fri 12/16/16	Mon 1/9/17
222	**10.02**	**Install New Wells**	**184 days**	**Tue 8/2/16**	**Wed 2/1/17**
223	10.02	Install and Develop New Wells	144 days	Tue 8/2/16	Fri 12/23/16
224	10.02	Prepare Tech Memo and IDW Report	15 days	Tue 12/27/16	Tue 1/10/17
225	10.02	ARNG Approve Tech Memo and IDW Report	22 days	Wed 1/11/17	Wed 2/1/17
226	**10.03**	**Well Redevelopment and Reconstruction**	**70 days**	**Tue 12/27/16**	**Mon 3/6/17**
227	10.03	Well Redevelopment and Reconstruction	32 days	Tue 12/27/16	Fri 1/27/17
228	10.03	Prepare Tech Memo and IDW Report	12 days	Mon 1/30/17	Fri 2/10/17
229	10.03	ARNG Approve Tech Memo and IDW Report	22 days	Mon 2/13/17	Mon 3/6/17
230	**11**	**Well Abandonment Work Plan**	**294 days**	**Wed 9/23/15**	**Tue 7/12/16**
231	**11.01**	**Well Abandonment Work Plan**	**294 days**	**Wed 9/23/15**	**Tue 7/12/16**
232	11.01	Prepare Preliminary Draft Well Abandonment Work Plan	80 days	Wed 9/23/15	Fri 12/11/15
233	11.01	ARNG Review and Comment	33 days	Mon 12/14/15	Fri 1/15/16
234	11.01	Prepare RTCs and Draft Work Plan	31 days	Tue 1/19/16	Thu 2/18/16
235	11.01	ARNG Review and Comment	32 days	Fri 2/19/16	Mon 3/21/16
236	11.01	Regulator Review Draft Work Plan	43 days	Tue 3/22/16	Tue 5/3/16
237	11.01	Prepare RTCs and Final Work Plan	21 days	Wed 5/4/16	Tue 5/24/16
238	11.01	Receive ARNG and Regulatory Approval of Well Abandonment Work Plan	49 days	Wed 5/25/16	Tue 7/12/16
239	**12**	**Well Sealing Report**	**571 days**	**Mon 8/7/17**	**Thu 2/28/19**
240	**12.01**	**Abandon Monitoring Wells**	**107 days**	**Tue 4/17/18**	**Wed 8/1/18**
241	12.01	Abandon Monitoring Wells	64 days	Tue 4/17/18	Tue 6/19/18
242	12.01	Prepare Tech Memo and IDW Report	22 days	Wed 6/20/18	Wed 7/11/18
243	12.01	ARNG Approve Tech Memo and IDW Report	21 days	Thu 7/12/18	Wed 8/1/18
244	**12.02**	**Abandon Production Wells**	**72 days**	**Mon 8/7/17**	**Tue 10/17/17**
245	12.02	Abandon Production Wells	26 days	Mon 8/7/17	Fri 9/1/17
246	12.02	Prepare Tech Memo and IDW Report	21 days	Tue 9/5/17	Mon 9/25/17
247	12.02	ARNG Approve Tech Memo and IDW Report	22 days	Tue 9/26/17	Tue 10/17/17
248	**12.03**	**Well Sealing Report**	**254 days**	**Wed 6/20/18**	**Thu 2/28/19**
249	12.03	Prepare Preliminary Draft Well Sealing Report	43 days	Wed 6/20/18	Wed 8/1/18
250	12.03	ARNG Review and Comment	29 days	Thu 8/2/18	Thu 8/30/18
251	12.03	Prepare RTCs and Draft Well Sealing Report	33 days	Fri 8/31/18	Tue 10/2/18
252	12.03	ARNG Review and Comment	29 days	Wed 10/3/18	Wed 10/31/18
253	12.03	Regulator Review Draft Well Sealing Report	49 days	Thu 11/1/18	Wed 12/19/18
254	12.03	Prepare RTCs and Final Well Sealing Report	26 days	Thu 12/20/18	Mon 1/14/19
255	12.03	Receive ARNG and Regulatory Approval of Well Sealing Report	45 days	Tue 1/15/19	Thu 2/28/19
256	**13.01**	**Monthly Status Report**	**1432 days**	**Fri 9/4/15**	**Mon 8/5/19**
257	**13.01**	**Monthly Reports**	**1432 days**	**Fri 9/4/15**	**Mon 8/5/19**
318		**Biweekly Calls**	**1416 days**	**Mon 9/14/15**	**Tue 7/30/19**
424		**Coordination with REIMS Contractor**	**937 days**	**Wed 9/23/15**	**Mon 4/16/18**
427		**Periodic Progress/Technical Meetings**	**1413 days**	**Wed 9/23/15**	**Mon 8/5/19**
430		**Public Relations and Regulatory Support**	**1413 days**	**Wed 9/23/15**	**Mon 8/5/19**
433		**Management of IDW**	**476 days**	**Tue 12/27/16**	**Mon 4/16/18**
436		**Ongoing Personnel Security/Access Training**	**937 days**	**Wed 9/23/15**	**Mon 4/16/18**
439	**14**	**Manpower Reporting**	**1377 days**	**Mon 10/26/15**	**Fri 8/2/19**



Groundwater and Environmental Investigation Services
at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Mon 12/19/16

Task | Summary | Field Work Activities (Yellow)
Milestone | Critical | Progress

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Figure 8-1 Project Schedule (Continued)

ATTACHMENT 1 – PRELIMINARY PLUME GROUP MAP

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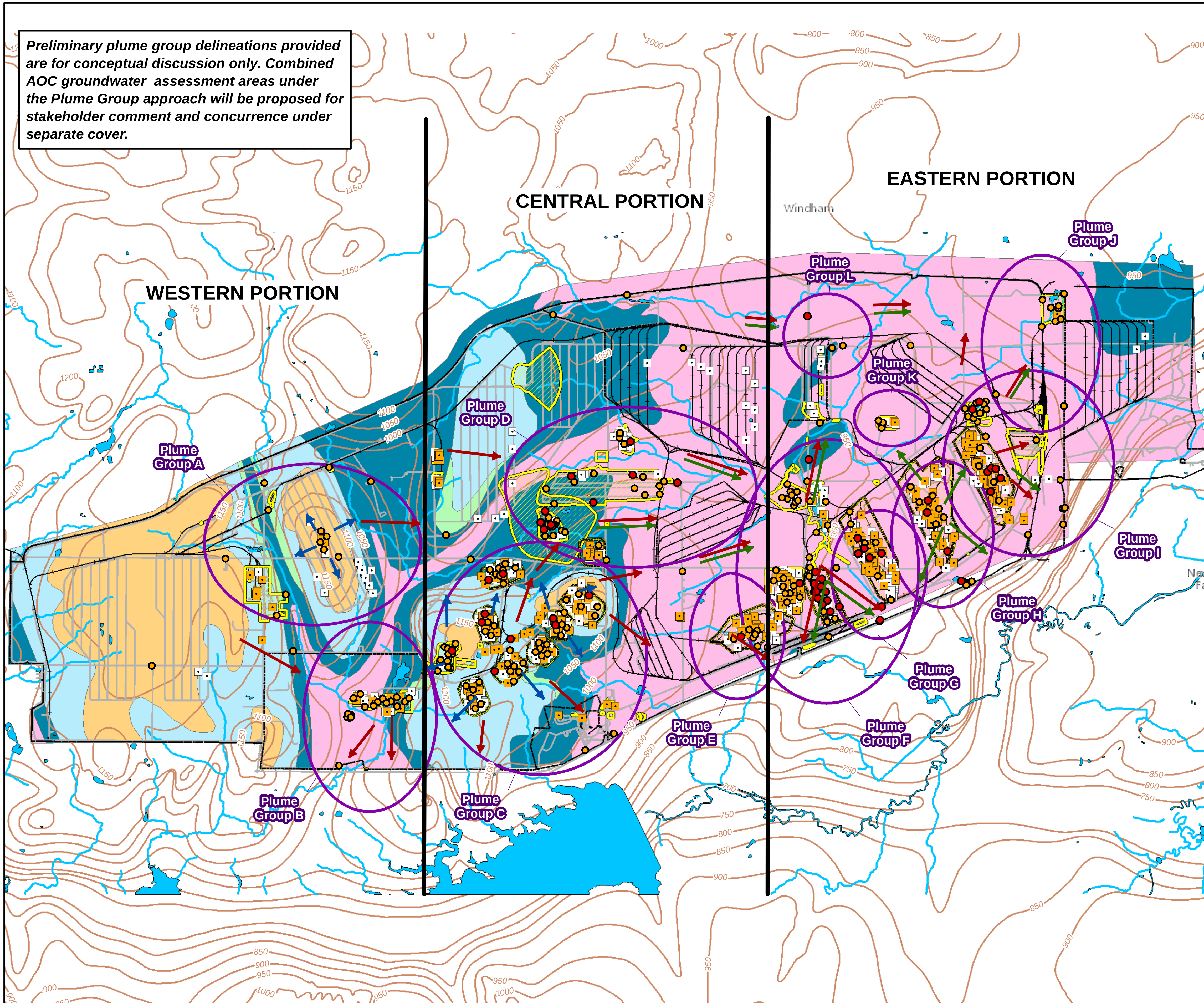

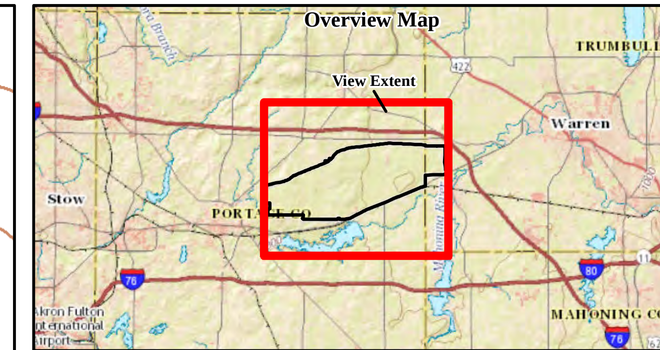

Legend

- Soil Sample Location > 1ft bgs
- Soil Sample Location < 1ft bgs
- Detected Groundwater Sample Concentration > Current Screening Level
- Groundwater Sample MDL > Current Screening Level
- Groundwater Sample MDL or Reported Concentration < Current Screening Level
- Plume Groups
- Direction of Groundwater Flow - Unconsolidated Aquifer (May 2014)
- Direction of Groundwater Flow - Upper Sharon Aquifer (May 2014)
- Direction of Groundwater Flow - Homewood Sandstone or Mercer

Geology Formation

- Homewood Sandstone
- Mercer Member
- Massillon Sandstone
- Sharon Member - Shale
- Sharon Member - Sandstone/Conglomerate

Base Layers

- AOCs
- Fenceline
- Roads
- Railroad
- Streams
- Water Bodies

Notes:
- Western/Central/Eastern Portions and indicated groundwater flow directions based on Facility Wide Groundwater Monitoring Program (FWGMP) reporting
- MDL = Method Detection Limit

N

0 2,500 5,000 7,500 10,000 Feet

1:60,000
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

GROUNDWATER EVALUATION PLUME GROUPS WITH 2014 ORGANIC COC RESULTS AND HISTORICAL SOIL SAMPLING LOCATIONS

Attachment 1

FINAL

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ATTACHMENT 2 – CAMP RAVENNA POLICY FOR INADVERTENT DISCOVERIES

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OHARNG Procedures for Inadvertent Discovery of Cultural Materials at Camp Ravenna Joint Military Training Center (taken from OHARNG ICRMP and modified for CRJMTC)

Contact(s): Kim Ludt, OHARNG Cultural Resources Manager, 614-336-6569
(Alternate contact, CRJMTC Environmental Office, 614-336-6568/6136)
CRJMTC Range Control 614-336-6041 or MARCS radio Channel #1

Scope: This Standard Operating Procedure (SOP) outlines the steps to be taken upon inadvertent discovery of human remains or artifacts at Camp Ravenna Joint Military Training Center (CRJMTC) during construction, demolition, training events, or other ground disturbing activities. If archaeological surveys or excavations become necessary as a result of the inadvertent discovery, they must be conducted by a person meeting the Secretary of Interior's professional qualification standards for archaeology. Anyone who does not meet these standards and engages in any excavations, including probing during metal detecting, shall be considered to be looting the cultural resources of CRJMTC and subject to prosecution under ARPA. This SOP is intended for all OHARNG personnel, contractors and users of CRJMTC.

Statutory Reference(s):

- Native American Graves Protection and Repatriation Act (NAGPRA) and its implementing regulation (43 CFR 10)
- Archaeological Resources Protection Act (ARPA)
- National Historic Preservation Act (NHPA) and its implementing regulation (36 CFR 800).

Procedures: In the event that artifacts or human remains are encountered, the ground disturbing activity should stop immediately and the following steps should be followed.

- Report any observations or discoveries of artifacts or human remains immediately to CRJMTC Range Control (614-336-6041 or MARCS radio Channel #1). Range Control will immediately notify the OHARNG Cultural Resources Manager (CRM)/CRJMTC Environmental Office.
- The Range Control or the CRM will secure any artifacts or human remains, as appropriate. If human remains are suspected, they are not to be disturbed and Range Control will promptly notify Ohio State Highway Patrol or Federal Bureau of Investigation, as appropriate.
- The CRM and Range Control will take measures to protect the location from further disturbance until appropriate parties are notified.
- If a concentration of artifacts or a burial site is identified as the source of materials discovered, the CRM will make arrangements for site recordation and stabilization, in consultation with the OHPO and any interested Native American tribes.
- Once the site has been cleared by the CRM and CRJMTC Range Control, the activity may resume. Depending on the findings, activities may be cleared to resume in 48 hours or up to 6 months.

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ATTACHMENT 3 – CAMP RAVENNA FIRST RESPONDER REPORTING FORM

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FIRST RESPONDER REPORTING FORM
(Print all information)

Collect as much of the information on the top half of this form as possible before making initial notification. Complete the top and bottom of the form before turning in to Camp Ravenna.

Name of individual reporting spill: ______________________________

When did the spill occur (Date and Time)? ______________________________

Spill Location (Building or area name / number, indoors or out; if vehicle involved, type and bumper number):
____

What was spilled? ____________________ **How much was spilled?** ____________________

Rate at which material is currently spilling. ______________________________

Extent of spill travel? ______________________________

Did the spill reach water (ditch, creek, stream, pond, well head)? ______________________________

Number of injured personnel and type injuries, if applicable. ______________________________

Do you need the Fire Department to respond to protect life, property, and environment? ____________________

Unit: ____________________ **State:** __________ **Report Date & Time:** ____________________

On Scene Coordinator Name and Grade: ____________________ **Phone:** ____________________

How did the spill occur (be specific). ______________________________

____

What remedial action was taken? ______________________________

____

Was soil and absorbent material generated? __________ **How much?** ____________________

What is the location of the soil and absorbents? ______________________________

Was the Environmental Office contacted (yes or No, date and time)? ______________________________

Who did you talk to in the Environmental Office? ______________________________

Was the site cleared by the Env. Office (Yes or No, date and time)? ______________________________

Who cleared the site (name and grade, date and time)? ______________________________

Initial information is critical. Get as much information as you can, but don't hesitate to make the initial notification if a spill is moving or worsening rapidly!

This form must be completed for all releases and turned-in to Camp Ravenna Range Control within 24 hours.

FIRST RESPONDER SPILL/RELEASE RESPONSE ACTIONS

Units or contractors performing training or other operations at Camp Ravenna shall be responsible for adhering to the provisions identified in the Camp Ravenna Integrated Contingency Plans (ICP). A copy of the ICP may be obtained from the Camp Ravenna Environmental Supervisor. Following discovery of a spill (any size), the procedures outlined below shall be executed where applicable:

1. **If necessary, initiate evacuation of the immediate area.**

2. **Notify Camp Ravenna Range Control via two-way radio or by calling (614) 336-6041, and report information contained on the "First Responder Reporting Form" if it is known or can reasonably be determined. This form has been copied on the opposite side of this page. If Range Control cannot be reached, contact a Camp Ravenna OSC (listed below).**

3. **Stop spill flow when possible without undue risk of personal injury.**

4. **If trained, contain the spill using available spill response equipment or techniques.**

5. **Make spill scene OFF LIMITS to unauthorized personnel.**

6. **Restrict all sources of ignition when flammable substances are involved.**

7. **Report to the OSC upon his/her arrival to the scene.**

8. **Turn in a completed copy of the Camp Ravenna First Responder Form to Camp Ravenna Range Control for ALL releases, even ones cleaned up by the reporter.**

TELEPHONE NUMBER

When **Camp Ravenna Range Control** is ***not available*****, the Camp Ravenna OSC** ***must be contacted*** **by the discoverer/first responder following a release if it is in water, at or above a reportable quantity (25 gallons or more of POL), a hazardous or extremely hazardous substance, a hazardous waste, or involves fire, explosion, or is otherwise a major incident.**

NAME	JOB TITLE	OFFICE	24 HOUR
Camp Ravenna Range Control	Operations and Training	(614)336-6041	(614) 202-5783
Tim Morgan (Primary OSC)	Environmental Supervisor	(614)336-6568	(330)322-7098
Brad Kline (Alternate OSC)	Environmental Specialist	(614)336-4918	Contact Alternate
Katie Tait (Alternate OSC)	Environmental Specialist	(614)336-6136	Contact Alternate
Joint Forces Command (Alternate POC)	OHARNG Emergency Center	(888)637-9053	(888)637-9053

Off-site (from Camp Ravenna area code 614 phones)

Ravenna Dispatch ...……………………………………..…. 9-1-330 296-6486

SEE REVERSE FOR FIRST RESPONDER REPORTING FORM

APPENDIX A

SAMPLING AND ANALYSIS PLAN

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APPENDIX A.1

FIELD SAMPLING PLAN

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Revised Final

Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Monitoring

Appendix A: Sampling and Analysis Plan, A.1 – Field Sampling Plan

Former Ravenna Army Ammunition Plant

Portage and Trumbull Counties, Ohio

December 21, 2016

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Prepared for:

National Guard Bureau

NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture

2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

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LIST OF ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
ARNG	Army National Guard
ASTM	American Society for Testing and Materials
bgs	below ground surface
Camp Ravenna	Camp Ravenna Joint Military Training Center
CAS	Chemical Abstract Services
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
cm	centimeter
COC	chain-of-custody
CRS	Compliance Restoration Site
DERP	Defense Environmental Restoration Program
DFFO	Director's Final Findings and Orders
DLA	Defense Logistics Agency
DO	dissolved oxygen
DoD	Department of Defense
DOT	Department of Transportation
DRMO	Defense Reutilization Marketing Office
EC	electrical conductivity
EM	Engineering Manual
FS	Feasibility Study
FSP	Field Sampling Plan
ft	feet/foot
FTL	Field Team Leader
FWGW	Facility-Wide Groundwater
FWQAPP	Facility-Wide Quality Assurance Project Plan
FWSAP	Facility-Wide Sampling and Analysis Plan
H&S	health and safety
hr	hour
IDW	investigation-derived waste

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

INRMP	Integrated Natural Resources Management Plan
LDR	Land Disposal Restriction
m	meter
m^2	square meter
MEC	munitions and explosives of concern
mg/L	milligrams per liter
mL/min	milliliters per minute
mm	millimeter
MRS	munitions response site
NAD	North American Datum
NGB	National Guard Bureau
NSF	National Sanitation Foundation
NTU	nephelometric turbidity unit
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
ORP	oxidation reduction potential
OSHA	Occupational Safety and Health Administration
OSP	Ohio State Plane
P.E.	Professional Engineer
P.G.	Professional Geologist
PID	photoionization detector
PM	Project Manager
PMP®	Project Management Professional
POC	point of contact
PP	Proposed Plan
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
REIMS	Ravenna Environmental Information Management System
RI	Remedial Investigation
RIWP	RI Work Plan

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

ROD	Record of Decision
RVAAP	Former Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
TCLP	Toxicity Characteristic Leaching Procedure
TEC-Weston JV	TEC-Weston Joint Venture
TLPE	Teflon™-lined polyethylene
TO	Task Order
TSDF	Treatment, Storage, and Disposal Facilities
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

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1.0 PROJECT DESCRIPTION

This Field Sampling Plan (FSP) is A.1 of the Sampling and Analysis Plan (SAP) is an addendum to the *Facility-Wide Sampling and Analysis Plan for Environmental Investigations (FWSAP)* (SAIC, 2011a). The FWSAP was developed in accordance with the United States Army Corps of Engineers (USACE) and Ohio Environmental Protection Agency (Ohio EPA) guidance documents to meet the requirements for the investigation of known or suspected contaminated sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Resource Conservation and Recovery Act (RCRA); and other federal or state regulations that govern environmental restoration activities at the Former Ravenna Army Ammunition Plant (RVAAP), now known as the Camp Ravenna Joint Military Training Center (Camp Ravenna). The FWSAP established the methods and procedures to characterize Areas of Concern (AOCs), compliance restoration sites (CRSs), and munitions response sites (MRSs) at Camp Ravenna. As this document refers to "AOCs" throughout, this term is inclusive of CRSs and MRSs.

The FSP, prepared by the TEC-Weston Joint Venture (TEC-Weston JV) for the Facility-Wide Groundwater (FWGW) Remedial Investigation (RI), details the expected sampling methods, equipment, and procedures; sample custody/documentation requirements; sample packaging, shipping, and handling requirements; management of investigation-derived waste (IDW); chemical quality control (QC) requirements; field documentation; data reporting; and corrective actions.

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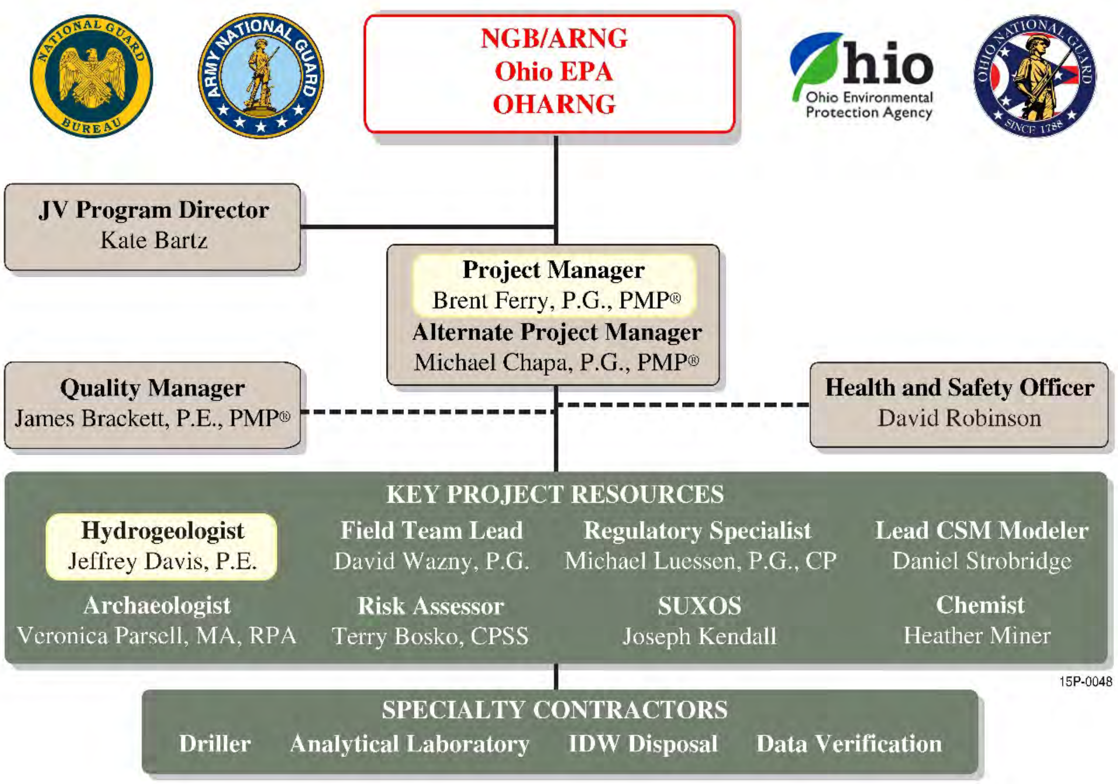
2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

A Project Management organization has been established in response to the Performance Work Statement requirements, as shown on **Figure 2-1**. Qualifications and responsibilities of the key TEC-Weston JV personnel are detailed below.

Figure 2-1. Project Organizational Chart



JV Program Director, Ms. Kate Bartz, who has supported several National Guard Bureau (NGB) contracts over the last 20 years, will lead the JV Team in the Task Order (TO). She will serve as the primary point of contact with the Army National Guard (ARNG) for overall NGB Programmatic issues and will always be available to the ARNG Program Manager and other ARNG staff in the unlikely event of performance issues.

Project Manager (PM), Brent Ferry, Professional Geologist (P.G.), Project Management Professional (PMP®), is the direct line of communication to the NGB PM and will be responsible for schedule, subcontractors, invoicing, manpower, and deliverables. Mr. Ferry will be the primary point of contact (POC) for the Contracting Officer's Representative for this TO. He has over 15 years of experience managing complex projects for the Department of Defense (DoD) throughout the country, including RI/Feasibility Study (FS)/Proposed Plan (PP)/Record of Decision (ROD) actions with expertise in risk-based closure following the RI. Mr. Ferry will be responsible for all aspects of managing the TO, including assigning/removing/directing staff, selecting subcontractors, managing budget/schedule, ensuring quality and health and safety (H&S), and overseeing preparation of deliverables. Mr. Ferry will also review training records and credentials to ensure TEC-Weston JV Team field personnel are qualified and proficient in field activities.

James Brackett, Professional Engineer (P.E.), PMP®, will be the Project Quality Manager responsible for development and implementation of the Quality Assurance (QA)/QC Program during the TO. He will ensure all planning documents prescribe defensible procedures for implementation during all work phases, and will provide overall QA/QC reviews of the primary deliverables.

David Robinson is the Project Health and Safety Officer on this TO. Mr. Robinson has more than 25 years of experience in industrial hygiene, health and safety, and environmental science. His experience includes developing environmental health and safety programs, including hazard communications, PPE, respiratory protection, and hearing conservation, for numerous projects. He has conducted industrial hygiene and safety assessments and audits at more than 100 facilities.

Heather Miner is the Project Chemist. Ms. Miner has 13 years working on federal environmental restoration projects and has served as Project Chemist for NGB Installations and Mission Support Directorate Operations, Division, Restoration Branch, United States (U.S.) Army, U.S. Navy and U.S. Air Force indefinite delivery, indefinite quantity contracts since 2002. Ms. Miner will manage the subcontract laboratory and data verification company and interface with the subcontractor PMs to ensure analytical chemistry deliverables meet QA and data quality objectives.

Dave Wazny, P.G., is the Field Team Leader (FTL) who is responsible for overseeing field efforts, managing local subcontractors, and helping to support compliance with local regulatory requirements. The FTL communicates requirements between the TEC-Weston JV PM and the field team.

3.0 SCOPE AND OBJECTIVES

This FSP is for FWGW RI at Camp Ravenna located in Portage and Trumbull Counties. The FSP sets forth the site-specific planning and guidance document to govern the fieldwork portions of the FWGW RI under this TO. This document will be utilized by the field sampling team to ensure this effort meets the specified project quality objectives for the TO. This project is contracted by NGB under Contract W9133L-14-D-0008, Task Order 0003, in support of the Compliance Restoration Program.

All activities conducted under this contract will be in accordance with the following guidance documents:

- Defense Environmental Restoration Program (DERP) Manual (DoD, 2012).
- Technical Guidance Manual for Ground Water Investigations, Chapter 10, Ground Water Sampling (Ohio EPA, 2006).
- Regulations and Technical Guidance for Sealing Unused Water Wells and Boreholes (Ohio Water Resources Council, 2015).
- Technical Guidance Manual for Ground Water Investigations, Chapter 9, Sealing Abandoned Monitoring Wells and Boreholes (Ohio EPA, 2009a).
- Facility-Wide Groundwater Monitoring Program Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio (Portage Environmental, 2004).
- FWSAP (SAIC, 2011a).

3.1 FACILITY WIDE SCOPE AND OBJECTIVES

NGB primarily conducts environmental restoration activities in accordance with DERP and CERCLA. NGB may also conduct activities in accordance with RCRA and other applicable federal, state, interstate, and local requirements. In accordance with 2701(b) of Title 10 United States Code and DERP, the facility-wide scope and objectives include:

- The identification, investigation, research and development, and cleanup of contamination from hazardous substances and pollutants or contaminants;
- The correction of other environmental damage (such as detection and disposal of unexploded ordnance) which creates an imminent and substantial endangerment to the public health or welfare or to the environment; and

- Response actions to correct this damage will normally be conducted in accordance with CERCLA, National Oil and Hazardous Substances Pollution Contingency Plan, and Executive Order 12580, “Superfund Implementation,” January 23, 1987, as amended.

Specific DERP regulations are documented in the DERP Manual (DoD, 2012).

3.2 FWGW RI SCOPE AND OBJECTIVES

The primary goal of the FWGW RI is to adequately characterize pertinent physical and chemical groundwater conditions in the multi-aquifer hydrostratigraphic units variably present across Camp Ravenna, so that potential risks posed by impacted groundwater (current and future) to human and environmental receptors can be ascertained, effectively managed, and mitigated as needed.

The primary field activities associated with executing the FWGW RI are site reconnaissance, well inspections, well installations, well development and redevelopment, total depth and water level measurements, well surveying, well sampling, and well abandonment.

4.0 FIELD ACTIVITIES

All field activities will be conducted in accordance with the procedures and specifications outlined in the FWSAP, and amended herein. The specific field activities for the FWGW RI are listed below with references to their corresponding section of the FWSAP. Field forms are included in **Attachment A**.

4.1 PREPARATORY ACTIVITIES

4.1.1 Wetlands Delineation and Stream Management Avoidance

Wetlands are present in the vicinity of some of the well abandonment sites, and may be present at potential monitoring well installation locations. In addition, trees may need to be removed at some locations as described in the following subsection. To assure wetlands avoidance, a wetlands biologist will demarcate the wetlands in the temporary access routes to each well site prior to beginning tree clearing operations. The wetlands biologist will perform a verification site visit prior to the start of installation/abandonment operations to verify that temporary access routes avoid wetlands. If any new wetland areas are observed during the verification visit, access routes may be altered to avoid these areas. If a stream or ditch must be temporarily crossed to access a well location, crane mats will be used to avoid disturbing these areas. The Contractor will make every attempt to also conduct well abandonment and installation activities in dry weather to avoid impacts to wetlands.

4.1.2 Management Considerations for Northern Long Eared Bat

All field activities must comply with Northern Long Eared Bat management practices, which require the marking of trees and brush 3-inches in diameter or greater for removal, and Ohio Army National Guard (OHARNG) approval by the Camp Ravenna Environmental Office. It is required to flag and coordinate access routes and trees/brush to be removed prior to cutting. Once approved, cutting may occur between 1 October and 31 March.

4.1.3 Cultural Resources Management

A large portion of the facility has been surveyed for cultural and archaeological resources. In the unlikely event that archaeological or cultural resources are identified during work activities, sites will be handled in accordance with the OHARNG *Procedures for Inadvertent Discovery of*

Cultural Materials at Camp Ravenna (OHARNG, 2014a) provided as Attachment 2 of the Remedial Investigation Work Plan (RIWP). All FWGW RI fieldwork locations involving new monitoring well installations will first be assessed and included in the pending Phase I Archaeological Survey Work Plan for the FWGW RI, as needed, based on completed cultural resource surveys.

4.2 MOBILIZATION

Field activities will be coordinated with the ARNG/OHARNG and Ohio EPA prior to fieldwork. Activities such as utility clearance will be coordinated through the Camp Ravenna DPW Office (Engineering). Access rosters will be sent to the Camp Ravenna Operations/Security Office via Vista Sciences for approval no later than 48 hours prior to start of work, and will coincide with the duty days and hours of the facility (Monday-Friday 0730 to 1630) as outlined in the Contractor Information, April 2014. If extended work schedules are required, a request will be made to the ARNG and OHARNG, who will submit the request to Camp Ravenna Range Control for approval. The JV will also work with the OHARNG/ARNG to locate equipment staging areas and coordinate activities with other site contacts. The area near Building 1036 has been identified by OHARNG as the main staging and storage area during the well drilling and abandonment activities. In the event that another location is needed for storage during these activities, field personnel will coordinate with the Camp Ravenna Operations office to minimize potential impacts to the daily facility operations. Equipment and materials to be used during these activities include, but may not be limited to the following: blade trimmers, chain saws, brush cutters, drill rigs, large trucks, tanks, and drums. During field activities, TEC-Weston JV will keep in close contact and will coordinate field locations with Camp Ravenna Range Control and the Camp Ravenna Environmental Office.

4.2.1 Utility Clearance

Some anticipated activities associated with the well drilling and abandonment tasks will have the potential for exposing or contacting subsurface utilities. TEC-Weston JV will contact the Ohio Utilities Protection Service (for wells outside of the perimeter fence) at least 48 hours, but no more than 10 working days, before beginning intrusive field activities. The Contractor will prepare a map of the well locations and present it to the Camp Ravenna Director of Public Works

Operations office for utility clearance. TEC-Weston JV will coordinate with the Camp Ravenna Operations office as outlined in the Contractor Information, April 2014 to locate and mark areas of anticipated subsurface impact.

4.2.2 Unexploded Ordnance Avoidance

For environmental field activities within MRSs or in other areas where munitions and explosives of concern (MEC) hazards may reasonably be expected (e.g., former ordnance disposal sites), MEC avoidance protocols will be implemented as outlined in Sections 3.0 and 10.16 of the FWSHP (SAIC, 2011b). Unexploded ordnance personnel will survey the area (visual and instrument-assisted) prior to work, establish appropriate controls, and accompany field teams during project execution.

4.2.3 Vegetation Removal

To gain access as necessary to implement the well drilling and abandonment procedures, vegetation will be cleared along some of the temporary access routes. Vehicles capable of off-road travel will be used to avoid disturbing the ground surface to the extent possible. As previously noted, vegetation removal will also adhere to the cutting restrictions developed for the Northern long-eared bat. All clearing activities will be performed to minimize erosion and sedimentation in accordance with federal, state, and facility regulations.

Access routes to the well locations will be cleared using a brush cutter and other relevant above grade vegetation removal equipment. A chainsaw or the equivalent will be used for the felling of trees. In accordance with facility requirements, all 8.5 feet (ft) and longer straight portions of hardwood and conifer trees, as measured from an 18-inch stump height to a 10-inch diameter outside of bark top will be felled, limbed flush to the tree bole, and neatly stacked in a location designated by OHARNG to be salvaged as sawtimber. All other hardwood trees shorter than 8.5 ft, or with diameters greater than 3 inches, or trees that are too crooked or deformed to be used as sawtimber, will be cut into lengths of 4.5 or 9 ft and will be salvaged and placed in a location designated by OHARNG to be used as firewood/biomass. All non-sawtimber portions of felled conifers and small portions of hardwoods along with all other woody brush not salvaged for firewood/biomass will be chipped, blown into trucks, and transported to a designated area at Camp

Ravenna. Stumps from felled trees will be cut as low to the ground surface as possible to facilitate the passing of vehicles during the abandonment process.

Following the completion of well installation/abandonment activities, TEC-Weston field personnel will ensure the re-vegetation of any small areas of soil disturbance in compliance with the *Integrated Natural Resources Management Plan (INRMP) at the Camp Ravenna Joint Military Training Center, Portage and Trumbull Counties, Ohio* (OHARNG, 2014b). Erosion controls will be maintained until the site work is completed and 70% of the area is revegetated.

4.2.4 Well Locating

Prior to well drilling and well installation/abandonment activities, the work locations will be confirmed and coordinated during site walk activities with the use of geospatial data. For the well abandonment tasks, if wellheads are determined to be buried, the buried well casings will be exposed by excavating up to 4 ft of soil cover using hand tools, a small excavator, or a backhoe. If the well casing is not encountered within the top 4 ft of soil, the OHARNG will be contacted to discuss the appropriate measures to be taken.

4.2.5 Wellhead Clearing

Wells to be installed, abandoned, or maintained may require heavy equipment to clear the existing structures surrounding the wellhead.

All equipment and materials for these processes will be brought as close to the well as possible; however, in the instances where this may not be possible, due to the steepness of the terrain for example, other measures may be employed to gain access. Equipment such as all-terrain vehicles, skid steers, and other relevant equipment may be used to access the wellheads. At locations where grout mixing equipment is not able to access the wellhead, hoses will be used to pump the grout from the mixing location to the wellhead.

Any soil disturbing activities will proceed in a manner to reduce the risk of erosion and sedimentation in accordance with the INRMP**.** All earthwork, grading, movement of equipment, and other operations, will be planned and performed to avoid pollution or sediment discharge into adjacent waters. Where necessary, and in accordance with the INRMP, silt fence will be installed at well locations where disturbance will be greater than 15 square meters (m^2). The fence will be inspected on a weekly basis as necessary to ensure its integrity and will be replaced or repaired as needed. The storm water inspection form is provided in **Attachment A**. The total areas that will be disturbed during field activities are not anticipated to be greater than one acre. This *de minimus* impact is less than the minimum acreage required by the Ohio EPA for Small Construction Projects (Ohio EPA, 2015). Best management practices for storm water will be utilized and a formal Storm water Pollution Prevention Plan will not be required. In areas less than 15 m^2 straw bales/sandbags may be used, as necessary, to intercept potential runoff at the well locations during any surface preparation or abandonment activities.

4.3 PERMANENT GROUNDWATER MONITORING WELL INSTALLATION

All new bedrock wells installed where an unconsolidated aquifer overlies the bedrock, or where a shallower bedrock aquifer overlies the targeted deeper bedrock aquifer, will be installed using a sonic rig with the drill casing utilized to seal off upper water-bearing zones from deeper screened zones. **Figure 4-1** illustrates the basic sonic multicase system that will be utilized for monitoring well installation. **Figure 4-2** illustrates how the casing will be utilized to seal the well across multiple water-bearing units. Sonic drilling allows a larger diameter temporary casing to be set into a confining layer while drilling proceeds into deeper aquifers. This temporary casing will then be removed during the grouting operation.

Figure 4-1. Sonic Multicase System

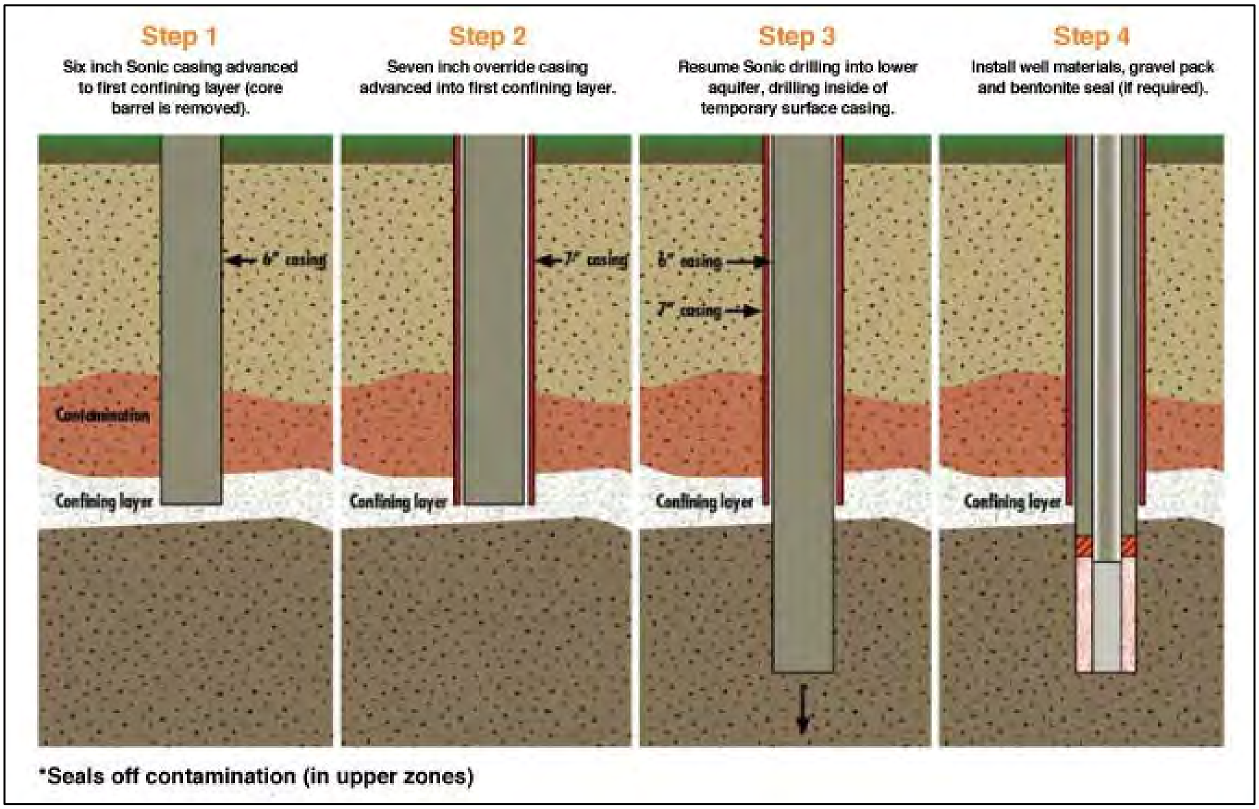
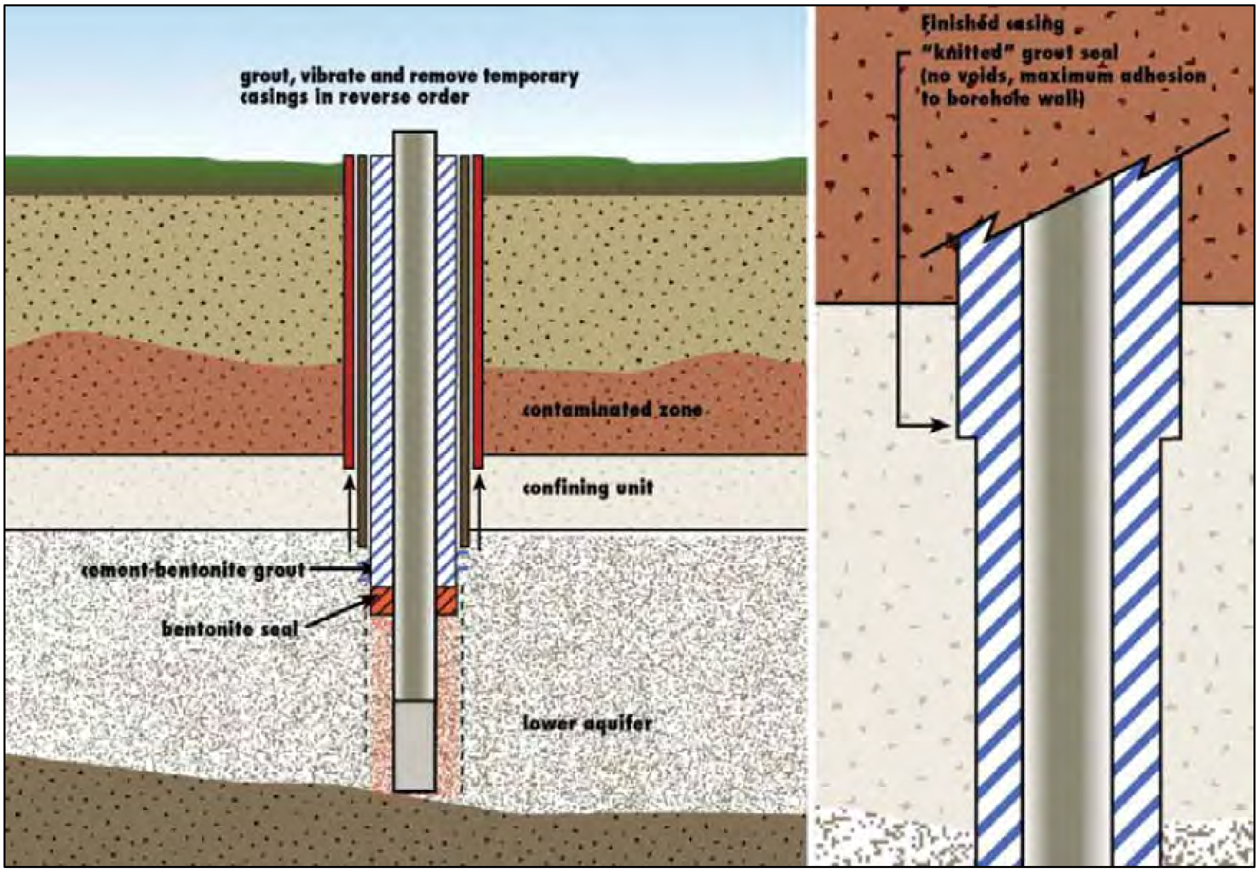


Figure 4-2. Well Sealing Across Multiple Water-Bearing Units



If sonic drilling methods are determined to be impractical, then hollow stem auger or air rotary drilling methods will be used for monitoring well installation. These drilling methods are described in Section 5.5.2.1 of the FWSAP.

Prior to the field activities, the FTL will submit the Granular Filter Pack Approval Form, Bentonite Approval Form, and Water Approval Form (**Attachment A**) to the ARNG/OHARNG. Section 2.2 of the RIWP specifics the number, depth, and location of each monitoring well that will be installed.

The Monitoring Well Construction Diagram Form and Monitoring Well Sealing Report (**Attachment A)** will be used to document monitoring well installation.

4.3.1 Construction Materials

4.3.1.1 Monitoring Well Casing and Screen

Following guidance of the FWSAP (Section 5.4.2.2.1), the casing, screen, and fitting materials to be used for monitoring well construction during the investigations will be composed of new, pre-cleaned, 5.0-centimeter (cm) (2.0-inch) rigid Schedule 40 or Schedule 80 polyvinyl chloride (PVC). Screen sections will be commercially fabricated and slotted with openings equal to 0.025 cm (0.010 inches). Screen and casing sections will be flush threaded, and thermal or solvent welded couplings will not be used. Gaskets, pop rivets, and screws will not be used during monitoring well construction. Pre-packed screens will be used for intervals that cannot be filter-packed conventionally.

All materials used for monitoring well construction will be as chemically inert as technically practical with respect to the environment. All PVC screens, casings, and fittings will conform to National Sanitation Foundation/American National Standards Institute Standard 14 (NSF, 2009) for potable water usage or the *Annual Book of ASTM Standards* (American Society for Testing and Materials [ASTM], 1995) and will bear the appropriate rating logo. Additional specifications are provided in the *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells* (U.S. Environmental Protection Agency [USEPA], 1991).

The well caps and centralizers used for monitoring well construction will be composed of new, pre-cleaned PVC. The tops of all new monitoring well casings associated with well installations will be covered with water-tight expandable-flange locking well caps. The caps will be fitted to the casings and will be designed to preclude binding to the casing resulting from tightness of fit, unclean surface, or frost and to allow for equilibration between hydrostatic and atmospheric pressures. The caps will be designed to fit securely enough to preclude debris and insects from entering the monitoring well.

Well centralizers will be used in construction of all monitoring wells that are installed within open boreholes exceeding approximately 6.1 meters (m) (20.0 ft) in depth to prevent the PVC well casing from deforming. Well centralizers will be attached to the well casing at regular and equal intervals with stainless steel fasteners or strapping. Centralizer placement will be determined in the field at the time of monitoring well installation based on the total depth of each well.

Centralizers will not be attached to well screens or to portions of well casings exposed to the granular filter pack or bentonite seal. Centralizers will be oriented to allow unrestricted passage of the tremie pipe used to place monitoring well construction materials within the annular space between the well and the borehole wall.

4.3.1.2 Filter Pack, Bentonite and Grout

Following guidance of the FWSAP (Section 5.4.2.2.2), the granular filter pack used during the investigations for monitoring well installation will comply with requirements defined in the *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites* (USACE, 1998) and will be approved by the ARNG/OHARNG prior to beginning fieldwork with the Bentonite Approval Form and (if needed) Water Approval Form included in **Attachment A**. Based on the screen slot size of 0.025 cm (0.010 inches) to be used for monitoring well construction, the granular filter pack material used will generally be Global Supply No. 7 (size equals 0.047 cm [0.0188 inches]) sand. Global Supply No. 5 alternately may be used with prior approval from the ARNG/OHARNG and Ohio EPA if conditions warrant.

The granular filter pack material will be visually clean, free of material that would pass through a No. 200 sieve, inert, siliceous, and composed of rounded grains. The filter pack material will be approved by the ARNG/OHARNG prior to beginning fieldwork with the Granular Filter Pack Approval Form and (if needed) Water Approval Form included in **Attachment A**. The filter material will be packaged in bags or buckets by the supplier and delivered. Filter pack material in pre-packed screens also will meet these criteria.

Bentonite will be used during the investigations for one or more of the following purposes:

- Creation of an annular seal during monitoring well construction between the granular filter pack and the grout seal;
- Additive in the grout mixture used to create the upper grout seal during monitoring well construction;
- Additive in the grout mixture used to abandon boreholes not converted into monitoring wells; and/or
- Abandonment of surficial boreholes and pilot holes.

4.3.2 Installation

4.3.2.1 Soil Sampling and Rock Coring During Drilling

Following guidance of the FWSAP (Section 5.4.2.3.2), all rock coring will be conducted in a manner to obtain maximum intact recovery of bedrock. The minimum core size will be "N" series, which is 50.0 millimeters (mm) (2.0 inches) in diameter. The Geologic Borehole Log (**Attachment A**) will be used to document rock coring activities in the field.

To the extent possible, bedrock coring/drilling activities will be accomplished without adding potable water. Any water lost to the formation will be removed from the formation during well development at 5 times the amount lost to the formation.

4.3.2.2 Borehole Diameter and Depth

Each borehole will be 6-10 inches in diameter and advanced to the depth specified in Section 2.2 of the RIWP. If sufficient groundwater to support a functional monitoring well is found to be present in the borehole, a monitoring well will be constructed. However, if insufficient groundwater is found to present, the borehole will be abandoned per procedures in the Well Abandonment Work Plan, which is submitted under separate cover.

4.3.2.3 Screen and Well Casing Placement

Monitoring wells will be installed per guidance in Chapter 5 of the *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites* (USACE, 1998). All screens used for monitoring well construction will be installed such that the bottom of each well screen is placed no more than 0.9 m (3.0 ft) above the bottom of the drilled borehole. The screen bottom will be securely fitted with a threaded PVC cap. The threaded cap will be within 15.2 cm (6.0 inches) of the open portion of the screen. The standard length of screen used for all Camp Ravenna monitoring wells will be 3.0 m (10.0 ft). The casing used to construct above-grade monitoring well installations will be of sufficient length to allow for 0.7 m (2.5 ft) of the casing to extend above the ground surface. The casing used to construct flush-mounted monitoring well installations will be of sufficient length to allow for location of the casing top 5.0 cm (2.0 inches) below ground surface (bgs). Silt traps that extend below the screen will not be used. The top of each installed monitoring well casing will be level so that the difference in elevation between the highest and lowest points on the top of the well casing is less than or equal to 0.6 cm (0.2 inches). The north side of the casing will be marked or etched in an identifiable manner.

4.3.2.4 Filter Pack Placement

Following guidance of the FWSAP (Section 5.4.2.3.5), approved granular filter pack material used for monitoring well construction will be placed within the annular space around the monitoring well screen. If approved water is used to place the filter pack, the amount of this water will be recorded and added to the volume of water to be removed during well development. The filter pack will extend from the bottom of the borehole to 0.9 m (3.0 ft) above the top of the well screen. In addition, 15.2 cm (6.0 inches) of filter pack will be placed under the bottom of the well screen to provide a firm footing. The final depth to the top of the filter pack will be measured directly with a weighted tape and recorded. The filter pack will be surged to compact the filter pack to ensure no settlement of the filter pack during development.

4.3.2.5 Bentonite Seal

Following guidance of the FWSAP (Section 5.4.2.3.6), the type of bentonite material used to construct monitoring well seals will be composed of commercially available pellets or chips. Bentonite seals will be from 0.9 to 1.5 m (3.0 to 5.0 ft) thick, as measured immediately after placement, without allowance for swelling. Granular bentonite may be an alternative if the seal is set in a dry condition. Tremie pipes are not recommended for installing bentonite. A weighted tape will be used to prevent bridging during placement and to measure bentonite. A small volume of approved water will be used to hydrate the pellets, and the hydration time for the pellets will be a minimum of 1 hour (hr). The bentonite seal should be placed in 0.15- to 0.3-m (6-inch to 1-ft) lifts, with each lift hydrated for a period of 30 minutes, rather than installing the entire seal at one time. An adequate bentonite seal should be allowed to form (ideally waiting overnight) before placing the grout to protect the screen and filter pack from downhole grout. The final depth to the top of the hydrated bentonite seal will be measured directly with a weighted tape and recorded.

4.3.2.6 Cement and Bentonite Grout Placement

Following guidance of the FWSAP (Section 5.4.2.3.7), all prescribed portions of grout material used for monitoring well construction will be combined in an above-ground rigid container and mechanically blended to produce a thick, lump-free mixture throughout the mixing vessel. The grout will be placed from within a decontaminated rigid side discharging grout tremie pipe, initially located just over the top of the bentonite seal, in such a manner as to minimize disturbance of the seal.

Before exposing any portion of the borehole above the seal by removal of any surface casings (includes hollow-stem augers and temporary surface casings such as sonic drill tooling), the annulus between the surface casing and well casing will be filled with sufficient grout to allow for planned surface casing removal. If all surface casing is to be removed in one operation, the grout will be pumped through the grout pipe until undiluted grout flows from the annulus at the ground surface. During the surface casing removal, the grout pipe will be periodically reinserted as needed for additional grouting.

If the surface casing is to be incrementally removed with intermittent grout addition, the grout will be pumped through the grout pipe until it reaches a level that will permit at least 3.0 m (10.0 ft) of grout to remain in the annulus after removing the selected length of surface casing. Using this method, the grout pipe will be reinserted only to the base of the casing yet to be removed before repeating the process. After grouting has been completed to within approximately 3.0 m (10.0 ft) of the ground surface, the remaining surface casing will be removed from the borehole and the remaining annulus will be grouted to 1.5 m (5 ft) bgs.

Grout for monitoring wells to be completed both as above-grade and flush-mounted well installations will be added until it is present at 1.5 m (5 ft) bgs.

When initiating the grouting operation, the process will be conducted continuously until all of the hollow-stem augers and temporary surface casings such as sonic drill tooling, if present, have been removed and all annular spaces are grouted to the required levels as noted above. After 24 hrs, the well will be checked for grout settlement, and more grout will be added at that time to fill any depression. This process will be repeated until firm grout remains within 1.5 m (5 ft) of the ground surface. Incremental quantities of grout added in this manner will be recorded on the well construction diagram.

4.3.2.7 Protective Cover and Well Pad Placement

Following guidance of the FWSAP (Section 5.4.2.3.8), a 0.15-cm (6-inch) protective iron/steel casing will be installed around each monitoring well the same day as the initial grout placement around the well. The protective casing's exterior will be pre-primed before being brought to Camp Ravenna. The protective casing used for above-grade well installations will be set approximately 1.5 m (5 ft) below grade and will extend approximately 0.9 m (3 ft) above the ground surface. The protective casing used for flush-mounted well installations will be set approximately 1.5 m (5 ft) bgs with the top of the casing flush to grade. All protective casings will be installed so that the distance between the top of the protective casing and the top of the well casing is no more than 6.0 cm (2.4 inches).

For monitoring wells constructed as flush-mounted well installations, the remaining annulus formed between the outside of the protective casing and borehole, or permanent surface casing if present, will be filled to the ground surface with concrete on the day that firm grout is found to be present in the borehole. A sloping concrete pad measuring approximately 0.76 by 0.76 m^2 (30 by 30 $inches^2$) will be poured around the exterior of the protective flush-mount casing. Concurrently, an internal mortar collar will be poured within the annulus between the protective casing and the well casing from the top of the firm grout to approximately 2.5 cm (1.0 inch) below the top of the well casing. The mortar mix will be (by weight) one part cement to two parts sand, with minimal approved water for placement.

For monitoring wells constructed as above-grade well installations, the mortar collar will be poured on the day firm grout is found in the borehole. The mortar collar will be poured within the annulus between the protective casing and the well casing from the ground surface to approximately 15.2 cm (6.0 inches) above the ground surface. After placing the mortar collar, the remaining annulus formed between the outside of the protective casing and the borehole, or permanent casing if present, will be filled with concrete to the ground surface and extended onto the apron around the well head to form a square-cornered concrete pad measuring approximately 0.91 by 0.91 m^2 (36 by 36 $inches^2$) with either fiber concrete utilized or rebar placed in the center of the pad for stability.

For flush-mounted installations, the pad will be sloped away from the casing and recessed into the ground approximately 12 cm (0.5 ft). For both types of installations, the thickness of each concrete pad will be uniform and no less than 10.2 cm (4.0 inches). Following placement and curing of the concrete pad, a drainage port measuring approximately 0.6 cm (0.25 inches) in diameter will be drilled into the above grade protective casing 0.3 cm (0.12 inches) above the top of the internal mortar collar.

Once the protective cover for above-grade well installations is in place, a minimum of three, preferably four, steel guard posts will be radially located 1.2 m (4.0 ft) around each monitoring well. The guard post length will be 1.8 m (6.0 ft), approximately 0.6 m (2.0 ft) of which will be set in cement below ground level. All of the guard posts, as well as the steel protective casing, including the hinges and cover/cap, will be painted high visibility yellow with a paint brush and will be completely dry before sampling of the well. Monitoring wells with slip-joint aluminum covers do not require painting.

4.3.2.8 Well Identification

Following guidance of the FWSAP (Section 5.4.2.3.9), for each monitoring well installed during the investigations, the well designation number will be painted, using black paint, on the outside of the protective casing (after application and drying of the yellow paint), and/or a metal tag bearing the designation will be attached to the protective casing or well casing depending upon the type of installation (e.g., above-grade or flush-mounted). The well designation number may also be stamped or etched into the monitoring well lid.

At AOCs where no existing monitoring wells are present, wells installed during the investigations will be numbered consecutively beginning with the designation XXXMW-001 (XXX = AOC designator). At AOCs where existing monitoring wells are present, wells installed during the investigations will be numbered consecutively beginning with the next highest unused number (i.e., if four existing wells designated as XXXMW-001 through XXXMW-004 are present, then numbering of the new investigation wells would begin with XXXMW-005). Boreholes drilled for monitoring well installation, but subsequently abandoned, also will be numbered consecutively beginning with the designation XXXSB-001. If boreholes previously have been drilled at the AOC, then numbering will begin with the next highest unused number. The well identification system will be consistent with the location/sample identification naming convention specified in Section 5.3 of this document.

4.4 TEMPORARY GROUNDWATER MONITORING WELLS

Temporary wells will also be installed as part of the investigation. These wells will be installed using one of the approved drilling methods discussed above or by using direct push technology (DPT). DPT involves driving or pushing small-diameter rods and tools into the subsurface by hydraulic or percussive methods and would be performed in accordance with the:

- Use of Direct-push Well Technology for Long-Term Environmental Monitoring in Groundwater Investigations (ITRC, March 2006) and
- Technical Guidance Manual for Ground Water Investigations, Chapter 15, Ground Water Sampling (Ohio EPA, 2016).

If DPT is used to install temporary wells for short term monitoring, the PVC well screens and risers will be a minimum of 1-inch diameter. The temporary wells will be installed with pre-packed well screens. The wells will consist of Schedule 40 PVC casing with 5 feet of 0.010 screen.

If sonic or hollow-stem auger drilling is used to install the temporary wells, the wells will be constructed as discussed above with the exception that there will be no surface completion (i.e., well pad and protective cover). The temporary well will be constructed with a filter pack, bentonite seal and annular seal. Well development and sampling will be conducted as described in this SAP, to include the use of small diameter bladder pumps for well purging and sampling of DPT temporary wells.

The temporary monitoring wells shall be appropriately sealed and abandoned in accordance with Ohio Administrative Code Rule 3745-9-10, Abandoned well sealing.

4.5 FIELD MEASUREMENT PROCEDURES AND CRITERIA

4.5.1 Equipment Calibration

4.5.1.1 Calibration Frequencies

All field instruments shall be calibrated on a daily basis to a known standard (if they are used that day). Calibration may be performed more frequently if equipment is noticeably out of range or as required by the FTL. Calibration shall provide QA checks on all field equipment used during implementation of the field investigations. These numbers shall be transcribed on field data records when using a particular instrument for a sampling event. Prior to field use, all calibration, repair, and service records shall be inspected by field personnel. Field equipment that consistently fails to meet calibration standards or exceeds manufacturer's critical limits shall be promptly repaired or replaced. Field personnel shall record equipment calibration on a Field Instrument Calibration Check Form (**Attachment A)**.

4.5.1.2 Calibration Procedures

4.5.1.2.1 Photoionization Detector

The photoionization detector (PID) shall be calibrated per manufacturer instructions each day prior to the start of field activities. Instrument calibration shall be performed using isobutylene calibration gas of a known concentration (100 or 250 parts per million). All adjustments to instrument settings shall be recorded on the Field Instrument Calibration Form (**Attachment A)**.

4.5.1.2.2 Electrical Conductivity, pH, Temperature, Dissolved Oxygen, Turbidity, and Oxidation Reduction Potential (ORP)

Each of these water quality parameters shall be calibrated each day prior to well development or sample purging in accordance with the steps outlined in the equipment manual as follows:

- The pH function shall be calibrated using at least three buffer solutions that bracket the expected pH. These solutions are commonly pH 4, 7, and 10.
- The electrical conductivity (EC) function shall be calibrated using two solutions of a known value that bracket the expected ranges of conductivities.
- The dissolved oxygen (DO) function shall be calibrated against temperature-compensated, air-saturated water.
- The calibration of the portable turbidity meter shall be evaluated by using two supplied standards within the range of anticipated sample turbidities.
- The ORP function shall be calibrated against temperature-compensated water containing fresh (i.e., opened for < 1 hour) ORP standard powder.

4.5.2 Static Water Level

Following guidance of the FWSAP (Section 5.4.3.1), static water level measurements will be made using an electronic water level indicator prior to well purging. Initially, the indicator probe will be lowered into each monitoring well, without touching the probe to the well casing, until the alarm sounds and/or the indicator light illuminates. The probe will then be withdrawn several feet and slowly lowered again until the groundwater surface is contacted as noted by the alarm and/or indicator light. All probe cords used for measurement will be incrementally marked at 0.003-m (0.01-ft) intervals. Water level measurements will be estimated to the nearest 0.003 m (0.01 ft) based on the difference between the nearest probe cord mark and the top of the well casing.

4.5.3 Electrical Conductivity, pH, Temperature, Dissolved Oxygen, Turbidity, and ORP

Following guidance of the FWSAP (Section 5.4.3.2), electrical conductivity, pH, temperature, DO, turbidity, and ORP measurements will be made using a combination meter designed to measure these parameters. Readings will be recorded as indicated in Section 4.5.1 and 4.8.1.

4.6 GROUNDWATER MONITORING WELL DEVELOPMENT/REDEVELOPMENT

The Monitoring Well Development Form (**Attachment A)** contains the required information for development as defined in Section 5.4.2.3.10 of the FWSAP. Field personnel will fill out the form in its entirety to ensure all documentation requirements are met.

If existing monitoring wells must be redeveloped, the integrity of each well will be checked prior to redevelopment. In accordance with the FWSAP Section 5.4.9, at a minimum, monitoring wells will be re-developed when 10% of the well screen is occluded by sediment or records indicate a change in yield and turbidity. If the integrity of the well is questionable, the well will not be redeveloped. The integrity of the well will be checked by visual inspection of the surface casing and riser pipe and by performing an alignment test (i.e., can a bailer move freely from the top to the bottom of the well).

4.6.1 Development Procedure

Monitoring well development will be initiated no sooner than 48 hours after installation, and no longer than 30 days beyond internal mortar collar placement or the final grouting of the wells. The three selected development methods are as follows:

1. **Development using a bottom discharge/filling Teflon® or stainless steel bailer.** During development operations utilizing a bailer, the bailer will be rapidly surged up and down within the screen section of the well to agitate and mobilize particulates around the well screen during removal of groundwater from the well.
2. **Development using a submersible pump:** During development operations utilizing a pump, the pump will be alternately started and stopped during groundwater removal, thus allowing the well to equilibrate and creating a surging action. The pump will be used at a higher rate than water will be extracted during purging or sampling events.
3. **Development using a lift/jack pump (i.e., Waterra):** During development, water will be removed throughout the entire water column in the well by periodically raising and lowering the tubing equipped with a check valve.

Under no circumstances should air or chemicals be used to aid in development. In situations where a high percentage of fine material is suspended in the groundwater, a surge block may be used in coordination with the noted devices to mobilize particulates drawn into the granular filter pack. Development criteria are:

- A turbidity reading of 10 nephelometric turbidity units (NTUs) or less is achieved using a turbidity meter.
- The sediment thickness remaining within the well is less than 3.0 cm (0.1 ft) or less than 1% of the well screen.
- A minimum removal of five times the standing water volume in the well (to include the well screen and casing plus saturated annulus, assuming 30% annular porosity) has been achieved.
  - The well volume will be calculated as follows:
    - Vt = Total Well Volume Vc = Riser Casing Volume Vf = Filter Pack Volume
    - Vt = Vc + Vf
    - Vc = (Height of water column) x (Volume of Casing per Foot)
    - Vf = (((Saturated thickness of filter pack) x (Volume of Borehole per Foot)) x (.3) – ((Saturated thickness of filter pack) x (Volume of casing per foot)))
- Indicator parameters have stabilized for three consecutive readings to within criteria defined by ASTM D6771-02, Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations (ASTM, 2002) and Chapter 8 of the Technical Guidance Manual for Groundwater Investigations (Ohio EPA, 2009b).
  - ±0.2 for pH;

- ±3% for conductivity;
- ±0.5 °C for temperature;
- ±20 mV for ORP; and
- ±10% or 0.2 milligrams per liter (mg/L) (whichever is greater) for DO.

- In addition to the ‘five times the standing water volume’ criteria, five times the amount of any water unrecovered from the well during installation will also be removed. Under specific circumstances, such as bedrock coring in dry rock, potable water may be introduced to the formation. Stabilization parameter measurement will not be initiated until these requirements are achieved.

During well development, the ARNG/OHARNG will be contacted for guidance if well recharge is slow such that the required volume of water cannot be removed during four consecutive hours of development and all parameters have stabilized, if persistent water discoloration is observed after completion of the required volume removal, if turbidity remains elevated, if stabilization does not occur, or if excessive sediment remains after completion of the required volume removal.

4.6.2 Redevelopment Procedure

Following guidance of the FWSAP (Section 5.4.9), each time a monitoring well is sampled, it should be inspected to determine if there is a need for maintenance. A drop in yield during purging, changes in water level fluctuations, or increases in turbidity over time may indicate a possible change in hydraulic connection of the well to the aquifer or siltation in the monitoring well. Slug tests may be conducted as part of the well evaluation. Well maintenance should be inspected and recorded at least annually. Inspections should note changes in water level trends; yield changes; turbidity; and external physical condition of the well, protective casing, and well pad internal integrity. At a minimum, monitoring wells will be re-developed when 10% of the well screen is occluded by sediment or records indicate a change in yield and turbidity.

Well redevelopment will follow the same procedures as development, outlined in Section 4.5.1 of this document.

4.6.3 Development Water Sample

Well development activities should be completed at least 14 days before groundwater sampling.

Following guidance of the FWSAP (Section 5.4.2.3.10.4), for each monitoring well developed at an AOC, a 500-cm^3 (1-pint) sample of the last water to be removed during development will be placed into a clear glass jar and labeled with the well number and date. Each sample will be individually agitated and immediately photographed close up with a digital camera using a back-lit setup to show water clarity. These photographs will be identified individually with project name, well number, and photograph date and will be provided to the Project Manager after development of all wells. Digital photographs will be submitted in electronic format. Data disks also will be provided to the ARNG/OHARNG. After the development water samples have been photographed, the samples will be disposed of in the same manner as the other water removed from the monitoring wells during the development operation. All well development water must be containerized, characterized, stored, and disposed of in accordance with Section 7.0 of this document.

4.7 MONITORING WELL SURVEY

A topographic survey of the horizontal and vertical locations of newly installed groundwater monitoring wells will be conducted after completion of all well installations. The topographic survey will be conducted by an Ohio-licensed surveyor as described in Section 5.4.2.3.10.6 of the FWSAP.

The topographic survey will be completed as near as possible to the time when the last monitoring well is installed. Survey field data (as corrected), to include loop closures and other statistical data in accordance with the standards and specifications referenced above, will be provided to the ARNG. Closure will be within the horizontal and vertical limits stated below (SAIC, 2011a). The final survey report will explicitly identify the coordinate system and elevation (either ft or m) in which the survey was conducted and will present the data in the following tabular format:

Monitoring well location ID	**Easting (Coordinate System)**	**Northing (Coordinate System)**	**Ground surface elevation (ft or m)**	**Top of casing elevation (ft or m)**

Additionally, the final survey report will describe all permanent and semi-permanent reference marks used for horizontal and vertical control (e.g., benchmarks, caps, plates, chiseled cuts, rail spikes) will be described in terms of their name, character, physical location, and reference value.

4.7.1 Horizontal Control Requirements

Each required survey element will be surveyed to determine its map coordinates referenced to the Ohio State Plane (OSP) Coordinate System, North American Datum (NAD) 83. The survey will be connected to the OSP by third-order, Class II control surveys in accordance with the *Standards and Specifications for Geodetic Control Networks* (Federal Geodetic Control Committee, 1984). All elements surveyed will have an accuracy of at least 0.3 m (1.0 ft) within the chosen system. Specific projects may require greater accuracy. Locations of monitoring wells will be measured at the rim of the uncapped well casing (not the protective casing).

4.7.2 Vertical Control Requirements

Each required survey element will be topographically surveyed at the notched or marked point on the north side of the solid well casing (not the protective casing). The ground surface elevation (not the pad surface) adjacent to each well will also be measured. The survey will be connected by third-order leveling to the National Geodetic Vertical Datum of 1988 with latest adjustments in accordance with the *Standards and Specifications for Geodetic Control Networks* (Federal Geodetic Control Committee, 1984). All elements surveyed will have an accuracy of at least 0.3 cm (0.01 ft). Specific projects may require greater accuracy.

4.8 DEDICATED BLADDER PUMP INSTALLATIONS

QED Well Wizard® bladder pumps will be installed at all monitoring well locations planned for multiple sampling events during the FWGW RI. These pumps will be constructed of PVC and include a Teflon®-coated stainless steel safety cable/retrieval line, Teflon™-lined polyethylene (TLPE) tubing or Teflon® tubing and bladder, and 2-inch slip fit well caps with fittings, as described below. The pumps will be installed a minimum of 48 hours weeks prior to sampling activities.

Once the bladder pump is constructed, the pump will be lowered slowly down the monitoring well until it contacts the groundwater surface, and then will continue to be lowered until the intake of the pump is placed either in the center of the screen (if the static water level is above the screen) or the center of the water column (if the water is contained in the screen). All bladder pumps will be driven by compressed air or nitrogen.

4.8.1 Bladder Pump

The bladder pump for 2-inch monitoring wells will have an outside diameter of 1.66 inches. The pump will be constructed entirely of PVC and Teflon® materials, with lead-free Viton® o-rings. Each pump will be fitted with a PVC inlet screen, 6 inches in length, and having a screen opening size of 0.10 inches. The screen will attach directly by threading to the pump inlet housing. Small diameter bladder pumps for DPT well sampling will have an outer diameter of ½ inch and be constructed of stainless steel with a Teflon bladder.

The pump assembly will be cleaned using a multi-stage washing and rinsing process utilizing phosphate-free laboratory-grade detergent and deionized water before installation into a monitoring well.

4.8.2 Tubing

The air supply and discharge tubing will be thermally bonded together for installation as a single line, without any external sheathing material or cable ties. Tubing will be ¼ inch air supply, with discharge sized to match the bladder pump and will fit into standard-sized, compression-type fittings without trimming, reaming, or resizing.

The pump air supply fitting will consist of a compression-type brass fitting for connection to the pump air supply tubing, and a quick-connect brass fitting for connection to the controlled air supply hose.

4.8.3 Slip-Fit Well Cap

The pump discharge fitting will be a bore-through design that allows the discharge tubing to pass continuously through the cap, preventing sample water from contacting the fitting. The cap will also include a flexible discharge tube, constructed of inert materials, which attaches via a slip fit grip ring to the pump discharge tube end and stores between uses in the water level measurement hole.

The cap will include an access hole for water level measurement and include a polyethylene dust protection cap to cover the entire cap to prevent accidental introduction of contaminants to the fittings or well.

4.8.4 Pump Controller (MP10 Option)

The system will include a pump controller to control the air on/off cycles (pump discharge/refill cycles) and regulate the air supply pressure under a wide range of field conditions. The controller will have a pump drive air regulator (throttle) to control air pressure applied to the pump, and a pressure gauge that reads actual pressure applied to the pump, even when the pump is not cycling. The regulator will be a multi-turn design, allowing the user to control the pressure from 0 to 120 pounds per square inch.

4.9 GROUNDWATER SAMPLING

4.9.1 Micro-Purge Procedure

Groundwater samples will be collected by micro-purging with dedicated bladder pumps. Pumps will be installed a minimum of 48 hours. The procedure for micro-purge sampling is provided below:

1. Connect all applicable hoses at the surface.
2. Turn the pump on and begin purging any stagnant water in the pump and tubing. (This purging does not represent a parameter for sampling.) For micro-purging, the pumping rate will not exceed 100 milliliters per minute (mL/min), unless it can be shown that higher purge rates (maximum of 500 mL/min) will not result in a drawdown greater than 0.3 ft. The pump rate is established once drawdown has been stabilized.
3. Begin recording water quality parameters every 3 to 5 minutes on the Groundwater Sample Form (**Attachment A**).
4. Continue purging for a minimum of 30 minutes and water quality parameters have stabilized. Stabilization is defined as three consecutive readings of:

Water Quality Parameter	Stabilization Requirement
pH	± 0.1
Conductivity	± 3%
Temperature	± 5°C
DO	± 0.3 mg/L
Turbidity	<10 NTU
ORP	± 10mV or 10%

5. If the turbidity cannot be reduced to less than 10 NTUs after 2 hours of purging, the ARNG/OHARNG will be informed; and if all other parameters are stable, the well will be sampled. Once the turbidity of the well is below 50 NTUs, then a sample collected for metals analysis will not require any filtering. If the turbidity cannot be brought below

50 NTUs, then both an unfiltered and a filtered sample will be collected for metals analysis. The filtered sample will be collected through a 5-micron filter. Both samples will be analyzed for metals, as applicable. The filtered sample will be placed into a pre-preserved sample container, and the unfiltered sample will be placed into a separate pre-preserved container. Collect sample immediately after micro-purging.

4.9.2 Alternative Method – Bailer Purging

If micro-purging cannot be accomplished for any reason, purging will be conducted in accordance with the conventional purging procedures. Following guidance of the FWSAP (Section 5.4.4.1), after initial measurement of field parameters, including measurement of the water level, purging of each monitoring well will commence until pH, conductivity, DO, temperature, turbidity, and ORP have reached equilibrium (as specified in Section 4.4.3 of this document). Equilibrium will be established by three consecutive readings, where one well casing volume is purged between each reading following the initial measurement consisting of the first flush of groundwater. A well casing volume for conventional well purging is defined as the total of the well casing plus the saturated filter pack annulus assuming a porosity of 30%. A discussion on calculating well volumes is presented in Section 4.5.1 of this document. However, purging will be terminated before establishment of equilibrium if one of the following conditions is met: (1) five well volumes, including the saturated filter pack assuming a porosity of 30%, have been removed from the well; or (2) the well is purged to dryness. Each bailer used for purging/sampling will be equipped with a nylon retrieval cord that will be properly discarded upon completion of the purging and sampling activities.

Monitoring well sampling will begin immediately after purging. When a bailer is used, the device will be lowered slowly until it contacts the groundwater surface, allowed to sink to the bottom of the monitoring well and fill with a minimum of surface disturbance, and raised slowly to the surface. The sample then will be transferred to the appropriate sample bottles by tipping the bailer so that a slow discharge of sample flows gently from the top of the bailer down the side of the sample bottle with minimum entry disturbance. Bottles designated for volatile organic analysis will be filled first and in a manner so that no headspace remains. Immediately after each sample is collected and the bottles are labeled, each sample container will be placed into a sealable plastic bag and placed in an ice-filled cooler to ensure preservation.

If a monitoring well is purged to dryness, sampling will be delayed for a time period of a minimum of 1 hr and up to 24 hr to allow for recharge. During the delay period, the atmosphere of the well will be isolated to the greatest extent possible from the surface atmosphere. Upon sufficient recharge of groundwater into the well (i.e., if the well recharges to 90% of its initial water level within 1 hr), a sample will be collected without additional well purging. If sufficient well recharge does not occur within 24 hr after the initial purging, the ARNG/OHARNG will be contacted for guidance.

4.9.3 Sample Containers and Preservation

QAPP Worksheet #19 lists the sample containers, minimum sample volume, preservation requirements, and maximum holding times for all investigative and IDW samples to be collected.

4.9.4 Decontamination Procedures

4.9.4.1 Drill Rig Decontamination

A decontamination station shall be established at each field site prior to initiating intrusive field activities. Approval for the location of the decontamination pad is provided by the ARNG/OHARNG. The decontamination procedure must match the degree of contamination of the tool. For example, steam cleaning or brushes and soap may be necessary to remove dirt from auger flights and to prepare well screens and riser pipe for installation into the borehole. Clean, disposable gloves shall be worn during and after decontamination so that equipment shall not be re-contaminated. General decontamination procedures for drilling devices are as follows:

- Steam clean if practical;
- Scrub equipment with a solution of potable water and a laboratory grade phosphate-free detergent (e.g., Alconox) to remove all visible dirt;
- Rinse sampling item thoroughly with potable water to remove residual dirt and rewash, if necessary.

4.9.4.2 Sampling Equipment Decontamination

Following guidance of the FWSAP (Section 5.4.8), non-dedicated equipment used to measure static water levels, develop and purge monitoring wells, and collect groundwater samples during the investigations will be decontaminated within a temporary decontamination area. The decontamination area will be designed so that all decontamination liquids are segregated in containers by type, contained from the surrounding environment, and can be recovered for disposal as IDW. Non-dedicated equipment will be decontaminated after each well is developed and again after each well is purged and sampled. The decontamination procedure will follow current guidance provided in Chapter 10 of the *Technical Guidance Manual for Groundwater Investigations* (Ohio EPA, 2006).

Solvent and acid rinses may be necessary only if high levels of contamination are expected. Further procedures will be defined in investigation-specific addenda. Individual dedicated containers should be used for each step of the decontamination process. Gloves should be changed between various stages of decontamination. The procedure for equipment decontamination is as follows:

1. Wash with approved water and phosphate-free detergent using various types of brushes required to remove particulate matter and surface films.
2. Rinse thoroughly with approved potable water.
3. If analyzing for metals and expecting high levels of contamination, rinse thoroughly with hydrochloric acid (2% solution) or nitric acid (10% solution).
4. Rinse thoroughly with ASTM Type I or equivalent deionized/distilled water with analytical certification.
5. If analyzing for organics and expecting high levels of contamination, rinse thoroughly with solvent-pesticide grade isopropanol, acetone, or methanol, depending on analytes of interest.
6. Rinse thoroughly with ASTM Type I or equivalent deionized/distilled water with analytical certification.
7. Allow equipment to air dry as long as possible.
8. Place equipment on clean, dry plastic if it is to be used immediately or wrap in aluminum foil to prevent contamination if storage is required.

In addition to the well development and sampling equipment, field measurement instruments will be decontaminated between monitoring well locations. Only those portions of each instrument that come into contact with potentially contaminated environmental media will be decontaminated. Due to the delicate nature of these instruments, the decontamination procedure will involve only initial rinsing of the instruments with approved water, followed by a final rinse using ASTM Type I or equivalent water. Field measurement instruments will be rinsed with source water at the next sampling location. All solutions used in steps 3 to 6 should be dispensed from Teflon® spray bottles or dispensers.

4.10 MONITORING WELL ABANDONMENT

This information is contained in the Well Abandonment Work Plan, which is submitted under separate cover.

4.11 INVESTIGATION-DERIVED WASTE MANAGEMENT

This information is contained in Section 7.0 of this document.

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5.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

Sample chain-of-custody (COC) and documentation procedures are described below. Additionally, **Attachment A** contains copies of the Daily Quality Control Report and the Field Change Request Form. The Daily Quality Control Report will be submitted to the TEC-Weston JV PM each day to document the field activities completed that day. The Field Change Request Form will be utilized only on an as-needed basis. The FTL will complete the Field Change Request From and submit it to the TEC-Weston JV PM, who will relay the request with the ARNG/OHARNG.

5.1 FIELD LOGBOOK

Complete and accurate documentation is essential to demonstrate that field measurement and sampling procedures are carried out as described. Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities. The logbook will list the contract name and number, the TO number, the project name and number, the site name and location, and the names of subcontractors, and the PM. At a minimum, the following information will be recorded in the field logbook:

- Name and affiliation of all on-site personnel or visitors;
- Weather conditions during the field activity;
- Personal protective equipment;
- Summary of daily activities and significant events;
- Information regarding sample collection, including collection date and time, sample ID, sample location, sample matrix (water or soil), sample type (regular, duplicate, blank, grab, composite), and sampling depth;
- Notes of conversations with coordinating officials;
- References to other field logbooks or forms that contain specific information;
- Discussions of problems encountered and their resolution;
- Discussions of deviations from the FWGW RIWP or other governing documents; and
- Description of all photographs taken.

Changes or corrections will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross-out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

5.2 PHOTOGRAPHS

Following guidance of the FWSAP (Section 5.4.2.4.2), for each photograph taken during the investigations, the following items will be noted in the field logbook:

- Date and time;
- Photographer (name and signature);
- Location;
- General direction faced and description of the subject taken; and
- Sequential number of the photograph.

While not required, it is recommended that all sampling points (i.e., wells and soil borings) be documented via photographs. These photographs will include two or more permanent reference points to facilitate relocating the point at a later date.

5.3 SAMPLE NUMBERING SYSTEM

Each sample collected will be given a unique ID. A record of all sample IDs will be kept with the field records and recorded on a COC form. In addition, the sample IDs will be used to identify and retrieve analytical results from the laboratory, validation, and upload into Ravenna Environmental Information Management System. Sample IDs pertinent to the FWGW RI will be formatted as follows:

Sampling Location Identification: XXXmm-NNN(n)	
XXX = Area Designator	Examples: LL1 – Load Line 1 RQL – Ramsdell Quarry Landfill FWG – Facility Wide Groundwater
mm = Sample Location Type	Examples: MW - Groundwater Monitoring Well
NNN(n) = Sequential Sample Location Number Unique, sequential number for each sample location beginning with the following number from the last number used from previous investigation stations and extending into any subsequent investigative phases.	Examples: 004 012 099 107
(n) Special identifier- Optional use (as needed) to identify special sample matrices or sample location characteristics. For example: Use a B to identify the well as a background location (BKG) Use an A to identify an abandoned well (099A)	
Sample Identification: XXXmm-NNN(n)-####-tt	
### = Sequential Sample Number [must be unique for entire project site/AOC]	Examples 0001 0002 0003
tt = Sample Type	Examples GW - Groundwater Sample (unfiltered) GF - Groundwater Sample (filtered) PR - Free Product Sample TB - Trip Blank FB - Field Blank ER - Equipment Rinsate SB – Source Blank

5.4 SAMPLE DOCUMENTATION

Documentation during sampling is essential to ensure proper sample identification. Field personnel will adhere to the following general guidelines for maintaining field documentation:

- Documentation will be completed in permanent black ink;
- All entries will be legible;
- Errors will be corrected by crossing out with a single line and then dating and initialing the lineout; and
- Unused portions of pages will be crossed out and each page will be signed and dated.

The FTL is responsible for ensuring that sampling activities are properly documented.

5.4.1 Sample Labels

Field personnel will use standard sample labeling procedures to maintain sample integrity during collection, transportation, storage, and analysis. Waterproof sample labels will be affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers can be placed in re-sealable plastic bags to protect the sample from moisture during transportation to the laboratory. The label will be completed with the following information written in indelible ink:

- Project name and location;
- Sample identification number;
- Date and time of sample collection;
- Preservative used;
- Sample collector's initials; and
- Analysis required.

5.4.2 Sample Analysis Request Form

Consistent with Section 6.4.2 of the FWSAP, sample analysis request forms will not be utilized. All information will be recorded on the COC.

5.4.3 Chain-of-Custody Records

COC forms will be used to document the integrity of all samples collected. To maintain a record of sample collection and transfer between personnel, shipment, and receipt by the laboratory, COC forms will be filled out for sample sets as determined appropriate during the course of fieldwork.

As defined in Section 6.4.3 of the FWSAP, the following information will be recorded on all COC forms:

- Project name;
- Name of Contractor (i.e., TEC-Weston JV);
- Name of TEC-Weston JV PM and contact information;
- Sample number (for each sample in shipment);
- Sample station (for each sample in shipment);

- Collection date and time (for each sample in shipment);
- Number of containers for each sample;
- Sample description (i.e., environmental medium);
- Sample type (discrete or composite);
- Analyses required for each sample;
- Sample methods;
- Sample preservation technique(s);
- COC or shipment number;
- Shipping address of the laboratory;
- Name of subcontractor laboratory PM and contact information;
- Date, time, method of shipment, courier, and airbill number; and
- A space to be signed as custody is transferred between individuals.

5.4.4 Receipt of Sample Forms

The contracted laboratory documents the receipt of environmental samples by accepting custody of the samples from the approved shipping company. This receipt is documented under the received by block on the COC. In addition, the contracted laboratory documents the condition of the environmental samples upon receipt. Sample receipt(s), including received COC, sample cooler receipt form, and sample login information, is transmitted to the TEC-Weston JV Project Chemist.

5.5 DOCUMENTATION PROCEDURES

Information regarding field tasks will be recorded on site field logs. Sample collection information will be recorded on individual sample field forms. Any changes that are made to the field logs or the field forms will be initialed and dated. Documents will be maintained in project files and will be submitted as an appendix to the Final Project Report. COC and air bills will also be completed for each sampling event.

5.6 CORRECTIONS TO DOCUMENTATION

Following guidance of the FWSAP (Section 6.6), all original information and data in field logbooks, on sample labels, on COC forms, and on any other project-related documentation are recorded in black waterproof ink and in a completely legible manner. Errors in any document are corrected by crossing out the error and entering the correct information or data. Any error discovered in a document is corrected in the field by the individual responsible for the entry. Erroneous information or data are corrected in a manner that will not obliterate the original entry, and all corrections are initialed and dated by the individual responsible for the entry.

5.7 MONTHLY REPORTS

Following guidance of the FWSAP (Section 6.7), monthly reports will be submitted during implementation of field investigations at AOCs as contracts require. The Monthly Reports focus on the progress to date of an investigation and are submitted directly to the ARNG/OHARNG by the 5th day of the month following the reporting period. Information from the Monthly Report are subsequently submitted in the Director's Final Findings and Orders (DFFO) Monthly Report that is submitted to the Ohio EPA Northeast District Office by the 10th day of the month. The Monthly Reports will document AOC identification and activities, status, percent complete, data collected to date (excluding analytical results), difficulties encountered, corrective actions, and planned activities.

5.8 SUBMITTAL OF INFORMATION

Following guidance of the FWSAP (Section 6.8), all information including, but not limited to, sample numbers, collection time and date, borehole and well depths, water level, and water quality measurements will be submitted in electronic format for entry into Ravenna Environmental Information Management System (REIMS) in accordance with procedures outlined in Section 10.3 of the Facility-Wide Quality Assurance Project Plan (FWQAPP), Electronic Data Deliverable File Specifications.

6.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

A courier service will be utilized to transport for samples to the laboratory for analysis. The following procedures will be implemented when transporting samples collected during this project:

- Samples will be placed in a plastic bag with bubble wrap or other packing materials and ice. Sufficient packing material will be used to prevent sample containers from breaking during transport. Enough ice will be added to maintain the sample temperature at less than 6 °C (but not frozen). A temperature blank will be placed in each cooler.

The COC records will be signed and relinquished to the courier at the pickup time.

In the event that samples will need to be shipped to laboratory, the following procedures will be implemented when shipping samples collected during this project:

- Plastic bags will be used to line the inside of the sample shipping cooler. Samples will be placed in a plastic bag with bubble wrap or other packing materials and ice. Sufficient packing material will be used to prevent sample containers from breaking during transport. Enough ice will be added to maintain the sample temperature at less than 6 °C (but not frozen). A temperature blank will be placed in each cooler.
- The COC records will be placed inside a plastic bag. The bag will be sealed and taped to the inside of the cooler lid. The laboratory will be notified if the sampler suspects that the sample contains any substance that would require laboratory personnel to take safety precautions. Multiple coolers may be sent in one shipment to the laboratory.
- The cooler will be closed and taped shut with strapping tape around both ends. If the cooler has a drain, it will be taped shut both inside and outside of the cooler.
- Signed and dated custody seals will be placed on the front and side of each cooler. Wide clear tape will be placed over the seals to prevent accidental breakage. The COC record will be transported within the taped sealed cooler. When the cooler is received at the analytical laboratory, laboratory personnel will open the cooler and sign the COC record to document transfer of samples.

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7.0 INVESTIGATION-DERIVED WASTE

All IDW generated during this RI will be handed in accordance with the *Camp Ravenna Waste Management Guidelines* (OHARNG, 2015). All IDW field activities will be coordinated though the Camp Ravenna POC, as identified in the Camp Ravenna Waste Management Guidelines (OHARNG, 2015):

Coordination:

- Coordinate all waste generation, manifests, profiles, and shipments with the appropriate Camp Ravenna POC listed on the Camp Ravenna Waste Management Guidelines.
- Notify Camp Ravenna POC prior to waste sampling for characterization. Details about sampling activities must be included (i.e., number of sample, analyticals).
- All Hazardous and Non-Hazardous waste management storage locations must be pre-approved prior to generation.
- Ensure all labels include: Date, Contractor, and Waste Type.
- When contractors have waste onsite, a weekly inspection inventory must be completed and submitted to the appropriate POC in the Camp Ravenna Environmental Office. This form is contained in **Attachment A**.
- All wastes shall be tracked and logged throughout the duration of the project. Contractor will provide the Camp Ravenna POC with a monthly rollup report of all waste and recycled streams generated by no later than the 10th day of the following month.

In addition to IDW management, an effort will be made to minimize all solid waste and recyclable materials. Good housekeeping will be implemented at all work sites to ensure a safe and clean working environment. The quantity of solid waste and recyclable materials generated during the course of this investigation is anticipated to be *de minimis*.

7.1 INVESTIGATION-DERIVED WASTE COLLECTION AND CONTAINERIZATION

Section 8.0 of the FWSAP identifies two types of IDW that may be generated during environmental investigations: indigenous and non-indigenous. Indigenous IDW consist of IDW that is native to Camp Ravenna (e.g., soils and waters from sampling or well installation activities). Non-indigenous IDW consist of IDW that is not native to Camp Ravenna (e.g., rinsate waters or acids from sampling containers). The generation of indigenous and non-indigenous IDW is anticipated in the FWGW RI. Once containerized, IDW will be documented and tracked using the "Weekly Waste Inventory and Container Log Sheet" (**Attachment A)**.

All liquid and soil indigenous IDW (i.e., purge water, development water, and soil from well installation activities) may be composited from multiple boreholes, wells, or AOCs until the drum is full. Similarly, all non-indigenous IDW (e.g., decontamination rinse water) IDW may be composited from multiple AOCs until the drum is full. Drum labels will include the AOC locations where the waste was generated.

All indigenous IDW will be collected either in labeled Department of Transportation (DOT)-approved, new 55-gallon, closed-top drums (liquids), labeled polyethylene storage tanks, open-top drums (solids), or roll-offs (solids), as applicable. Sampling of IDW for disposal characterization will be performed using a composite grab sampling technique.

All non-contaminated non-indigenous IDW (i.e., municipal solid wastes) will be contained in trash bags with potentially contaminated non-indigenous IDW being additionally contained in labeled, DOT-approved, open-top 55-gallon drums equipped with plastic drum liners and sealed with bung-top lids.

7.1.1 Liquid Investigation-Derived Waste Composite Sampling Procedure

All IDW will be characterized at the conclusion of each sampling event. Following guidance of the FWSAP (Section 8.4.2), sampling of liquid IDW (groundwater and decontamination water) for disposal characterization will be performed using a composite grab sampling technique. The equipment used in liquid IDW sampling will consist of sample containers and disposable or decontaminated sampling equipment (e.g., bailers, pump tubing, and drum thief). Coliwasa samplers should be used if the liquid IDW is determined or expected to be stratified. The handling, storage, and shipment of IDW samples will follow procedures as described in Section 7.1 of this document. Liquid IDW (i.e., groundwater and decontamination rinse water) will be sampled and analyzed separately. Composite grab sample collection will be performed as follows:

1. Correlate the number of grab samples and sample volume required by the laboratory to determine the volume needed to provide equal amounts of aliquot from each grab sample (drum container) at the recommended sample volume (e.g., five 20-mL aliquots from five

discrete grab samples to generate a 100-mL composite sample representing five IDW containers).

2. Using decontaminated or clean disposable equipment, collect discrete grab samples from each drum.
3. Using a clean pipette or equivalent clean measuring device, deliver equal aliquots of the grab samples directly into sample container(s) to be sent to the laboratory.
4. Repeat this process until equal amounts of each aliquot from each grab sample have been collected. Each discrete grab sample should be collected in identical fashion.
5. Seal the sample container and shake well to mix. Prepare the container for shipment to the laboratory.

7.1.2 Soil Investigation-Derived Waste Composite Sampling Procedure

All IDW will be characterized at the conclusion of each sampling event. Following guidance of the FWSAP (Section 8.4.1), sampling of soil IDW for disposal characterization will be performed using a composite grab sampling technique. The equipment used in soil IDW sampling will consist of sample containers and disposable or decontaminated sampling equipment (e.g., small-diameter hand augers or soil push probes, stainless steel bowls, and mixing instruments [e.g., knives and spoons]). The handling, storage, and shipment of IDW samples will follow procedures as described in Section 7.1 of this document. Composite grab sample collection will be performed as follows:

1. Collect discrete grab samples using clean, decontaminated, or disposable equipment such as small-diameter hand augers or soil push probes from each segregated IDW waste container. Each discrete grab sample should be collected in an identical fashion (frequency and volume).
   a. For volatile organic characterization, grab samples of equal proportions will be transferred directly from each IDW waste container to the sample container with minimum head space for laboratory analysis.
   b. For all analyses other than VOCs, individual grab samples will be transferred into a sample bowl for homogenizing.
2. Homogenize individual grab samples using a sampling bowl and mixing instrument by stirring and turning over the sample until the mixture is adequately homogenized. The mixture is then divided by half, and equal portions from each half will be used to fill sample containers.
3. Assemble the sample containers that contain the homogenized grab samples that will make up a specific composite sample.

4. Remove an aliquot of sample from each container to be sampled and place it in a decontaminated stainless steel mixing bowl. Each aliquot amount is to be as identical as possible to facilitate representativeness.
5. Homogenize the aliquots as described in Step 2.
6. Remove sample amounts from the homogenized composite sample and place them into the proper containers for shipment to the laboratory.

7.2 WASTE CONTAINER LABELING

In accordance with Section 8.2 of the FWSAP, all containers, including empty ones, must be properly labeled. All waste storage containers (drums and poly tanks) will be labeled immediately before and continuously during their use to ensure proper management of the contained wastes. All labels will be weather-resistant, commercially available labels. Two labels will be affixed and located on opposite sides on the upper one-third of each storage container. Labels will be legibly completed using indelible ink. The drum number will be legibly recorded directly on a clean dry drum surface on the top and upper one-third of each storage container using an indelible paint marker. Additional label information may be recorded directly on a clean dry drum surface.

The following procedure will be used for waste container labeling:

- Place each label on a smooth part of the container and do not affix it across drum bungs, seams, ridges, or dents.
- Upon use of a container, replace the empty label with a drum label filled out with the information listed below.
- When sampling each container per the procedures outlined in Section 7.1.1 of this document, affix an appropriate pending analysis label to the container.
- When classifying the IDW based on analytical results, affix the appropriate hazardous or non-hazardous label to the drum.
- Record the following information on each label:
    - Contractor-assigned container number;
    - Contents;
    - Source of waste;
    - Source location (if applicable);
    - Project name and AOC identification;

- Physical characteristic of the waste;
- Generation date(s);
- Address of waste generation; and
- Contact information for a Contractor contact and the Camp Ravenna POC.

* Record all information on container labels with indelible ink (permanent marker or paint pen) and record necessary information in a field logbook or on an appropriate field form.
* Protect all container labels so that damage or degradation of the recorded information is prevented.
* Drum labels will be photographed when affixed to the container. Photographs will be provided to the Camp Ravenna Environmental Office. New photographs will be collected whenever drum status is updated (i.e., pending analysis, final classification).

7.3 INVESTIGATION-DERIVED WASTE FIELD STAGING

Nonhazardous IDW will be stored onsite, at Building 1036 pending analysis and disposal. Liquid waste, whether drums or poly tanks, will be stored within secondary containment. In the unlikely event that hazardous waste is generated, it will be stored at Building 1047. In accordance with the Camp Ravenna Waste Management Guidelines (OHARNG, 2015) (**Attachment A)**, all satellite accumulation storage sites and containers will comply with 40 Code of Federal Regulations (CFR) 262.34(c)(1):

* Any material that is subject to Hazardous Waste Manifest Requirements of the USEPA must comply with 40 CFR Part 262.
* From the time any waste is placed in a satellite storage container, proper labeling must be on the container (proper labeling includes date, Contractor’s name, and product type).
* Pending analysis label is to be used from the time the sample is taken until the results are received.
* In no case will waste labeled pending analysis exceed 45 days.

7.4 INVESTIGATION-DERIVED WASTE CHARACTERIZATION AND CLASSIFICATION FOR DISPOSAL

For the FWGW RI, liquid and soil IDW will be analyzed for the following (as applicable to the waste stream):

- Toxicity Characteristic Leaching Procedure (TCLP) volatile organic compounds;
- TCLP semivolatile organic compounds;
- TCLP metals;
- TCLP herbicides;
- TCLP pesticides;
- Total sulfide;
- Total cyanide;
- Corrosivity (pH); and
- Flashpoint for proper disposal.

Specific bottle ware, preservatives, holding times, and analytical methods for IDW analysis are presented in Worksheet #19 of the UFP-QAPP (Part II of Appendix B of the FWGW RIWP).

Analytical results from the subcontracted laboratory will be reviewed to determine if any potentially hazardous wastes exist. This review includes a comparison of the TCLP criteria against the liquid analytical results and the leachate concentrations for soil (i.e., TCLP Preparation Method 1311). Analytical results for TCLP analysis will be compared to **Table 7-1** (originally Table 8-1 of the FWSAP), and non-TCLP analysis will be compared to **Table 7-2** (originally Table 8-2 of the FWSAP) to determine if the IDW is classified as hazardous or non-hazardous.

Table 7-1. Concentration of Contaminants for Toxicity Characteristic (40 CFR 261.24)

USEPA Hazardous Waste Number	Contaminant	CAS Number	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-9	0.5
D006	Cadmium	7440-43-2	1.0
D019	Carbon Tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	200.0a
D024	m-Cresol 65794-96-9	108-39-4	200.0a
D025	p-Cresol	106-44-5	200.0a
D026	Cresol	--	200.0a
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13b
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8/1024-57-3	0.008
D032	Hexachlorobenzene	118-74-1	0.13b
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone (2-Butanone)	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0b
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl Chloride	75-01-4	0.2

Notes:

a. If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L.

b. Quantitation limit is greater than the calculated regulatory level. The quantitation limit, therefore, becomes the regulatory level.

-- = No standard exists

CFR = Code of Federal Regulations

CAS = Chemical Abstracts Service

USEPA = United States Environmental Protection Agency

Table 7-2. Maximum Concentration of Hazardous Waste Characterization Analytes (40 CFR 261.21-23)

USEPA Hazardous Waste Number	Analyte	CAS Number	Aqueous Reporting Limit	Solid Reporting Limit
D002	pH/Corrosivity	Q183	$2 \leq pH \leq 12.5$	--
D003	Cyanide, total	57-12-5	--	--
D001	Flashpoint	Q376	<140°F	<180°F
D003	Sulfide, total	Q1314	3.0 mg/L	39.5 mg/kg

Notes:

-- =No standard exists
CAS = Chemical Abstracts Service
CFR = Code of Federal Regulations
USEPA = United States Environmental Protection Agency

After all analytical results have been received for each investigation and prior to the disposal of any waste, an IDW Characterization and Disposal Plan will be prepared by the FTL and will include:

- An inventory of all stored IDW.
- The analytical results and IDW characterization.
- Recommendations for the disposal of all IDW.

The recommendations for IDW disposal presented in the IDW Characterization and Disposal Plan will be submitted to the ARNG/OHARNG and, upon approval, implemented. A copy of the approved IDW Plan will be included in the corresponding sampling reports.

7.5 INVESTIGATION-DERIVED WASTE DISPOSAL

In accordance with the Camp Ravenna Waste Management Guidelines (OHARNG, 2015) (**Attachment A)**, should a waste be determined to be hazardous, "Contractors are required to utilize hazardous waste haulers and Treatment, Storage, and Disposal Facilities (TSDF) on the latest Defense Reutilization Marketing Office (DRMO) approved list. The current qualified waste hauler and TSDF list can be viewed by following the "Qualified Facilities" and "Qualified Transporters" links found on the Defense Logistics Agency (DLA) Hazardous Waste Disposal Homepage, http://www.dispositionservices.dla.mil/newenv/hwdisposal.shtml.

If the waste is non-hazardous, a waste hauler/recycler will be identified and submitted to the ARNG/OHARNG for approval and a recommendation for disposal or recycling will be made.

Should onsite discharge or dispersal for non-hazardous, non-contaminated wastes (i.e., soils and water) be a potential option, the ARNG/OHARNG will be provided a plan for approval. The process necessary to discharge or disperse of the materials onsite will be presented within the plan.

For Hazardous or Non-Hazardous manifests, the following must be included:

- Restoration Program waste Site Name = Former Ravenna Army Ammunition Plant. Mailing address is Camp Ravenna ENV, 1438 State Route 534 SW, Newton Falls, Ohio 44444. Site address: 8451 State Route 5, Ravenna, Ohio 44266, (614) 336-6136. Ohio EPA ID # – OH5210020736.
- Contractor's shipping Hazardous Waste must provide a Land Disposal Restriction (LDR) in accordance with 40 CFR Part 268.
- Profiling:

The required shipping documentation (i.e., waste profile and summary of lab reports (IDW Plan)) need to be submitted to appropriate Camp Ravenna POC or designee(s) for approval and signature prior to shipping.

- Results of characterization must be submitted to appropriate Camp Ravenna POC within 30 days after collecting the sample.
- Manifests - Hazardous and Non-Hazardous:

The waste carrier/transporter provides appropriate manifest to the Contractor.

The Contractor is required to:

- Ensure that Camp Ravenna POC or designee(s) is available to sign the manifest on the scheduled day of shipment;
- Verify that each manifest is properly completed and signed by Camp Ravenna POC or designee(s);
- Provide the Generator copy of the manifest to Camp Ravenna POC or designee(s); and
- Ensure that the original Generator copy of the manifest signed by the treatment storage disposal facility is returned to Camp Ravenna within 30 days of the shipping date for Hazardous and Non-Hazardous Waste.
- The use of a Bill of Lading, in lieu of a waste manifest, must be approved by the Camp Ravenna Environmental Office.

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ATTACHMENT A: FIELD FORMS

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Stormwater Inspection Sheet

Silt Fence

A silt fence will be constructed at the perimeter of a disturbed area greater than 15 square meters (approximately 162 square feet [sq ft]). Its use is limited to small drainage areas on relatively flat slopes or around small soil storage piles. It will not be used where runoff is concentrated in a ditch, pipe or through streams. The silt fence will be capable of pooling runoff so that sediment can settle out of suspension. Silt fence will be installed within 7 days of first grubbing the wellhead area it controls.

Inspection Checklist

Inspections will be conducted weekly basis or as necessary (within 24 hours a 0.5 inches or greater rainfall event).

GENERAL INSPECTION INFORMATION

Site Inspection Date: _______ Inspector Name: _______________________

Location: _________________________

Storm Events of the Last 7 Days

Storm Event	Storm Event Time	Storm Event Duration	Total Rainfall Amount	Discharge Occur? (Y/N)

Weather Information at the Time of Inspection

Temperature ______________ Climate (Sunny, Cloudy, Rain)? _____________________________

Is Storm Water Being Discharged? ____

SILT FENCE INSPECTION

Key things to look for

Y/N

1. ____ Is the fence at least 4 to 6 inches into the ground?
2. ____ Is the trench backfilled to prevent runoff from cutting underneath the fence?
3. ____ Is the fence pulled tight so it won't sag when water builds up behind it?
4. ____ Are the ends brought upslope of the rest of the fence so as to prevent runoff from going around the ends?
5. ____ Is the fence placed on a level contour? If not, the fence will only act as a diversion.

6. ____ Have all the gaps and tears in the fence been eliminated?
7. ____ Is the fence controlling an appropriate drainage area?

TEMPORARY STABILIZATION

Key things to look for

Y/N

1. ____ Are there any areas of the site that are disturbed, but will likely lie dormant for over 14 days?
2. ____ Have all dormant, disturbed areas been temporarily stabilized in their entireties?
3. ____ Have disturbed areas outside the silt fence been seeded or mulched?
4. ____ Have soil stockpiles that will sit for over 14 days been stabilized?
5. ____ Has seed and mulch been applied at the proper rate? In general, seed is applied at 3 to 5 pounds (lbs) per 1,000sq ft and straw mulch is applied at 2-3 bales per 1,000 sq ft.
6. ____ Has seed or mulch blown away? If so, repair?

PERMANENT STABILIZATION

Key things to look for

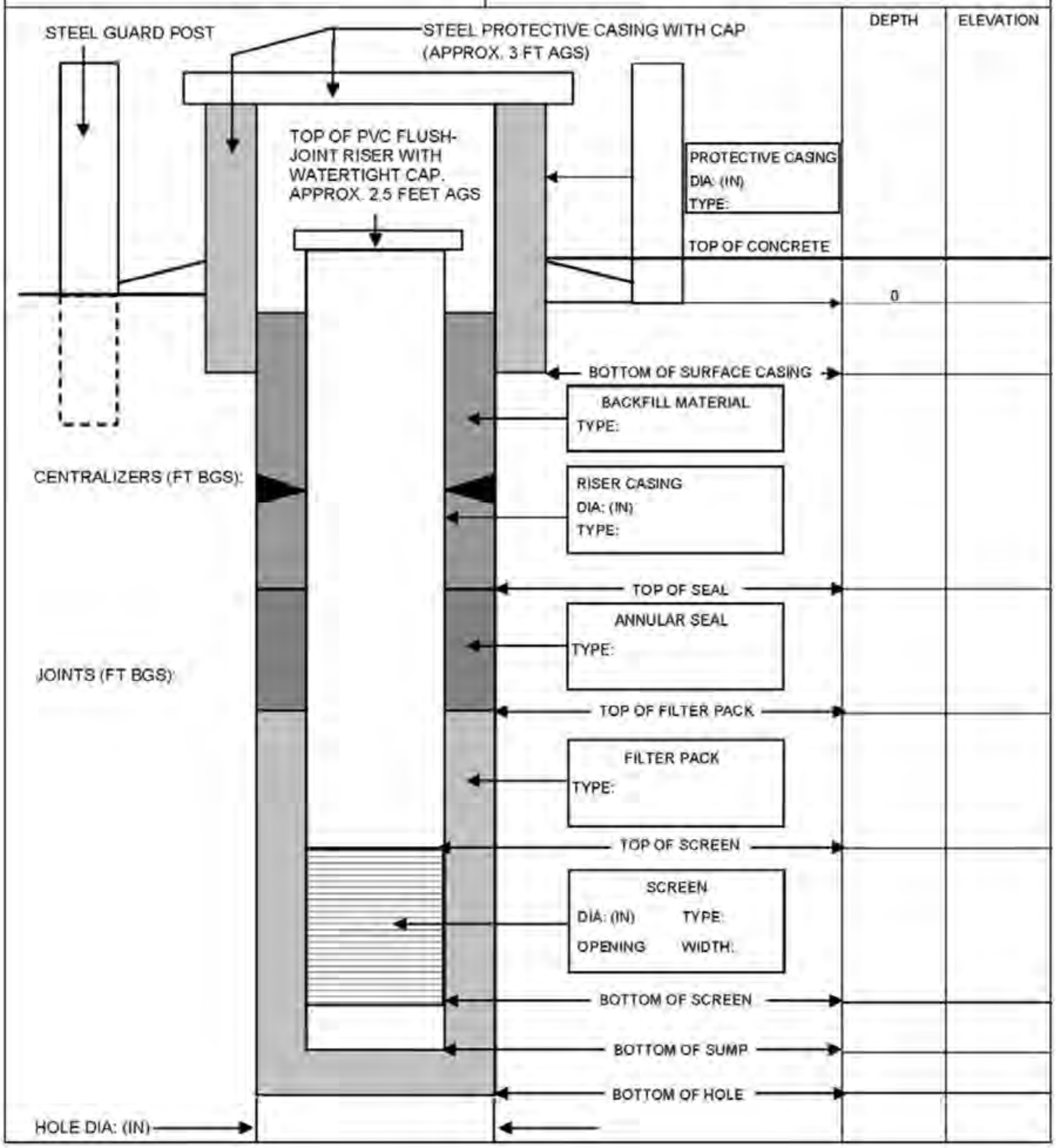
Y/N

1. ____Are any areas at final grade?
2. ____Has the soil been properly prepared to accept permanent seeding?
3. ____Has seed and mulch been applied at the appropriate rate?
4. ____If rainfall has been inadequate, are seeded areas being watered?
5. ____For sites with steep slopes or fill areas, is runoff from the top of the site conveyed to the bottom of the slope or fill area in a controlled manner so as not to cause erosion?

Note areas where repairs or maintenance is needed or where this practice needs to be applied:

MONITORING WELL

PROJECT NAME:		PROJECT NO:
WELL NUMBER:	BEGIN:	END:
COORDINATES: N: E:	REFERENCE POINT:	ELEVATION: MSL



Recorded by:________________________ QA performed by:________________________

DNR 7810.06

WATER WELL SEALING REPORT
OHIO DEPARTMENT OF NATURAL RESOURCES
Division of Water
2045 Morse Rd., Bldg B
Columbus, OH 43229-6693
Voice: (614) 265-6740 Fax: (614) 265-6767

LOCATION

County ____________ Township ____________ Section/Lot Number ____________ (Circle One or Both)

Owner/Builder ____________ (Circle One or Both)

Address of Well Location ____________ Number ____________ Street Name

City ____________ Zip Code ____________

Property Location Description ______ miles ______ (n, e, s, w) of ______ (nearest intersection)

on the ______ (n, e, s, w) side of ______ (road name)

Location of Well in either: State Plane N ☐ S ☐ X |_|_|_|_|_|_|_|.|_|_| +/- ______ ft. or m Y |_|_|_|_|_|_|_|.|_|_| +/- ______ ft. or m

OR

Latitude/Longitude Check ONE ☐ In Decimal Degrees ☐ Degrees Minutes ☐ Degrees Min. Sec. Latitude ____________ Longitude ____________

Elevation of Well |_|_|_|_|.|_|_| +/- ______ ft. or m Datum Plain: ☐ NAD27 ☐ NAD83

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other ____________

ORIGINAL WELL ODNR Well Log Number ____________ Copy attached? Yes or No (circle one)

MEASURED CONSTRUCTION DETAILS

Date of measurements ____________

Depth of Well ____________ Static Water Level ____________
Size of Casing ____________ Length of casing ____________
Well Condition ____________

SEALING PROCEDURE

Method of Placement ____________

			Sealing Material	Volume
Placement:	From ______	To ______	______	______
	From ______	To ______	______	______
	From ______	To ______	______	______

Was Casing Removed? Yes or No (circle one)

Condition of Casing ____________
Perforations: From ______ To ______
From ______ To ______

Date Sealing Performed ____________
Reason(s) for Sealing ____________

CONTRACTOR

Name ____________ ODH Registration # ____________
Address ____________
City/State/Zip ____________

Signature ____________
I hereby certify the information given is accurate and correct to the best of my knowledge.

Completion of this form is required by section 1521.05 (B) (9), Ohio Revised Code - file within 30 days after completion of sealing.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 2045 MORSE ROAD, COLS., OHIO 43229-6693

Blue - Customer's copy Pink - Driller's copy Green - Local Health Dept. copy

GRANULAR FILTER PACK APPROVAL

Project for Intended Use:

Filter Material Brand Name:

Lithology:

Grain Size Distribution:

Source/pit or quarry of origin:

Manufacturer:

Manufacturer address:

Processing method:

Slot Size of Intended Screen:

SUBMITTED BY:

Company:

Person:

Telephone Number:

Date

FOR APPROVAL (A)/DISAPPROVAL (D)	(circle one)	
Project Officer/Date:	A	D
Project Geologist/Date:	A	D
ARNG/OHARNG/Date:	A	D

BENTONITE APPROVAL

Project for intended use:

Bentonite Material Brand Name:

Annular seal:

Grout additive:

Manufacturer:

Manufacturer's Address

Manufacturer's Telephone Number(s):

Product Description:

Intended Use of Product:

Potential Effects on Subsequent Chemical Analyses:

SUBMITTED BY:

Company:

Person:

Telephone Number:

Date

FOR APPROVAL (A)/DISAPPROVAL (D)	(circle one)	
Project Officer/Date	A	D
Project Geologist/Date:	A	D
ARNG/OHARNG/Date:	A	D

WATER APPROVAL

Project for intended use:

Water Source:

Owner:

Address:

Telephone Number:

Water Tap Location:

Operator:

Aquifer:

Well Depth:

Static water level from ground surface:

Date measured:

Type of treatment or filtration prior to tap:

Type of access:

Cost per cubic gallon charged for use:

Results and dates of chemical analyses for past 2 years:

Results and dates of chemical analyses for project analytes:

SUBMITTED BY:

Company:

Person:

Telephone Number:

Date

FOR APPROVAL (A)/DISAPPROVAL (D)	(circle one)	
Project Officer/Date	A	D
Project Geologist/Date	A	D
U.S. Army Project Manager /Date:	A	D

EQUIPMENT CALIBRATION

IDENTIFIER	DESCRIPTION	BACKGROUND READING	PRE	ADJUSTMENT (IF NEEDED)	POST	NAME	DATE

CATEGORY 1 CALIBRATION STANDARDS LOG

PROJECT NAME:				DELIVERY ORDER NO:	
INCLUSIVE DATES FOR CALIBRATION MATERIAL USAGE	INSTRUMENT DESCRIPTION	CALIBRATION MATERIAL *	Psi/BOTTLE	NIST # LOT # AND MANUFACTURER	PERSON (INITIALS)
Start: Finish					
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Start: Finish					
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Figure 6-2. Calibration Standards Logs

MONITORING WELL DEVELOPMENT FORM

Project:	Location ID:	Date Developed:
Personnel Conducting Development:	Date Installed:	
Development Method Used (*circle one*): Bailer Submersible Pump Peristaltic Pump	Pump / Bailor Type (size/model):	Pumping Rate (gal/min) =

<u>Development Criteria:</u>

(1) Turbidity >10 NTU. <u>or</u> if natural Turbidity >10 NTU, water is clear to the unaided eye and turbidity ± 10%
(2) Sediment thickness < 0.1 ft. <u>or</u> Sediment thickness < 1% well screen
(3) Removal 5X well volume. See calculation below.
(4) 3 consecutive readings of development parameters

DEVELOPMENT CONFIRMATION MEASURMENTS (minimum 24 hours after development)

Date / Time:	Total Depth (ft btoc):	Depth to water (ft btoc):

PURGE VOLUME CALCULATION

Well Total Depth before development (ft btoc)=		Length of screen = (ft)	
Depth to Water before development (ft btoc)=		Saturated thickness of filter pack /screen (**Hfp**) (ft toc) =	
Total water column (**H**)(ft)=		Assumed porosity (-) =	**0.3**
Volume of Riser Casing (gal) = (**H**) x (**V**) =		Volume of Filter Pack (gal) = (**Hfp** x **V** x **0.3**) – (**Hfp** x **V**)=	
Total Well Volume = (Volume of Riser Casing) + (Volume of Filter Pack) =			
Minimum purge volume = 5 x (Total Well Volume) =			
Height of casing above ground surface (ft) =		Estimated Rate of Recharge (gal/min) =	

Diameter of casing (in) (*circle one*)	Gallons per foot of depth (**V**) (*circle one*)
2	0.163
4	0.653
6	1.469
8	2.611
9	3.305
10	4.080
12	5.875

INDICATOR PARAMETERS

Date / Time	**Volume purged (gal)** ***Min. 5X Total Volume***	**Temp (°C)** ***(±0.5°C)***	**pH (s.u.)** ***(±0.2)***	**Cond. (mS/cm)** ***(±3%)***	**Turb. (NTU)** ***(<10 NTU or ±10%)***	**ORP (mV)** ***(±20mV)***	**DO (mg/L)** ***whichever is greater: (±10% or < 0.2mg/L)***	**Comments (color, odor)**

MONITORING WELL DEVELOPMENT FORM (CONTINUED)

Project: | Location ID:

INDICATOR PARAMETERS

Date / Time	**Volume purged (gal)** *Min. 5X Total Volume*	**Temp (^oC)** ***(±0.5°C)***	**pH (s.u.)** ***(±0.2)***	**Cond. (mS/cm)** ***(±3%)***	**Turb. (NTU)** ***(<10 NTU or ±10%)***	**ORP (mV)** ***(±20mV)***	**DO (mg/L)** ***whichever is greater: (±10% or < 0.2mg/L)***	**Comments (color, odor)**

LOW FLOW WELL PURGING AND FIELD WATER QUALITY MEASUREMENT FORM

Date: ______________________

Project Name: Camp Ravenna

Site Name: ______________________

Location ID: ______________________

Sample ID: ______________________

Well Head Condition: Locked: Y__ N__

Pooled water at head: Y__ N__ Inner Casing Clean: Y__ N__

Exterior Seal Good: Y__ N__ Inner Casing Straight and Clear: Y__ N__

PID Borehole Reading: ______________________

LNAPL: Y __ N __ DNAPL: Y __ N__ Product Depth ______________________

Purge Style: Peristaltic / Bladder / Submersible /Other ______________________

Mid Screen Depth (ft btoc): ______________________

Pump Intake (ft btoc) ______________________

Sampler(s) ______________________

QC Sample: Y / N Type: ______________________

Parameter(s) Types Collected: ______________________

Time	Purge Rate (100 – 500 mL/min)	Total Purge (L)	Depth to Water	Temp.× °C	pH×	Sp. Cond. (mS/cm)×	Turbidity (NTUs)	DO (mg/L)	ORP (mV)	Comments
Stabilization Requirements				±5°C	± 0.1	± 3%	<10 NTU	±0.3 mg/L	± 10mV or 10%	
Final Parameter Readings Listed Below to be recorded for reporting purposes. (Dup. Info on bottom line) [1]**Water Level Measurements in these boxes must match!**										
			1							
(DUP)										

Additional Comments:

CAMP RAVENNA WASTE MANAGEMENT GUIDELINES

PURPOSE: Guidelines to be followed by contractors working at Camp Ravenna Joint Military Training Center who are generating/shipping Hazardous, Non-Hazardous, Special or Universal Waste.

POLICY: The policy at Camp Ravenna is to comply with all local, state, federal and installation requirements. Contractor is responsible for waste minimization and is required to recycle materials if possible.

Restoration Program POC: Katie Tait (614) 336-6136 **Military & Non-Restoration POC: Brad Kline (614) 336-4918**

Coordination:

- Coordinate all waste generation and shipments with the appropriate Camp Ravenna POC listed above or the Environmental Supervisor in their absence at (614) 336-6568.
- Notify Camp Ravenna POC prior to waste sampling for characterization. Details about sampling activities must be included (i.e., number of sample, analyticals, etc.).
- All Hazardous and Non-Hazardous waste management storage locations must be pre-approved prior to generation.
- Ensure all labels include: Date, Contractor, and Waste Type.
- When contractors have waste onsite, a weekly Inspection inventory must be completed and submitted to the appropriate POC in the Camp Ravenna environmental office.
- All wastes shall be tracked and logged throughout the duration of the project. Contractor will provide Camp Ravenna POC with a monthly rollup report of all waste and recycled streams generated by no later than the 10th day of the following month.

Hazardous Waste Treatment, Storage and Disposal Facilities and Waste Haulers: Contractors are required to utilize hazardous waste haulers and Treatment, Storage, and Disposal Facilities on the latest Defense Reutilization Marketing Office (DRMO) approved list. The current qualified waste hauler and TSDF list can be viewed by following the "Qualified Facilities" and "Qualified Transporters" links found on the DLA Hazardous Waste Disposal Homepage, http://www.dla.mil/DispositionServices/newenv/hwdisposal/.

Hazardous or Non-Hazardous manifest form, the following must be included:

- Military and non-restoration operations waste Site Name = Camp Ravenna Joint Military Training Center. Mailing and Site address: Camp Ravenna ENV, 1438 State Route 534 SW, Newton Falls, Ohio 44444, (614) 336-4918. Ohio EPA ID # – OHD981192925.
- Restoration Program waste Site Name = Former Ravenna Army Ammunition Plant. Mailing address is same as address above. Site address: 8451 State Route 5, Ravenna, Ohio 44266, (614) 336-6136. Ohio EPA ID # – OH5210020736.
- Contractor's shipping Hazardous Waste must provide a Land Disposal Restriction (LDR) in accordance with 40 CFR Part 268.
- Profiling:
  - The required shipping documentation (i.e. waste profile and executive summary of lab reports (if available)) need to be submitted to appropriate Camp Ravenna POC or designee(s) for approval and signature prior to shipping.
  - Results of characterization must be submitted to appropriate Camp Ravenna POC within 30 days after collecting sample.
- Manifests - Hazardous and Non-Hazardous:
  - The waste carrier/transporter provides appropriate manifest to the contractor.
  - The contractor is required to:
    - Ensure that Camp Ravenna POC or designee(s) is available to sign the manifest on the scheduled day of shipment;
    - Verify that each manifest is properly completed and signed by Camp Ravenna POC or designee(s);
    - Provide the Generator copy of the manifest to Camp Ravenna POC or designee(s); and
    - Ensure that the original Generator copy of the manifest signed by the treatment storage disposal facility is returned to Camp Ravenna within 30 days of the shipping date for Hazardous and Non-Hazardous Waste.
    - The use of a Bill of Lading, in lieu of a waste manifest, must be approved by the Camp Ravenna environmental office.

All satellite accumulation storage sites and containers will comply with 40CFR 262.34(c)(1):

- Any material that is subject to Hazardous Waste Manifest Requirements of the US Environmental Protection Agency must comply with 40 CFR Part 262.
- From the time any waste is placed in a satellite storage container, proper labeling must be on the container (proper labeling includes date, contractors name and product type).
- Pending analysis label is to be used from the time the sample is taken until the results are received.
- In no case will waste labeled pending analysis exceed 45 days.

All Camp Ravenna Hazardous and Non-Hazardous records are maintained at the Camp Ravenna environmental office, point of contacts are Katie Tait at (614) 336-6136 and Brad Kline at (614) 336-4918.

CAMP RAVENNA WEEKLY NON-HAZARDOUS & HAZARDOUS WASTE INSPECTION/INVENTORY SHEET

Contractor: _____________ Month: __________________ Year: ____________ Waste Description: ____________

Container Nos. ____

	WEEK 1	WEEK 2	WEEK 3	WEEK 4
	Date: **Time:**	**Date:** **Time:**	**Date:** **Time:**	**Date:** **Time:**
Point of Contact (Name / Number)				
Project Name:				
Contracting Agency and POC:				
Waste Determination: Pending Analysis, Hazardous, Non-Hazardous, etc.				
*Location on installation:				
Date Generated:				
Projected date of disposal:				
Non-Haz, Satellite, 90 day storage area				
Waste generation site:				
Number of Containers (size / type):				
Condition of Container:				
Containers closed, no loose lids, no loose bungs?	yes / no	yes / no	yes / no	yes / no
Waste labeled properly and visible (40 CFR 262.34 (c) (1):	yes / no	yes / no	yes / no	yes / no
Secondary containment	yes / no	yes / no	yes / no	yes / no
Incompatibles stored together?	yes / no	yes / no	yes / no	yes / no
Any spills?	yes / no	yes / no	yes / no	yes / no
Spill kit available?	yes / no	yes / no	yes / no	yes / no
Fire extinguisher present and charged?	yes / no	yes / no	yes / no	yes / no
Containers grounded if ignitables?	yes / no / na	yes / no / na	yes / no / na	yes / no / na
Emergency notification form/info present?	yes / no	yes / no	yes / no	yes / no
Container log binder present?	yes / no	yes / no	yes / no	yes / no
Signs posted if required?	yes / no	yes / no	yes / no	yes / no
Photo’s submitted	yes / no	yes / no	yes / no	yes / no
Printed Name:				
Signature:				

This form is required for Non-Hazardous and Hazardous waste including PCB and special waste.

CONTRACTORS ARE REQUIRED TO SUBMIT THIS FORM WEEKLY TO THE CAMP RAVENNA ENV OFFFICE WHEN WASTE IS STORED ON SITE.

CONTRACTORS ARE ENCOURAGED TO INCLUDE PHOTOS WITH EACH WEEKLY INSPECTION SHEET WHEN WASTE IS STORED ON SITE.

*Draw detailed map showing location of waste within the site.

CONTAINER LOG

Container No. [1] ___________________ **Page ___ of ___**

Satellite Accumulation Area ☐ **Generator Accumulation Area** ☐

Date [2]	Material Name [3]	Quantity Added [4]	Cumulative Quantity [5]	Person Adding Material [6]

(When 55 gals total reached, must move from SAA within 3 calendar days.)
Date Container Transferred to Generator Accumulation Area ______________________

Materials shipped offsite date: ________________________

(1) Container ID Number (e.g., FC-FMS#1-2)

(2) Date when waste was added to container

(3) Name of waste added (e.g., Diesel Fuel)

(4) For items such as filters, note the number of items. For liquids, note the number of gallons.

(5) The total quantity of items of number of gallons currently in the container.

(6) The name of the person adding the waste.

GEOLOGIC BOREHOLE LOG

Borehole (Location) ID: ___________________________ Page _____ of _____

Company/Project		Location Type
Location Description		
Establishing Company	Geologist	Drilling Company
Drilling Foreman	Ground Surface Elevation	Datum
Sampling Device	Borehole Diameter (inches)	Total Depth (Feet)
Date/Time Drilling Started	Date/Time Total Depth Reached	

Depth (feet)	Sampling				Graphic	ASTM CODE	Lithologic Codes	Lithology Description SOIL TYPE, modifiers/grain size, sorting, color, cement/ lithification, moisture content, porosity, permeability/fracturing	Remarks: Drilling Problems, Equipment, Water levels, Time Samples Collected, Weather
	% Recov	Sample Depth	Blow Counts	PID					

DATE________________

DAY

S	M	T	W	T	F	S

DAILY QUALITY CONTROL REPORT

COE PROJECT MANAGER____________________

PROJECT________________________________

JOB NO.________________________________

CONTRACT NO.___________________________

WEATHER	Bright Sun	Clear	Over-cast	Rain	Snow
TEMP	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder.	High	Report No.	
HUMIDITY	Dry	Moder.	Humid		

SUB-CONTRACTORS ON SITE:

EQUIUPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLING):

PROJECT________________________ REPORT NO.________________

JOB NO.________________________ DATE:________________

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):

HEALTH AND SAFETY LEVELS AND ACTIVITIES:

PROBLEMS ENCOUNTERED/CORRECTIVE ACTION TAKEN:

SPECIAL NOTES:

TOMORROW'S EXPECTATIONS:

By:________________________ (Signature and date)

QA Check by:________________________ (Signature and date)

Field Change Request (FCR)

FCR NO.______________ DATE INITIATED________________

PROJECT____

CONTRACT NO.______________________________________

REQUESTOR IDENTIFICATION

NAME_____________________________________ ORGANIZATION___________________ PHONE___________________

TITLE_____________________________________ SIGNATURE____

BASELINE IDENTIFICATION

BASELINE(S) AFFECTED ○ Cost ○ Scope ○ Milestone ○ Method of Accomplishment

AFFECTED DOCUMENT (TITLE, NUMBER AND SECTION)______________________________________

DESCRIPTION OF CHANGE:

JUSTIFICATION:

IMPACT OF NOT IMPLEMENTING REQUEST:

PARTICIPANTS AFFECTED BY IMPLEMENTING REQUEST:

COST ESTIMATE ($)____________ ESTIMATOR SIGNATURE____

PHONE__________________________ DATE_____________________

PREVIOUS FCR AFFECTED ○ YES ○ NO; IF YES, FCR NO. ______________________

CLIENT PROJECT MANAGER ____ DATE______________

CLIENT QA SPECIALIST ____ DATE ____________________

SAIC H&S MANAGER SIGNATURE (IF APPLICABLE)____ DATE______________

NONCONFORMANCE REPORT	DATE OF NCR	NCR NUMBER
	LOCATION OF NONCONFORMANCE	PAGE ____ OF ____
INITIATOR (NAME/ORGANIZATION/PHONE)	FOUND BY	DATE FOUND
RESPONSIBLE ORGANIZATION/INDIVIDUAL		PROGRAM
		PROJECT

DESCRIPTION OF NONCONFORMANCE

CATEGORY: ____ ____ ____ ____ ____

A INITIATOR ____ DATE ____ QA/QC OFFICER ____ DATE ____ CAR REQ'D YES ☐ NO ☐

DISPOSITION:

PROBABLE CAUSE:

ACTIONS TAKEN TO PREVENT RECURRENCE:

B PROPOSED BY: ____ NAME ____ DATE

JUSTIFICATION FOR ACCEPTANCE

C INITIATOR: ____ NAME ____ DATE

VERIFICATION OF DISPOSITION AND CLOSURE APPROVAL

REINSPECTION/RETEST REQUIRED YES ☐ NO ☐ IF YES; ____ DATE ____ RESULT

D QUALITY ASSURANCE: ____ NAME ____ DATE

Figure 11-2. Example of NCR to be Used for RVAAP AOC-Specific Investigations

TEC-Weston Joint Venture

EMPLOYEE/VISITOR DAILY ROSTER

This roster is required for emergency response planning. All personnel arriving to and from the site must sign this roster. This log does not replace the H&S Orientation

Site Name:	**Contract No.:**
Date:	**Delivery Order No.**
Project Manager:	

DATE	NAME	COMPANY	TIME ONSITE	TIME OFF-SITE

TEC-Weston Joint Venture

SITE SPECIFIC SAFETY AND HEALTH PLAN COMPLIANCE AGREEMENT

Project Name: ____

Project Number: ____

I have read and understand the health and safety plan indicated above and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Name	Signature	Employer	Date

TEC-Weston Joint Venture

TAILGATE SAFETY MEETING REPORT

A tailgate safety meeting should be held before each unique activity, for each new crew and daily thereafter.

Site Name: **Date:**

Contract No.: **Delivery Order No.:**

HEALTH & SAFETY PLAN REVIEW

☐ H & S objectives	☐ Site emergency procedures	☐ Chem. hazards. contaminants	☐ Physical hazards
☐ Site history	☐ Air-horn signals, if any	☐ Exposure pathways	☐ Well drilling oper.
☐ Gen. site hazard assess.	☐ Hospital location	☐ Exposure monitoring program	☐ Noise monitoring
☐ Chain of command	☐ Telephone location	☐ Acute symptoms, if distinct	☐ Heat stress
☐ Visitor policy	☐ Response to media inquiries	☐ Decontamination procedures	

FIELD ACTIVITY

Safety Topics and Suggestions

Personal Protective Equipment (PPE)

Emergency Information and Procedures

Injuries and Accidents Since Previous Meeting

Additional comments

TAILGATE SAFETY MEETING ATTENDEES	DATE	
NAME	COMPANY	SIGNATURE

Meeting conducted by ______________________ Title ______________________________

Signature ______________________ Date/Time ______________________________

TEC-Weston Joint Venture

Borehole Abandonment Log

Location Identifier	Direct Push (DP) or Auger (A)	Date	Total Depth (ft)	Diameter (in)	Backfill Material	Surface Completion

Notes:

HBP - Hydrated bentonite pellets

BHS- Bore hole soil

AS- Asphalt

CEM- Neat Cement

SO- Soil

TEC-Weston Joint Venture

Static Groundwater Level Measurement Form

Project Location: Lincoln ANGB

Well Identifier	Date	Time	Well Depth (FTOC)	Screen Length (ft)	Measuring Point (GL or TOC)	Depth to Water (FTOC)	PID Reading (Above Bkgrd) (ppm)

Notes: Well depth to be measured at time of sampling

DAILY DRILL RIG CHECKLIST

Date ______________________ **Rig Description** ______________________

Project # ______________________ **Serial or License #** ______________________

Location ______________________ **Rig Owner** ______________________

Item Name	Requirement	OK	No*	Comment
Hydraulic systems controls and levers	No leaking fittings or connections. Levers are in good operating condition. Fluid levels are full.			
Fuel, oil, water, and coolant lines	No leaks.			
Hoses	No leaks in hoses or connections. No signs of excessive wear, kinked or bent hoses.			
Gauges	Operational and visible to operator.			
Emergency kill switch and life line	Operational and accessible to operator.			
Shear pins	In place.			
Drive chains	No signs of excessive wear, broken or defective links.			
Outriggers	No leaks. Set on pads (as necessary to avoid damage).			
Cables and ropes	No fraying, birdnesting, flattening, stretching. Must be braided or properly clamped at connections.			
Pulleys, drums and spools	No excessive wear or cracking.			
Hoists	Properly spooled cable, rated to lift loads.			
Derrick/Mast	Locked in position. Frame is not cracked or bent.			

Item Name	Requirement	OK	No*	Comment
Guards	Power take-offs (PTOs) and all rotating parts designed with guards. Guards must have warning labels.			
Parking brakes	Set and operational.			
Windshield wipers	Operational.			
Lights (head, tail and running lights)	Operational and without cracked lenses.			
Back-up alarm	Operational, spotter used.			
Safety equipment	Safety harness, fire extinguisher, flares, safety reflectors, first aid kit, grounding wire for fueling, and spill response equipment (for fueling & repairs).			
Miscellaneous(as applicable)	Diverter systems; auger and head seals; cyclones; grout plant guards; etc. (list): • • •			

Deficiencies (Explain all negative responses and list corrective actions; all deficiencies must be corrected before the rig is entered into service):

____

____

____

Other Repairs or Routine Maintenance: ______________________________

____

____

Inspection Conducted and Rig Certified by:
(Owner/Operator) ______________________________
Name and Date

Report Reviewed by:
(TEC-Weston) ______________________________
Name and Date

INCIDENT INVESTIGATION REPORT

To: ____ Prepared by: ________________________________
Division Health and Safety Manager
Position: ________________________________
Project name: ______________________________ Office Location: ____________________________
Project number: ____________________________ Telephone/FAX number: _____________________

INFORMATION REGARDING INJURED OR ILL EMPLOYEE

Name: ____ Social Security Number: ___________
Home Address: ___________________________ Date Of Birth: ______________
____ Home Telephone Number: __________
Occupation (Regular Job Title): _____________ Gender: M ☐ F ☐
Office Location: _______________________________ Division: _________________________

INFORMATION ABOUT THE INCIDENT

Date and Time of Incident

Date of Incident: _____________________________ Time of Incident: a.m. ☐ p.m. ☐
☐ Check if time cannot be determined
Time Employee Began Work: _________________ Did the employee die? Yes ☐ No ☐
If Yes, Date Of Death:

Location of Incident Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Street address: ____

City, state, and zip code: ____County: __________

Describe equipment, materials, and chemicals the employee was using when incident occurred

Describe specific activity the employee was performing when incident occurred

Describe how injury or illness occurred: Describe sequence of events; specify object or exposure that produced injury of illness. Use separate sheet if necessary

INFORMATION ABOUT THE INCIDENT (continued)

Describe The Injury Or Illness: Describe The Part(s) Of The Body Affected And How It Was Affected. Be More Specific Than "Hurt," "Pain," Or "Sore." Examples "Strained Back"; "Chemical Burn, Right Hand"

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐ Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this report.

Medical Treatment Required? ☐ Yes ☐ No ☐ First aid only

If medical treatment was provided, provide the information below.

Name of physician or health care professional: ______________________________

Facility name: ______________________________

Street address: ______________________________

City: ____________________ State:__________ Zip code: __________

Telephone number: ______________________________

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized overnight as an in-patient? ☐ Yes ☐ No

If employee was hospitalized, provide the information below

Facility name: ______________________________

Street address: ______________________________

City: ____________________ State:__________ Zip code: __________

Telephone number: ______________________________

Witness (Attach additional sheets for other witnesses.)

Name: ______________________________

Company: ______________________________

Street address: ______________________________

City: ____________________ State: __________ Zip code: __________

Telephone number: ______________________________

INITIAL NOTIFICATION

Name of employee the injury or illness was first reported to: ______________________________

Date of Report: ______________________________ Time of Report: ______________________________

INJURED EMPLOYEE'S REVIEW

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

______________________________ ______________________________
Printed Name of Injured Employee ***Telephone Number***

______________________________ ______________________________
Signature of Injured Employee ***Date***

INCIDENT NOTIFICATION

By signing below, the following Cardno officials indicate they have been briefed on (a) pertinent details concerning this incident or injury, and (b) of progress and status of the incident investigation.

Title	Printed Name	Signature	Telephone Number	Date
Site Safety Coordinator				
Project Manager				
Division Health & Safety Manager				
Division HR Manager				
Office Manager				

CORRECTIVE ACTIONS IDENTIFIED IN THE INCIDENT INVESTIGATION

Corrective Action(s) Identified Use Additional Sheets, if needed (consider other Cardno sites for impacts)	*Date Implemented Or Corrected*	*Signature*
1.		
2.		
3.		

INVESTIGATION CLOSURE

All identified corrective actions have been implemented.

Comments: ______________________________

____

____

______________________________ ______________
Signature (Division Health & Safety Manager) Date

TO BE COMPLETED BY THE DIVISION H&S MANAGER AND DIVISION HR MANAGER

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First aid only

☐ Days away from work

☐ Remained at work but incident resulted in job transfer or work restriction

☐ Incident involved days away and job transfer or work restriction

☐ Medical treatment only

Date of Employer's Knowledge /Notice of Injury / Illness ____________________

Date Employee Last Worked ____________________

Date employee returned to work ____________________

No. of days away from work ____________________

No. of days placed on restriction or job transfer: ____________________

OSHA Recordable Case Number ____________________

Social Security Number: ____________________

Date Of Hire: ____________________ Hire Date For Current Job: __________

Wage Information: $ __________ Per ☐ Hour ☐ Day ☐ Week ☐ Month

Other Payments Not Reported As Wages/Salary ☐ No ☐ Yes $ ________ Per ________

Position At Time Of Hire: ____________________

Current Position: ____________________ Shift Hours: __________

State In Which Employee Was Hired____________________

Status: ☐ Full-Time ☐ Part-Time Hours Per Week: _____ Days Per Week: _____

Temporary Job End Date: ____________________

To Be Completed during Report to Workers' Compensation Carrier

Date Reported: ____________________

Confirmation Number: ____________________

Name of contact: ____________________

Field Office Of Claims Adjuster: ____________________

Date Employee Was Provided Employee Claim Form: ____________________

APPENDIX A.2

QUALITY ASSURANCE PROJECT PLAN

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Final

Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater

Appendix A: Sampling Analysis Plan,
A.2 – Quality Assurance Project Plan

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

December 21, 2016

Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Prepared for:

National Guard Bureau
NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

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LIST OF ACRONYMS/ABBREVIATIONS

µg/L	microgram per liter
%R	percent recovery
AOC	area of concern
ARNG	Army National Guard
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	Chain of Custody
COPC	Chemical of Potential Concern
Cr(VI)	hexavalent chromium
DERR	Division of Environmental Response and Revitalization
DFFO	Director's Final Findings and Orders
DoD	Department of Defense
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ELLE	Eurofins Lancaster Laboratories Environmental
FS	Feasibility Study
FSP	Field Sampling Plan
FWQAPP	Facility-Wide Quality Assurance Project Plan
FWSAP	Facility-Wide Sampling and Analysis Plan
GW	groundwater
HASP	Health and Safety Plan
IDW	investigation derived waste
L	liter(s)
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
MCL	Maximum Contaminant Level
MRS	Munitions Response Site
MS	matrix spike

LIST OF ACRONYMS/ABBREVIATIONS (CONTINUED)

MSD	matrix spike duplicate
N+N	Nitrate + Nitrite
NGB	National Guard Bureau
NGB-AQ-E	National Guard Bureau, Environmental Support Branch
OHPO	Ohio Historic Preservation Office
Ohio EPA	Ohio Environmental Protection Agency
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Project Action Limit
PCB	Polychlorinated Biphenyls
P.E.	Professional Engineer
P.G.	Professional Geologist
PM	Project Manager
PMP®	Project Management Professional
PQO	Project Quality Objectives
PRL	Project Reporting Level
PWS	Performance Work Statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
REIMS	Ravenna Environmental Information Management System
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RPD	relative percent difference
RSL	Regional Screening Level
RVAAP	Former Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TEC-Weston JV	TEC-Weston Joint Venture

LIST OF ACRONYMS/ABBREVIATIONS (CONTINUED)

USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
VOC	Volatile Organic Compound
WP	Work Plan

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) is developed in accordance with the National Guard Bureau (NGB) and Ohio Environmental Protection Agency (Ohio EPA) guidance documents to meet the requirements for the investigation of known or suspected contaminated sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Resource Conservation and Recovery Act (RCRA); and other federal regulations that govern environmental restoration activities at the Former Ravenna Army Ammunition Plant (RVAAP) (Camp Ravenna). The SAP establishes the methods and procedures to characterize areas of concern (AOCs), compliance restoration sites, and munitions response sites (MRSs) at Camp Ravenna. The term "AOCs," as used throughout this document, is to be considered inclusive of compliance restoration sites and MRSs.

This SAP details the expected sampling methods, equipment, and procedures; sample custody/documentation requirements; sample packaging, shipping, and handling requirements; generic management of investigation-derived waste (IDW); chemical quality control (QC) requirements; field documentation; data reporting; and corrective actions to be used during the Remedial Investigation (RI). The SAP comprises two parts: A.1 is the Field Sampling Plan (FSP) and A.2 is the Quality Assurance Project Plan (QAPP), which follows the Uniform Federal Policy Quality Assurance Project Plan guidelines and format (United States Environmental Protection Agency [USEPA], 2005).

This document is an appendix to the RVAAP-66 Facility-wide Groundwater Monitoring Remedial Investigation Work Plan (RIWP) and provides elements of the work that are investigation-specific. This QAPP appendix contains specific project management, measurement data acquisition, assessment oversight, and data review information. This QAPP will be tiered under the facility-wide plan and used in conjunction with it to the extent practical.

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1.0 TITLE AND APPROVAL PAGE (QAPP WORKSHEET #1)

Final

Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater

Appendix A: Sampling and Analysis Plan, A.2 – Quality Assurance Project Plan

Former Ravenna Army Ammunition Plant

Portage and Trumbull Counties, Ohio

December 21, 2016

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Prepared for:

National Guard Bureau
NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

Reviewed by:

TEC-Weston JV Project Manager Signature/ Date
Brent Ferry, P.G., PMP®, TEC-Weston JV Project Manager

TEC-Weston JV Quality Manager Signature/ Date
Jim Brackett, P.E., PMP®, TEC-Weston JV Quality Manager

Approved by:

NGB-ZC-AQ Installation Program Manager and COR Signature/Date
Mark Leeper, National Guard Bureau

SEDLAK.KEVIN.MICHAEL.1254440171 Digitally signed by SEDLAK.KEVIN.MICHAEL.1254440171
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=CONTRACTOR, cn=SEDLAK.KEVIN.MICHAEL.1254440171
Date: 2016.12.21 10:22:37 -05'00'

ARNG Restoration Project Manager Signature/Date
Kevin Sedlak, Army National Guard

2.0 IDENTIFYING INFORMATION (QAPP WORKSHEET #2)

Project Name/Number:	Sampling and Analysis Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater
Operable Unit:	Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio
Contractor Name:	TEC-Weston JV
Contract Number:	W9133L-14-D-0008
Task Order Number:	0003

1. This Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) was prepared in accordance with the requirements of:	• Submission Format Guidelines for the Ravenna Army Ammunition Plan Restoration Program, Version 21. Contract no. W912QR-13-C-0031. (October 21, 2015). • UFP-QAPP Manual (USEPA, 2005)
2. Identify regulatory program(s):	Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
3. Identify regulatory Agency(ies):	Ohio Environmental Protection Agency (Ohio EPA), Division of Environmental Response and Revitalization (DERR). Ohio EPA.
4. This UFP-QAPP is a:	Project-specific document to provide detailed information on the execution of the field program for the Remedial Investigation (RI) at Former Ravenna Army Ammunition Plant (RVAAP), Portage and Trumbull Counties, Ohio.
5. List dates of scoping sessions that were or will be held:	October 14, 2015
6. List dates and titles of any UFP-QAPP documents written for previous site work that are relevant to the current investigation:	Final Facility-Wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations (SAIC, 2011a). Final Facility-Wide Quality Assurance Project Plan for Environmental Investigations (SAIC, 2011b).
7. List organization(s):	National Guard Bureau, Environmental Support Branch (NGB-AQ-E)
8. If any required UFP-QAPP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted UFP-QAPP elements and provide an explanation for their exclusion:	All required elements are included in this UFP-QAPP.

Table 2-1. Identifying Information

	Required Information	Page # or Locations
A. Project Management		
Documentation		
1	Title and Approval Page	1-1
2	QAPP Identifying Information	2-1
3	Distribution List	3-1
4	Project Personnel Sign-off Sheet	4-1
Project Organization		
5	Project Organization Chart	5-1
6	Communication Pathways	6-1
7	Personnel Responsibilities and Qualifications Table	7-1
8	Special Personnel Training Requirements Table	8-1
Project Planning/ Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	9-1
10	Site History and Background. Site Maps (historical and present). Conceptual Site Model.	10-1
11	Site-Specific Project Quality Objectives	11-1
12	Measurement Performance Criteria Table	12-1
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	13-1
14	Summary of Project Tasks	14-1
15	Reference Limits and Evaluation Table	15-1
16	Project Schedule/Timeline	16-1
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	17-1
18	Sampling Locations and Methods/ SOP Requirements Table Sample Location Map(s)	18-1
19	Analytical Methods/SOP Requirements Table	19-1
20	Field Quality Control Sample Summary Table	20-1
21	Project Sampling SOP References Table Sampling SOPs	21-1
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	22-1
Analytical Tasks		
23	Analytical SOPS Analytical SOP References Table	23-1
24	Analytical Instruments Calibration Table	24-1
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	25-1

	Required Information	Page # or Locations
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	26-1
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification	27-1
Quality Control Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	28-1
Data Management Tasks		
29	Project Documents and Records Table	29-1
30	Analytical Services Table Analytical and Data Management SOPs	30-1
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	31-1
32	Assessment Findings and Corrective Action Responses Table	32-1
33	QA Management Reports Table	33-1
D. Data Review		
34	Verification (Step I) Process Table	34-1
35	Validation (Steps IIa and IIb) Process Table	35-1
36	Validation (Steps IIa and IIb) Summary Table	36-1
37	Usability Assessment	37-1
E. Additional Information		

Notes: QA = Quality Assurance
QC = Quality Control
SOP = Standard Operating Procedure
UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan

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3.0 DISTRIBUTION LIST (QAPP WORKSHEET #3)

This worksheet identifies key project personnel for the lead organization and regulating authorities that will receive a complete copy of the UFP-QAPP, including future updates, change pages, and/or addenda.

Table 3-1. Distribution List

Name of Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Document Control Number (Optional)
Mark Leeper	Contracting Officer's Representative/Installation Program Manager	NGB-ZC-AQ	703-607-7955	mark.s.leeper.civ@mail.mil	N/A
Kevin Sedlak	ARNG Restoration Project Manager	ARNG	614-336-6000 ext. 2053	kevin.m.sedlak.ctr@mail.mil	N/A
Kathryn Tait	Environmental Scientist	OHARNG	614-336-6136	kathryn.s.tait.nfg@mail.mil.	N/A
Justin Burke	Regulatory Oversight	Ohio EPA-CO-DERR	614-644-2902	justin.burke@epa.ohio.gov	N/A
Kevin Palombo	Regulatory Oversight	Ohio EPA DERR	330-963-1292	kevin.palombo@epa.ohio.gov	N/A
Al Muller	Regulatory Oversight	Ohio EPA DERR	330-963-1211	albert.muller@epa.ohio.gov	N/A
Jim Brackett	Quality Manager	TEC-Weston JV	303-273-0231	jim.brackett@cardno-gs.com	N/A
Brent Ferry	Project Manager	TEC-Weston JV	512-651-7108	brent.ferry@westonsolutions.com	N/A
Heather Miner	Project Chemist	TEC-Weston JV	303-273-0231	heather.miner@cardno-gs.com	N/A
David Wazny	Field Team Leader	TEC-Weston JV	440-781-2373	david.wazny@cardno.com	N/A
Patrick McEntee or designee	Laboratory Project Manager	TestAmerica Laboratory Inc.	303-736-0107	patrick.mcentee@testamericainc.com	N/A
Travis Withers or designee	Validation Chemist	TEC-Weston JV	303-273-0231	travis.withers@cardno-gs.com	N/A
Stock Drilling	Drilling Subcontractor	Stock Drilling	734-279-2059	rich@stockdrilling.com	N/A

Notes: ARNG = Army National Guard
DERR = Division of Environmental Response and Revitalization
N/A = Not Applicable
NGB–ZC-AQ = National Guard Bureau Environmental Support Branch
OHARNG = Ohio Army National Guard
Ohio EPA-CO-DERR = Ohio Environmental Protection Agency, Division of Environmental Response and Revitalization
TEC-Weston JV = TEC-Weston Joint Venture

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4.0 PROJECT PERSONNEL SIGN-OFF SHEET (QAPP WORKSHEET #4)

This worksheet documents that all key project personnel performing work have read the applicable sections of this UFP-QAPP and will perform the tasks as described.

Table 4-1. Project Personnel Sign-Off Sheet

Name	Title	Organization	Telephone Number	Signature/Email Receipt	Date UFP-QAPP Reviewed
Jim Brackett	Quality Manager	TEC-Weston JV	303-273-0231		
Brent Ferry	Project Manager	TEC-Weston JV	512-651-7108		
Mike Chapa	Technical Lead	TEC-Weston JV	210-380-2570		
David Wazny	Field Team Leader	TEC-Weston JV	440-262-2373		
Heather Miner	Project Chemist	TEC-Weston JV	303-273-0231		
Patrick McEntee or designee	Laboratory Project Manager	TestAmerica Laboratories, Inc.	303-736-0107		
Travis Withers	Validation Chemist	TEC-Weston JV	303-273-0231		

Notes: UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan
TEC-Weston JV = TEC-Weston Joint Venture

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5.0 PROJECT ORGANIZATION CHART (QAPP WORKSHEET #5)

This information is contained in Section 2.0 of the SAP A.1 — Field Sampling Plan.

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6.0 COMMUNICATION PATHWAYS (QAPP WORKSHEET #6)

This worksheet identifies the communication pathways between project personnel.

Table 6-1. Communication Pathways

Communication Drivers	Organization/Title	Name/Email	Phone Number	Procedure
Installation Points of Contact Manage and oversee the project	Contracting Officer's Representative/ARNG Cleanup Program Manager	Mark Leeper/ mark.s.leeper.civ@mail.mil	703-607-7955	E-mail/phone communication with TEC-Weston JV PM, and Installation Points of Contact.
	ARNG Restoration Project Manager	Kevin Sedlak/ kevin.m.sedlak.ctr@mail.mil	614-336-6000 ext. 2053	E-mail/phone communication ARNG TEC-Weston JV PM, and State Regulator.
	OHARNG, Environmental Scientist	Kathryn Tait/ kathryn.s.tait.nfg@mail.mil	614-336-6136	
Regulatory Oversight	Ohio EPA	Justin Burke/ justin.burke@epa.ohio.gov	614-644-2902	E-mail/phone communication with Installation Points of Contact, NGB, and TEC-Weston JV PM.
		Kevin Palombo/ kevin.palombo@epa.ohio.gov	330-963-1292	
		Al Muller/albert.muller@epa.ohio.gov	330-963-1211	
Manage all Contract Phases	TEC-Weston JV Project Manager	Brent Ferry/ brent.ferry@westonsolutions.com	512-651-7108	All materials and information about the project will be forwarded by TEC-Weston JV PM to Installation Points of Contact or their representative. TEC-Weston JV PM will notify Installation Points of Contact or their representative of field-related problems by phone, email, or fax by the next business day.
	TEC-Weston JV Alternate Project Manager	Mike Chapa/ mike.chapa@westonsolutions.com	210-380-2570	
Health and Safety Oversight	TEC-Weston JV Program Safety and Health Officer	David Robinson/ David.Robinson@westonsolutions.com	303-729-6181	Ensure HASP addresses safe execution of all fieldwork and designate a site-safety and health officer. If site conditions become unsafe, stop work and report to the TEC-Weston JV PM.
Field and Analytical Corrective Actions	TEC-Weston JV Field Team Leader	David Wazny/ david.wazny@cardno.com	440-262-2373	TEC-Weston JV Field Team Leader (or designee) will e-mail daily field progress reports to TEC-Weston JV PM.
Reporting Lab Data Quality Issues	TestAmerica Laboratories, Inc., Laboratory Project Manager	Patrick McEntee or designee/ patrick.mcentee@testamericainc.com	303-736-0107	All QA/QC issues with project field samples will be reported by Laboratory PM to TEC-Weston JV Project Chemist within two business days. If corrective measures are required, TEC-Weston JV Project Chemist will notify the Quality Manager and TEC-Weston JV PM.

Communication Drivers	Organization/Title	Name/Email	Phone Number	Procedure
Release of Analytical Data	TEC-Weston JV Project Chemist	Heather Miner/ heather.miner@cardno-gs.com	303-273-0231	TEC-Weston JV Project Chemist will e-mail or fax analytical data as requested by TEC-Weston JV PM or TEC-Weston JV Field Team Leader to Installation Points of Contact.
UFP-QAPP Amendments	TEC-Weston JV Project Chemist	Heather Miner/ heather.miner@cardno-gs.com	303-273-0231	TEC-Weston JV Project Chemist will e-mail any changes to this UFP-QAPP to TEC-Weston JV PM and TEC-Weston JV Field Team Leader. Specific personnel are listed in Worksheet #3

Notes: ARNG = Army National Guard
HASP = Health and Safety Plan
NBG = National Guard Bureau
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
PM = Project Manager
QA/QC = Quality Assurance/Quality Control
TEC-Weston JV = TEC-Weston Joint Venture
UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan

7.0 PERSONNEL RESPONSIBILITIES AND QUALIFICATION (QAPP WORKSHEET #7)

This worksheet identifies the responsibilities of each project role. In addition, the education and experience qualifications are described for assigned personnel.

Table 7-1. Personnel Responsibilities and Qualifications

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Mark Leeper, P.G.	NGB Contracting Officer's Representative	NGB-ZC-AQ	- Primary point of contact on all contractual matters	N/A
Kathryn Tait	Environmental Scientist	OHARNG	- Primary point of contact at Camp Ravenna - Provides installation management and support/insight during data collection and project execution	N/A
Kevin Sedlak	ARNG Restoration Project Manager/ Installation Point of Contact	ARNG	- Provides installation management and support/insight during data collection and project execution	N/A
Justin Burke Kevin Palombo Al Muller	Regulatory Oversight	Ohio EPA DERR	- Provides regulatory oversight	N/A
Kate Bartz	JV Program Manager	TEC-Weston JV	- Lead for the JV Management Committee - Primary point of contact for NGB programmatic issues	B.S. Environmental Studies/ M.S. Landscape Architecture & Environmental Planning, 29 years environmental experience
Brent Ferry, P.G., PMP®	Project Manager	TEC-Weston JV	- Programmatic Oversight - Ensure consistency across all project documents - Ensure adherence to Investigation Guidance	B.S. Geology, M.S. Hydrogeology, 15 years of experience

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jim Brackett, P.E., PMP®	Quality Manager	TEC-Weston JV	- Responsible for defining field elements and developing the UFP-QAPP - Monitors field, laboratory, and validation activities to ensure compliance with UFP-QAPP requirements - Identifies non-conformances through QA/QC review activities/audits and recommends corrective action - Prepares reports for submittal	B.S. Mechanical Engineering/M.S. Mechanical Engineering, 34 years of experience
David Robinson	Health and Safety Officer	TEC-Weston JV	- Responsible for development of Environmental Remediation Services Health and Safety Program. - Oversees preparation of HASP	B.S. Chemistry, 25 years of experience
Mike Chapa, P.G., PMP	Technical Lead/Alternate Project Manager	TEC-Weston JV	- Responsible for implementing all activities listed in TO - Prepares or supervises preparation of UFP-QAPP and approves document - Oversees field activities including sampling and visual monitoring - Prepares or supervises preparation of reports for submittal	B.S. Resources & Environmental Studies, 21 years of experience
David Wazny, P.G.	Field Team Leader	TEC-Weston JV	- Responsible for implementing all field activities - Communicates with Project Manager - Monitors field activities to ensure compliance with UFP-QAPP requirements - Ensure HASP is followed	B.S. Environmental Studies/M.S. Hydrology, 19 years environmental experience
Heather Miner	Project Chemist	TEC-Weston JV	- Responsible for defining analytical requirements - Responsible for resolution of laboratory QC issues with Project Manager - Provides program-level QA/QC guidance to installation Points of Contact, TEC-Weston JV Project Manager, and project team - Reviews validation reports before release to the project team	B.S. Chemistry/M.S. Geochemistry, 13 years environmental experience
Driller	Driller	Stock Drilling	- Perform drilling activities	N/A
Patrick McEntee (or designee)	Laboratory Project Manager	TestAmerica Laboratories, Inc.	- Point of contact for TEC-Weston JV - Responsible for adhering to laboratory PWS requirements	N/A
Travis Withers	Validation Chemist	TEC-Weston JV.	- Responsible for adhering to validation PWS requirements	B.S. Chemistry, 1 year experience

Notes ARNG = Army National Guard
B.S. = Bachelor of Science
CIH = Certified Industrial Hygienist
HASP = Health and Safety Plan
M.S. = Master of Science
NGB = National Guard Bureau
N/A = Not Applicable
NGB-ZC-AQ = National Guard Bureau Environmental Support Branch
Ohio EPA DERR = Ohio Environmental Protection Agency, Division of Environmental Response and Revitalization
P.E. = Professional Engineer
P.G. = Professional Geologist
PMP = Project Management Professional
PWS = Performance Work Statement
TEC-Weston JV = TEC-Weston Joint Venture
TO = Task Order
QA/QC = Quality Assurance/Quality Control
UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan

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8.0 SPECIAL PERSONNEL TRAINING REQUIREMENTS (QAPP WORKSHEET #8)

This worksheet documents specialized training or course certification required on this project.

Table 8-1. Special Personnel Training Requirements

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
Environmental Fieldwork	40-hour HAZWOPER Training for all staff and at least one 8-hour OSHA supervisor trained person onsite	Qualified vendor	various	All TEC-Weston JV and subcontractor personnel that will be onsite	TEC-Weston JV staff, subcontractors	Training records are maintained in the home office for each employee or onsite, as appropriate.
Environmental Fieldwork	8-hour HAZWOPER Refresher Training	Qualified vendor	various	All TEC-Weston JV and subcontractor personnel that will be onsite	TEC-Weston JV staff, subcontractors	
Environmental Fieldwork	Ongoing training and monitoring to ensure field activities are performed in accordance with the SOPs	TEC-Weston JV	various	All TEC-Weston JV personnel that will be performing fieldwork	TEC-Weston JV staff	
Environmental Fieldwork	CPR/Adult Standard First Aid	various	various	All TEC-Weston JV personnel that will be onsite performing fieldwork	TEC-Weston JV staff	
Data Management	Acceptable Rules of Behavior, and Federal Information Systems Security Awareness Training Certificate	various	various	All TEC-Weston JV personnel designated to upload data to REIMS	TEC-Weston JV staff	

Notes: CPR = Cardiopulmonary Resuscitation
HAZWOPER = Hazardous Waste Operations and Emergency Response
OSHA = Occupational Safety and Health Administration
REIMS = Ravenna Environmental Information Management System
SOP = Standard Operating Procedure
TEC-Weston JV = TEC-Weston Joint Venture

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9.0 PROJECT SCOPING SESSION (QAPP WORKSHEET #9)

Project Name/Number: Sampling and Analysis Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater

Operable Unit: Former Ravenna Army Ammunition Plant

Projected Date(s) of Sampling: See Worksheet #16

Site Location: Portage and Trumbull Counties, Ohio

Project Manager: Paul Bartz, TEC-Weston JV

Date of Session: October 14, 2015

On October 14, 2015, a Groundwater Scoping Technical Meeting was held to discuss regulatory oversight, Work Plan (WP) preparation (consisting of a UFP-QAPP and Health and Safety Plan [HASP]), and screening criteria and cleanup levels. Meeting participants, and the draft meeting minutes (as compiled by Ms. Rebecca Haney of Vista Sciences Corporation) are included below.

Table 9-1. Project Scoping Session Participants

Name of Meeting Attendee	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Bob Princic	Ohio EPA DERR	Ohio EPA DERR	330-963-1230	bob.princic@epa.ohio.gov
Rod Beals	Ohio EPA DERR	Ohio EPA DERR	330-963-1218	bob.beals@epa.ohio.gov
Paul Bartz	Project Manager	TEC-Weston JV	517-381-5933	paul.bartz@westonsolutions.com
David Wazny	Field Team Leader	TEC-Weston JV	440-262-2372	david.wazny@cardno.com
Mike Chapa	Alternate Project Manager	TEC-Weston JV	210-380-2570	mike.chapa@westonsolutions.com
Kathryn Tait	Environmental Scientist	OHARNG	614-336-6136	kathryn.s.tait.nfg@mail.mil
Kevin Sedlak	ARNG Restoration Project Manager	ARNG	614-336-6000 ext. 2053	kevin.m.sedlak.ctr@mail.mil
Eric Stahl	Client Service Manager	TEC-Weston JV	610-324-1988	eric.stahl@westonsolutions.com
Joe Davis	Camp Ravenna Task Order Scheduling	JD2-IM, LLC	615-791-1139	jdavis@jdtwo.com
Mark Leeper	Contracting Officer's Representative/Installation Program Manager	ARNG	703-607-7955	mark.s.leeper.civ@mail.mil

Name of Meeting Attendee	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Kevin Palombo	Ohio EPA DERR	Ohio EPA DERR	330-963-1292	kevin.palombo@epa.ohio.gov
Al Muller	Ohio EPA DERR	Ohio EPA DERR	330-963-1211	albert.muller@epa.ohio.gov
Carrie Rasik	Ohio EPA DERR	Ohio EPA – CO	614-644-2902	carrie.rasik@epa.ohio.gov
Justin Burke	Environmental Specialist Division of Emergency and Remedial Response (DERR)	Ohio EPA – CO	614-644-2902	justin.burke@epa.ohio.gov

Notes: ARNG = Army National Guard
OHARNG = Ohio Army National Guard
Ohio EPA DERR = Ohio Environmental Protection Agency, Division of Environmental Response and Revitalization
Ohio EPA – CO = Ohio Environmental Protection Agency – Central Office
TEC-Weston JV = TEC Weston Joint Venture

A technical meeting to discuss the RVAAP Restoration Program Facility-Wide Groundwater Scoping and path forward was held on Wednesday October 14, 2015. Meeting participants are indicated above. The following items were discussed along with development of any corresponding decisions and/or action items.

General Meeting Objectives:

- Identify stakeholder issues and end goals.
- Identify high priority objectives for stakeholders.
- Describe/establish specification of successful outcomes.
- Discuss thought process and development of technical approach.
- Review document submission and sampling schedule.
- Risk assessment approach.
- Other items not included above.

Scheduling and Document Clarification:

- Director's Final Findings and Orders (DFFO) FY15 Milestone Extension Request
  - The Army submitted an extension request for the FY15 DFFO Milestone for RVAAP-66 Remedial Investigation (RI)/Feasibility Study (FS) WP due to a change in Contractor.

- There was some confusion about the proposed extension date of 28 March 2016.
- The project schedule was reviewed. The Preliminary Draft document is scheduled for submission November 19 or 20, 2015. There were some discrepancies in required review times that were noted and corrected. With the timeframe as it stands, the Draft document would be expected at the end of January 2016 and the Final document to follow in Mid-April.
- In the proposed schedule, the first sampling event should be held in March and covers 179 wells. The approval for the Draft RI WP may not be received in sufficient time to achieve the March sampling event.
- If needed, the sampling plan can be approved separately from the WP.
- The Draft WP will be submitted for Ohio EPA review by 1 February 2016.

- Annual Groundwater Monitoring Report and Semiannual Groundwater Addendum
  - The DFFO requires the Semiannual Groundwater Addendum be submitted as a separate item, not included in the submission of The Annual Groundwater Annual Report (typically in March).
  - The Semiannual Groundwater Addendum allows stakeholders a yearly chance to review the status of Groundwater Monitoring and regroup accordingly.
  - It was decided that for 2016 the WP will also serve as the Addendum. The letter of transmittal for the 2016 WP will state that it also serves as the Addendum. In 2017 and subsequent years, the Addendum will be submitted under separate cover.

Technical Approach:

- **Mike Chapa of TEC-Weston JV gave a review of the rationale behind the Technical Approach that was submitted for contract bid.**
  - The first step was to try to evaluate the previous RVAAP groundwater data, which is very challenging due to the amount of data.
  - The technical approach was developed using guidance from USEPA published in February 2014. The goal was to get to a holistic RI with individual AOCs and a mix of chemicals of potential concern (COPCs) considered. TEC-Weston JV tried to develop an approach that took a practical aspect, based on the whole installation and what has been characterized historically at the AOCs.
  - The first stage of the approach begins with looking at the installation boundaries, turbidity, inorganics (even at low levels), and determining whether any COPCs are moving offsite. A high priority is understanding potential offsite migration.

- TEC-Weston JV analyzed technical data available on Ravenna Environmental Information Management System (REIMS) and in RI reports to look at what had been characterized in groundwater at localized AOCs. This information was correlated to what was characterized in the soil at those AOCs. There are many AOCs where constituents were present in groundwater or soil, but not in both. This was not an exhaustive analysis and hasn't been looked at in great detail but did factor in the scoping process.
- Plume groups were identified to better manage the vast amount of data. Available groundwater data and directional flow data were accessed to develop the size and extent of each plume. Due to co-mingling of COPCs, differences in COPCs present at AOCs, and different layers where COPCs were found, there are instances of overlapping plume groups in various locations.
- With these variations in mind, it made more sense to address the installation as a consolidated mass. This approach allows the team to identify and focuses on problem/high priority areas or chemicals of concern/COPCs. This approach will also make evident problems at the individual AOC level.
- TEC-Weston JV and the Army believe this approach is more economical and efficient than addressing all AOCs on an individual basis.

Remedial Investigation Work Plan:

- **Discussion to determine the best methodology in developing the WP.**
  - Looking at the Groundwater Program, there are many issues such as identifying boundaries, placeholders, and interior areas that have not characterized to date, and the time lapse between samples. The decision process looked at data sets as plume groups to assess if/which wells need to be reviewed.
  - How can all this be addressed and managed in a document that is reviewable in a few months. Plumes make this approach more feasible, but also require reassessment as the program evolves. The AOC-specific well data needed for the Ohio EPA can and will be addressed as the area included in the plumes is better identified.
  - The vast amount of data produces a time constraint to organize it to a point where informative decisions can be made.
  - The Ohio EPA believes Groundwater is Facility-Wide because each AOC-specific document states that groundwater will be addressed under the Facility-Wide Groundwater Monitoring Program. Each AOC needs to be evaluated to ensure Groundwater has been adequately addressed. This can only be accomplished by assessing COPCs present (if any) at the site, their location, whether there are enough existing wells for sampling and the proximity of those wells in relation to the hits. There

are some sites where existing wells adequately address COPCs present, other sites where additional wells are needed, and some sites that have not been evaluated at this level. This is the only opportunity to ensure that wells are in the right place and address COPCs found at each AOC.

- This model will address each current AOC and COPC characterized. It will also evaluate what has not been addressed and address it under the current project. Knowledge of any data gaps the Ohio EPA is aware of will be helpful in addressing those issues as soon as possible.
- The bottom line is there are multiple objectives for this project. Understanding the hierarchy of those objectives will focus the work and give a better concept of the path forward. The RI will define the objectives and rational for prioritization.
- A high priority objective of the project is to establish accurate background wells. Once this is done many of the questionable wells and COPCs will no longer be considered a concern. It is not practical or efficient to assess these issues until accurate backgrounds are established (some metals for example).
- Addressing data gaps onsite and plume levels are also high priority objectives.
- The Ohio EPA prefers that current groundwater data be assessed on an AOC basis.

Groundwater Modeling:

- **Mike Chapa of TEC-Weston JV gave a review of the methodology in the Groundwater Modeling:**
  - The starting point for the model was an installation base map. Then historical cross sections were imported. The projections were based on the limited number of wells at certain depths and contact to develop the current model lithology. It’s important to have historical data crossed mapped with current.
  - The Preliminary model – surface topography and upper bedrock surface elevation with projection of contours overlapping Sharon conglomerate and upper contact levels. The next level was the Sharon conglomerate with RVAAP wells installed.
  - As work progresses the model will evolve and be more usable.
  - Static map discrepancies that affect the modeling images need to be evaluated and corrected.
  - An AOC specific overlay needs to be added to evaluate plumes and whether each AOC is adequately addressed.
  - The Ohio EPA wants to make sure leaching potential from soil to groundwater is considered in the RI.

- State and public information will be used to correlate and better understand soil types present at the facility.

<u>End of Meeting Summary:</u>

- It would be very beneficial to the project if stakeholders could develop a list of AOCs where they believe there are groundwater concerns.
- The project has time constraints, and development of an AOC list may create delays in that schedule.
- If there are no high or elevated contaminated soil areas, there is nothing to drive the installation of new well.
- Tabulated data that show a roadmap to logic will be included in the WP.
- Regardless, Ohio EPA is going to ask and want to see the information used to eliminate areas and focus on other areas.
- In this Groundwater project more wells will be sampled using better sampling methods. The team might want to wait until some of the data come back. There will be a lot more data that are more accurate than what are currently available and this will change things.
- There are also some outstanding soil data that will affect the direction of the project. The WP is meant to communicate the logic proposed.
- Some new wells will be installed, for example new background wells and some to fill already identified data gaps. Drilling of these wells needs to proceed as planned in the current project schedule. The placement of the remaining new wells needs to be handled through another meeting once background data are established.
- The overall goal is to craft an RI that is as specific as possible but can be adapted as additional data are collected.
- The Ohio EPA prefers a tabular document that states each AOC was evaluated.
- This is a Facility-Wide project, but future or current AOCs with no RI in place will not be addressed. A list is needed of AOCs that constitute the scope of this project as it stands now.
- The team discussed having a project status meeting in about a month, but no concurrence or date was established.

10.0 PROBLEM DEFINITION, SITE HISTORY AND BACKGROUND (QAPP WORKSHEET #10)

Site history and background information is contained in Section 2.0 of the Facility-Wide Sampling and Analysis Plan (FWSAP) (SAIC, 2011a). The problem definition is contained in Sections 2.0 and 3.0 of the WP.

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11.0 PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS (QAPP WORKSHEET #11)

11.1 Goals of the Study

This information is contained in Section 2.2 of the RIWP.

11.2 Information Inputs

Worksheet #17 outlines data to be collected to meet the requirements of the decision statements described above.

- Accurate groundwater potentiometric maps to evaluate hydraulic gradients over time.
- Accurate bore logs to evaluate subsurface migration pathways in the vadose and saturated zones for COPCs.
- Accurate survey data to accurately produce site maps and potentiometric surfaces.
- Rigorous sampling procedures to ensure results accurately measure and represent field concentrations.
- Rigorous analytical methods to ensure laboratory results accurately measure and represent field concentrations.

Target analytes, analytical methods, and project action limits (PALs) are shown in Worksheet #15.

11.3 Study Boundaries

The proposed sample locations are selected based on results from previous investigations. Groundwater samples will be collected from within Camp Ravenna and potentially from federal land outside of the facility perimeter fence. Figures in Section 1.0 of the RIWP show the spatial boundaries for the regional vicinity and of each AOC.

The RI risk assessment will consider analytical results from previous environmental studies as applicable to facility-wide groundwater as well as analytical results from this RI. Data not rejected during data validation will be used for decision-making.

11.4 Analytic Approach

Analytical data to be gathered at each site will augment data provided in the SI phase of the CERCLA process. Maximum RI results will be used to determine exposure point concentrations for groundwater.

All definitive groundwater samples will be analyzed by TestAmerica Laboratories, Inc. (TestAmerica). TestAmerica is accredited by the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) for all definitive data except free cyanide. TestAmerica will deliver environmental data in compliance with the DoD Quality System Manual (QSM) v5.0 (DoD, 2013) and electronic data deliverables (EDDs) will adhere to the latest specifications and structure of the REIMS. Samples will be shipped via preservative and chain of custody (COC) requirements specified in Worksheet #27.

USEPA Level III and IV data packages and project-specific EDDs will be provided by the laboratory to the TEC-Weston JV Project Chemist. The JV team's data validation staff will conduct manual review of the data packages for compliance with the established QC criteria. Ten percent of the definitive level data will undergo comprehensive validation, including review of the raw data, chromatograms, and recalculation of representative results. Data verification and validation will be performed in accordance with the method-specific Data Validation Guidance Sheets (Attachment A). These guidance sheets are based on the requirements of the DoD QSM Version 5.0, the analytical method, the FWSAP (SAIC, 2011), and USEPA National Functional Guidelines (2014) (in priority order).

11.5 Performance and Acceptance Criteria

There are two types of decision errors: sampling design errors and measurement errors. Sampling design errors are a function of the selection of sample locations or analytical methods used to characterize the site. Measurement errors are a function of the procedures used to collect and analyze the samples. The possible decision errors are:

- Concluding that a contaminant is present at a depth or in groundwater when it is not actually present. This error results in investigating or cleaning up a non-impacted site.

- Concluding that a contaminant is not present at a depth or in groundwater, when it is actually present. This error results in not investigating or cleaning up an impacted site.

The following procedures will reduce the uncertainty associated with these errors:

- The sampling design will be based on historical and current site reconnaissance, previous soil and groundwater investigations, and the site's environmental setting (e.g., topography and geology).
- Procedures for all field and reporting activities will follow approved standard operating procedures (SOPs) that follow ARNG requirements.
- Laboratories providing definitive level data are DoD ELAP accredited and will follow the DoD QSM v5.0.
- All definitive data will be compared to the measurement performance criteria specified in Worksheet #12 to determine acceptability of analytical laboratory results.

11.6 Design for Obtaining Data

Worksheet #17 presents the detailed sampling design and rationale for each location. Worksheets #19, #20, #24-#28, and #30 specify analysis design requirements.

11.7 Assessments and Audits

Worksheet #31 presents a summary table as well as a detailed description of the assessment/audits tasks. Worksheet #33 lists the Quality Assurance (QA) Management reports to be completed during the RI.

11.8 Data Review and Verification

Worksheets #34 and #35 specify data verification process for Step I, and Step IIa and IIb, respectively. Worksheet #36 presents a cumulative analytical data validation summary. Appendix A provides the method-specific Data Validation Guideline Sheets.

11.9 Data Management

11.9.1 Screening Level Data

Screening level data are used to provide a general indication of analyte identification and estimated concentration for the purposes of delineation of contaminated zones, gross determination of analytes in samples, or health and safety screening.

Screening level data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation may be restricted to a simple dilution with a solvent, instead of elaborate extraction/digestion and cleanup or direct matrix introduction. Screening data provide analyte identification and may supply limited quantitation, although the quantitation may be relatively imprecise.

Screening level data are often used to provide qualitative real-time results using hand-held instruments that may identify the presence of a class of compounds without actually identifying or quantifying a specific compound. Screening level data can also be generated by a laboratory but may not undergo higher levels of review or be associated with QC samples. Screening level data for this investigation will consist of the following:

- Natural attenuation parameters;
  - Ammonia-N;
  - Anions (Chloride, Nitrate-N, Nitrite-N, Sulfate, Sulfide, Orthophosphate);
  - Total Phosphorus;
  - Chemical Oxygen Demand;
  - Total Organic Carbon;
  - Total Recoverable Phenols; and
  - Dissolved Gases (Methane, Ethane, Ethene).
- Investigation-Derived Waste (IDW) results;
  - Toxicity Characteristic Leaching Procedure (TCLP) VOCs;
  - TCLP Semi-Volatile Organic Compounds (SVOCs);
  - TCLP metals;
  - TCLP herbicides;
  - TCLP pesticides;
  - total sulfide;
  - total cyanide;
  - corrosivity (pH); and
  - flashpoint.
- Health and safety monitoring; and
- Field measurements (groundwater field parameters).

11.9.2 Definitive Level Data

Definitive level data are used to provide quantitative data that are used to support project decisions such as investigation and confirmation sampling, risk assessments, long-term monitoring.

Definitive data undergo validation in accordance with USEPA Contract Laboratory Program (CLP) National Functional Guidelines (2014).

Definitive data are generated using rigorous analytical methods, such as those described in EPA's SW-846 *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (2015). Data are analyte-specific with confirmation of analyte identity and concentration. Definitive level data are often characterized by analysis at a certified laboratory. Analytical protocols provide data at lower detection limits, generate information on a wide range of calibrated analytes, matrix recovery information, laboratory process control information, and produce analytical data at known levels of precision and accuracy.

Definitive data for this investigation will consist of laboratory analysis of groundwater samples and associated field and laboratory QC samples. Definitive data for this investigation will consist of the following:

- VOCs;
- SVOCs;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Pesticides;
- Polychlorinated Biphenyls (PCBs);
- Explosives and propellants;
- Perchlorate;
- Nitrocellulose;
- Nitrate+nitrite;
- Metals;
- Hexavalent chromium;
- Free cyanide;
- Total cyanide; and
- Total alkalinity.

11.9.3 REIMS Database System

All data generated for investigations will be in the format required for upload to REIMS, the Ravenna Environmental Information Management System. The electronic dataset will include validation flags in accordance with the Data Validation Evaluation Sheets. The validation staff will apply the validation flags to the sample results. After validation flags are applied, the EnviroData EDDs will be uploaded to the REIMS project database.

12.0 MEASUREMENT PERFORMANCE CRITERIA (QAPP WORKSHEET #12)

Measurement Performance Criteria are defined in this worksheet to provide a data set that will achieve data quality objectives (DQOs) be technically defensible, and support project decisions. The criteria are related to the Data Quality Indicators of precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity. The criteria for each matrix and analytical group are consolidated from the DoD QSM v5.0 and the analytical methods, where applicable. The following parameters will be used to measure outliers associated with project results.

12.1 Precision

For each field duplicate and laboratory duplicate pair, including laboratory control sample (LCS)/ laboratory control sample duplicate (LCSD) and matrix spike (MS)/ matrix spike duplicate (MSD), the relative percent difference (RPD) will be calculated for each analyte whose original and duplicate values are greater than or equal to the limit of quantitation (LOQ). The RPDs will be checked against the measurement performance criteria presented on Worksheet #12. The RPDs exceeding criteria will be identified in the RI Report. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be described in the RI Report. Precision is most often expressed in terms of RPD:

$$RPD = 100 \times \left(\frac{C_R - C_D}{[C_R + C_D]/_2} \right);$$

Where;

RPD = Relative Percent Difference,
C_R = Measured concentration of the Result,
C_D = Measured concentration of the Duplicate Result.

12.2 Accuracy/Bias Contamination

Results for all laboratory method blanks and field blanks (e.g., trip blanks and equipment blanks) will be reviewed by the data validator. In addition, LCS/LCSDs, MS/MSDs, surrogates, post-digestion spikes, and serial dilutions will be reviewed. The results for each analyte will be checked against the measurement performance criteria presented on Worksheet #12. Results for analytes that exceed criteria will be identified in the data validation report. A discussion will summarize the results of the laboratory accuracy/bias. Conclusions about the accuracy/bias of the analyses based on contamination or outlying recoveries' limitations on the use of the data will be described in the RI Report.

Bias values are commonly expressed as Percent Recovery (%R), which is calculated as follows:

$$\%R = \frac{C_S - C_R}{C_{Sknown}} \times 100;$$

Where;
%R = Percent Recovery,

C_R = Measured concentration of the Result,

C_S = Measured concentration of the Spiked Result,

C_{Sknown} = Known concentration of Spike sample.

12.3 Representativeness

As described in the UFP-QAPP Manual (USEPA, 2005), representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental condition of the site, takes into consideration the magnitude of the site area represented by one sample, and indicates the feasibility and reasonableness of that design rationale. Representativeness also reflects the ability of the sampling team to collect samples and the ability of the laboratory to analyze those samples so that the generated data accurately and precisely reflect site conditions.

Field and laboratory sampling and subsampling techniques will follow sampling and laboratory SOPs that specify premixing/homogenization procedures to ensure that all sub-samples taken from a given sample or sampling point are representative of the sample as a whole. Representativeness will be assessed by a review of the precision obtained by analysis of field and laboratory duplicate samples. Representativeness will also be assessed through documentation of proper sample handling techniques and the use of field blanks (e.g., equipment blanks and trip blanks) and laboratory method blanks. Previous project data may be employed to assess the representativeness of a population by defining the continuity of data from point to point.

12.4 Comparability

Sample data will be comparable for similar samples and sample conditions. This goal is achieved using standard techniques to collect representative samples, consistent application of analytical method protocols, and reporting analytical results with appropriate units.

12.5 Completeness

A completeness check will be done on all of the data generated by the laboratory. Completeness criteria are presented in the measurement performance criteria tables (Worksheet #12). As described in the UFP-QAPP Manual (USEPA, 2005), completeness is a measure of the amount of valid data collected using a measurement system and is expressed as a percentage of the number of measurements that are specified in this UFP-QAPP.

The percentage of valid data points will be calculated by dividing the number of valid (i.e., non-rejected) data points by the total number of data points expected. Analytical results qualified as rejected during data validation are not considered “valid.” A discussion summarizing data completeness will be included in the RI Report. Conclusions about the completeness of the data and limitations on the use of the data will be described in the RI report.

12.6 Sensitivity

As defined by the UFP-QAPP Manual, sensitivity is the ability of the method or instrument to detect target analytes at the level of interest. As defined by DoD QSM 5.0, the LOQ is the smallest concentration that produces a quantitative result with known and recorded precision and bias. The DoD LOQ is set at or above the concentration of the lowest initial calibration standard and is within the calibration range. The DoD QSM 5.0 defines the Limit of Detection (LOD) as the smallest concentration that must be present in order to be detected with 99% confidence. Non-detections are reported at the LOD.

Worksheet #15 includes the LODs and LOQs as well as the site PALs for each analyte The project team will compare the LODs against the site PALs for each analyte to ensure, wherever possible, that the selected analytical method will achieve the site PALs. In the event that the PAL cannot be achieved by the method, the RI Report will discuss the limitations on the use of the data with respect to laboratory sensitivity.

Measurement performance criteria for each matrix and analytical group are compiled in the tables shown below. For the site evaluation parameters, full measurement performance criteria are included; however, depending on the site-specific goals, full validation may not be performed on those parameters.

Table 12-1. Measurement Performance Criteria Table for VOCs

Matrix	**Water**
Analytical Group	**VOCs**
Analytical Method/ SOP Reference[1]	**SW-846 8260B**

DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	IS	Retention times ± 10 seconds from retention time of midpoint standard in the ICAL; and EICP area within -50 to + 100% of ICAL midpoint standard	Every sample	A
Accuracy/Bias	Surrogates	Water: 1,2-Dichloroethane-d4: 81-118%; 4-Bromofluorobenzene: 85-114% Dibromofluoromethane: 80-119%; Toluene-d8: 89-112%	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD $\leq$ 20% for LCS/LCSD and MS/MSD. RPD $\leq$ 30% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Trip Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per cooler used to ship VOC samples	S
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A

Matrix	Water			
Analytical Group	**VOCs**			
Analytical Method/ SOP Reference[1]	**SW-846 8260B**			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A
Accuracy	BFB Tune	See Worksheet #24	See Worksheet #24	A

Table 12-2. Measurement Performance Criteria Table for SVOCs

Matrix	**Water**
Analytical Group	**SVOCs**
Analytical Method/ SOP Reference[1]	**SW-846 8270D**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	IS	Retention times ± 10 seconds from retention time of midpoint standard in the ICAL; and EICP area within -50 to + 100% of ICAL midpoint standard	Every sample	A
Accuracy/Bias	Surrogates	Water: 2,4,6-Tribromophenol 43-140%, Nitrobenzene-d5 44-120%, Phenol-d5 10-115% , Terphenyl-d14 50-134%, 2-Fluorophenol 19-119%., 2-Fluorobiphenyl 44-119%	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A
Accuracy	DFTPP Tune	See Worksheet #24	See Worksheet #24	A

Table 12-3. Measurement Performance Criteria Table for PAHs

Matrix	**Water**
Analytical Group	**PAHs**
Analytical Method/ SOP Reference[1]	**SW-846 8270D SIM**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	IS	Retention times ± 30 seconds from retention time of midpoint standard in the ICAL; and EICP area within -50 to + 100% of ICAL midpoint standard	Every sample	A
Accuracy/Bias	Surrogates	Water: 2-Fluorobiphenyl: 53-106%; Terphenyl-d14: 58-132% Nitrobenzene-d5: 55-111%	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A
Accuracy	DFTPP Tune	See Worksheet #24	See Worksheet #24	A

Table 12-4. Measurement Performance Criteria Table for Pesticides

Matrix	**Water**
Analytical Group	**Pesticides**
Analytical Method/ SOP Reference[1]	**SW-846 8081B**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	Surrogates	Water: Tetrachloro-m-xylene 33-134%, DCB Decachlorobiphenyl 34-122%.	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 30% for LCS/LCSD and MS/MSD. RPD ≤ 40% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A

Table 12-5. Measurement Performance Criteria Table for PCBs

Matrix	**Water**
Analytical Group	**PCBs**
Analytical Method/ SOP Reference[1]	**SW-846 8082A**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	Surrogates	Water: Tetrachloro-m-xylene 20-143%, DCB Decachlorobiphenyl 36-140%.	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 30% for LCS/LCSD and MS/MSD. RPD ≤ 40% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A

Table 12-6. Measurement Performance Criteria Table for Explosives and Propellants

Matrix	**Water**
Analytical Group	**Explosives and Propellants**
Analytical Method/ SOP Reference[1]	**SW-846 8330B**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	Surrogates	Water: 1,2-Dinitrobenzene 83-119%.	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 30% for LCS/LCSD and MS/MSD. RPD ≤ 40% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A

Table 12-7. Measurement Performance Criteria Table for Perchlorate

Matrix	**Water**
Analytical Group	**Perchlorate**
Analytical Method/ SOP Reference[1]	**SW-846 6860**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	IS	Measured ^{18}O-labeled Internal Standard area within ± 50% of the value of the average of the Internal Standard area counts of the initial calibration (ICAL). Relative Retention Time (RRT) of the perchlorate ion must be 1.0 ± 2% (0.98 – 1.02)	Every sample	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 15% for LCS/LCSD and MS/MSD. RPD ≤ 25% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	See Worksheet #24	See Worksheet #24	A
Accuracy	ICV	See Worksheet #24	See Worksheet #24	A
Accuracy	CCV	See Worksheet #24	See Worksheet #24	A

Table 12-8. Measurement Performance Criteria Table for Nitrocellulose

Matrix	**Water**
Analytical Group	**Nitrocellulose**
Analytical Method/ SOP Reference[1]	**MCAWW Colorimetric Cadmium Reduction 353.2**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ	1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	1 per batch of 20 samples	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 15% for LCS/LCSD and MS/MSD. RPD ≤ 25% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	$r^2 \geq 0.99$	Initially and as needed	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 10 sample injections and at the end of the run	A

Table 12-9. Measurement Performance Criteria Table for Nitrate + Nitrite

Matrix	**Water**
Analytical Group	**Nitrate+Nitrite**
Analytical Method/ SOP Reference[1]	**MCAWW 353.2**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ	1 per batch of 20 samples	A
Accuracy/Bias	LCS, MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples	A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 15% for LCS/LCSD and MS/MSD. RPD ≤ 25% for field duplicates.	When analyzed, all normal and duplicate samples	S+A
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	$r^2 \geq 0.99$	Initially and as needed	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 10 sample injections and at the end of the run	A

Table 12-10. Measurement Performance Criteria Table for Total and Dissolved Metals (6010C)

Matrix	**Water**
Analytical Group	**Metals**
Analytical Method/ SOP Reference[1]	**SW-846 6010C**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Daily and/or 1 per batch of 20 samples	A
Bias/Contamination and Representativeness	Initial and Continuing Calibration Blanks	No analytes detected > LOD.	Before beginning an analytical run, every 10 field samples, and at the end of the analysis sequence.	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	Serial Dilution	5x dilution must agree within 10% of the original result.	1 per batch of 20 samples	A
Bias	Post Digestion Spike Addition	Recovery limits 80-120%	When dilution test fails or analyte concentration is <50x LOD.	S+A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all parent and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	Low Level Calibration Check Standard	± 20% of true concentration.	Daily.	A
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A

Matrix	Water			
Analytical Group	Metals			
Analytical Method/ SOP Reference[1]	SW-846 6010C			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	If more than one standard is used, r ≥ 0.995	Daily	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 10 sample injections and at the end of the run	A
Accuracy	ICS-A	Absolute value of the true concentration < LOD.	At beginning of analytical run	A
Accuracy	ICS-AB	± 20% of true concentration	At beginning of analytical run	A

Table 12-11. Measurement Performance Criteria Table for Total and Dissolved Metals (6020A)

Matrix	**Water**
Analytical Group	**Metals**
Analytical Method/ SOP Reference[1]	**SW-846 6020A**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Daily and/or 1 per batch of 20 samples	A
Bias/Contamination and Representativeness	Initial and Continuing Calibration Blanks	No analytes detected > LOD.	Before beginning an analytical run, every 10 field samples, and at the end of the analysis sequence.	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	Serial Dilution	5x dilution must agree within 10% of the original result.	1 per batch of 20 samples	A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Bias	Post Digestion Spike Addition	Recovery limits 80-120%	When dilution test fails or analyte concentration is <50x LOD.	S+A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all parent and duplicate samples	S+A
Sensitivity	Low Level Calibration Check Standard	± 20% of true concentration.	Daily.	A
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A

Matrix	Water			
Analytical Group	**Metals**			
Analytical Method/ SOP Reference[1]	**SW-846 6020A**			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	Instrument Tuning	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height.	Prior to ICAL.	A
Accuracy	ICAL	If more than one standard is used, r ≥ 0.995	Daily	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 10 sample injections and at the end of the run	A
Accuracy	ICS-A	Absolute value of the true concentration < LOD.	At beginning of analytical run	A
Accuracy	ICS-AB	± 20% of true concentration	At beginning of analytical run	A

Table 12-12. Measurement Performance Criteria Table for Mercury

Matrix	**Water**
Analytical Group	**Mercury**
Analytical Method/ SOP Reference[1]	**SW-846 7470**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Daily and/or 1 per batch of 20 samples	A
Bias/Contamination and Representativeness	Initial and Continuing Calibration Blanks	No analytes detected > LOD.	Before beginning an analytical run, every 10 field samples, and at the end of the analysis sequence.	A
Accuracy/Bias	LCS	See limits in Worksheet #15	Daily and/or 1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Accuracy/Bias	Serial Dilution	5x dilution must agree within 10% of the original result.	1 per batch of 20 samples	A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Bias	Post Digestion Spike Addition	Recovery limits 80-120%	When dilution test fails or analyte concentration is <50x LOD.	S+A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all parent and duplicate samples	S+A
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A

Matrix	**Water**			
Analytical Group	**Mercury**			
Analytical Method/ SOP Reference[1]	**SW-846 7470**			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Accuracy	ICAL	If more than one standard is used, r ≥ 0.995	Daily	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 10 sample injections and at the end of the run	A

Table 12-13. Measurement Performance Criteria Table for Hexavalent Chromium

Matrix	**Water**			
Analytical Group	**Chromium (VI)**			
Analytical Method/ SOP Reference[1]	**SW-846 7196A**			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ	1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all parent and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	$r^2 \geq 0.99$	Daily, prior to sample analysis	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 15 sample injections and at the end of the run	A

Table 12-14. Measurement Performance Criteria Table for Free Cyanide

Matrix	**Water**			
Analytical Group	**Free Cyanide[3]**			
Analytical Method/ SOP Reference[1]	**SM 4500 CN I**			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ	1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all parent and duplicate samples	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	$r^2 \geq 0.99$	Daily, prior to sample analysis	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 15 sample injections and at the end of the run	A

Table 12-15. Measurement Performance Criteria Table for Total Cyanide

Matrix	**Water**			
Analytical Group	**Total Cyanide**			
Analytical Method/ SOP Reference[1]	**SW-846 9012B**			
DQI	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Measurement Performance Criteria**	**Frequency of QC Check**	**QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)**
Bias/Contamination and Representativeness	Method Blank	No analytes detected > 1/2 LOQ	1 per batch of 20 samples	A
Accuracy/Bias	LCS	See limits in Worksheet #15	1 per batch of 20 samples	A
Accuracy/Bias	MS/MSD	See limits in Worksheet #15	1 per batch of 20 samples if client designated	S+A
Bias/Contamination and Representativeness	Equipment Blank	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ.	1 per day, when using non-dedicated or non-disposable equipment.	S
Precision	LCS/LCSD[2], MS/MSD, and/or field duplicates	RPD ≤ 20% for LCS/LCSD and MS/MSD. RPD ≤ 30% for field duplicates.	When analyzed, all parent and duplicate samples	S+A
Accuracy/Bias	Post-Digestion Matrix Spike	85-115%	One per preparatory batch	S+A
Sensitivity	LOD Determination and Verification	Laboratory establishes the LOD by spiking a matrix at 2-4x the DL.	Initial establishment and quarterly verification	A
Sensitivity	LOQ Determination and Verification	Laboratory sets the LOQ within the calibration range of the instrument. The LOQ must be greater than or equal to the LOD.	Initial establishment and quarterly verification	A
Completeness	Data completeness check	≥ 95%	After validation is complete	S+A
Accuracy	ICAL	$r^2 \geq 0.99$	Daily, prior to sample analysis	A
Accuracy	ICV	90-110%	After ICAL, prior to beginning a sample run	A
Accuracy	CCV	90-110%	After every 15 sample injections and at the end of the run	A

Table 12-16. Measurement Performance Criteria Table for Alkalinity

Matrix	**Water**
Analytical Group	**Alkalinity**
Analytical Method/ SOP Reference[1]	**Method SM2320B**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Field Precision	Field Duplicates	RPD < 50%.	1 per 10 samples.	S+A
	Duplicates	RSD < 10% for results above the LOQ based on Field Duplicate range – Laboratory Duplicate range.	1 per 10 samples.	S+A
Accuracy/Precision	Calibration	Calibrated in accordance with lab SOP and manufacturer's guidance/manual.	Per SOP and manufacturer's guidance/manual.	A
Accuracy/Bias	Initial Check	Within ±10% of expected value.	After each calibration.	A
Precision	CCV	All analytes within ±10% of true value (See Worksheet #15 for MPC).	Before sample analysis, after every 10 samples and at end of sequence.	A
Laboratory Representativeness/ Accuracy/Bias	MB	No analytes detected greater than the LOQ.	1 per preparatory batch or 1 per 20 samples, whichever is more frequent.	A
Sampling Completeness	Calculate percentage of QA/QC samples from total samples collected	Compliance with frequency of QA/QC samples and total expected based upon rationale in Worksheet #17	Once per project.	S+A
Laboratory Accuracy/Sensitivity	LCS/LCSD[2]	%R - See Recovery Limits in Worksheet #15.	1 per preparatory batch per matrix or 1 per 20 samples, whichever is more frequent.	A

Table 12-17. Measurement Performance Criteria Table for Hydrazine

Matrix	**Water**
Analytical Group	**Hydrazines**
Analytical Method/ SOP Reference[1]	**Method 8315A Modified**

DQI	QC Sample and/or Activity Used to Assess Measurement Performance	Measurement Performance Criteria	Frequency of QC Check	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S+A)
Field Precision	Field Duplicates	RPD < 20%.	1 per 10 samples.	S+A
Accuracy/Precision	Calibration	See Worksheet #24.	See Worksheet #24.	A
Accuracy/Bias	Initial Check	See Worksheet #24.	See Worksheet #24.	A
Precision	CCV	See Worksheet #24.	See Worksheet #24.	A
Laboratory Representativeness/ Accuracy/Bias	MB	No analytes detected greater than ½ the LOQ.	1 per preparatory batch or 1 per 20 samples, whichever is more frequent.	A
Sampling Completeness	Calculate percentage of QA/QC samples from total samples collected	Compliance with frequency of QA/QC samples and total expected based upon rationale in Worksheet #17	Once per project.	S+A
Laboratory Accuracy/Sensitivity	LCS/LCSD[2]	%R - See Recovery Limits in Worksheet #15. RPD < 25%.	1 per preparatory batch per matrix or 1 per 20 samples, whichever is more frequent.	A
Field Accuracy/Bias	MS/MSD	78-120% for %Rs; RPD < 25%.	1 per preparatory batch per matrix or 1 per 20 samples, whichever is more frequent.	A

Notes:
[1] Laboratory SOPs are listed in Worksheet #23.
[2] LCSDs are not required, but may be performed.
[3] The laboratory does not hold DoD ELAP accreditation for free cyanide.
> = Greater than
< = Less than
≥ = Greater than or equal to
≤ = Less than or equal to
% = Percent
± = plus or minus
amu = atomic mass units
BFB =
DQI = Data quality indicator
ECIP = Extracted ion current profile
ICAL = Initial calibration
ICS-A = Interference check standard A
ICS-AB = Interference check standard AB
ICV = Initial calibration verification
IS = Internal standards
LCS = Laboratory control sample
LCSD = Laboratory control sample duplicate
LOD = Limit of detection
LOQ = Limit of quantitation
MCAWW = Methods for Chemical Analysis of Water and Wastes
MS = Matrix spike
MSD = Matrix spike duplicate
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyls
QC = Quality control
r^2 = Coefficient of determination
RPD = Relative percent difference
RRT = Relative Retention Time
SIM = Selective ion monitoring
SM = Standard Method
SOP = Standard Operating Procedure
SVOC = Semi-volatile organic compound
SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
VOC = Volatile organic compound

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13.0 SECONDARY DATA CRITERIA AND LIMITATIONS (QAPP WORKSHEET #13)

This worksheet identifies sources of existing and historical data pertinent to project decisions. For each data source, the following considerations were evaluated: whether the data were validated or reviewed, whether the analytical methodologies or technical protocols are comparable to current data handling procedures, and whether limitations on use of the data can be identified.

Table 13-1. Secondary Data Criteria and Limitations

Secondary Data	**Data Source** (Originating Organization, Report Title, and Date)	**Data Generator(s)** (Originating Org., Data Types, Data Generation/Collection Dates)	**How Data Will Be Used**	**Limitations on Data Use**
Analytical data collected during the 1996 investigation at 11 high priority AOCs	SAIC 1998. Final Phase I Remedial Investigation Report for the Phase I Remedial Investigation of High Priority Areas of Concern	Soil and limited groundwater data collected at the 11 high priority AOCs during 1996.	Data will be used to identify historical groundwater contaminant conditions and compare newly acquired results for temporal and spatial changes. Soil data generated during this investigation may also be referenced during the FWGW RI to assess contaminant source relationships to current groundwater conditions.	Data will be considered qualitative due to age and uncertainties regarding QA/AC adequacies for the field, laboratory and reporting components of the 1996 RI.
Analytical data collected at specific AOCs, MRSs, and CRSs	Various Authors 1996 – 2015. Multiple Preliminary Assessment, Site Investigation, RI, and Environmental Studies at the numerous AOCs, MRSs, and CRSs; refer to www.ravenna.org/docs	Soil, sediment, surface water, and limited groundwater data collected at the numerous AOCs, MRSs, and CRSs across Camp Ravenna.	Data will be used to identify historical groundwater contaminant conditions and compare newly acquired results for temporal and spatial changes. Soil data generated during this investigation may also be referenced during the FWGW RI to assess contaminant source relationships to current groundwater conditions.	More recent groundwater data that were validated/verified will be used to potentially eliminate certain AOCs/MRSs/CRSs as requiring further groundwater contaminant delineation efforts. Older groundwater data will be used to qualitatively assess historical conditions compared to newly acquired data. Non-groundwater media sample data will be used to qualitatively assess ongoing soil to groundwater leaching conditions.

Secondary Data	**Data Source** (Originating Organization, Report Title, and Date)	**Data Generator(s)** (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Analytical data collected during 2005-2006 FWGW events	SpecPro 2005 - 2006. Final Facility Wide Groundwater Monitoring Program Reports	All groundwater data collected during the various FWGW sampling event conducted by SpecPro during 2005 and 2006.	Data will be used to identify historical groundwater contaminant conditions and compare newly acquired results for temporal and spatial changes.	Data were collected using Ohio EPA and U.S. EPA methods and the data were verified for decision-making. The data will be used for FWGW site characterization, delineation, and risk assessment decision-making.
Analytical data collected during 2007-2014 FWGW events	EQM 2007 - 2015. Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Annual Reports	All groundwater data collected during the various (quarterly, semi-annual) FWGW sampling events conducted by EQM since 2007.	Data will be used to identify historical groundwater contaminant conditions and compare newly acquired results for temporal and spatial changes.	Data were collected using Ohio EPA and U.S. EPA methods and the data were verified for decision-making. The data will be used for FWGW site characterization, delineation, and risk assessment decision-making.

Notes: FWGW = Facility-wide Groundwater
RI = Remedial Investigation
EPA = Environmental Protection Agency
EQM = Environmental Quality Management, Inc.
QA/QC = Quality Assurance/Quality Control
SAIC – Science Applications International Corporation
AOC = Area of Concern
MRS = Munitions Response Site
CRS = Compliance Restoration Site

14.0 SUMMARY OF PROJECT TASKS (QAPP WORKSHEET #14)

This information is contained in Section 3.0 of the WP.

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15.0 REFERENCE LIMITS AND EVALUATION (QAPP WORKSHEET #15)

This worksheet provides the target analytes, their PALs, the laboratory's LOD/LOQ values, and the DoD QSM v5.0 LCS limits, where applicable. LOQs/LODs/DLs are evaluated, reviewed, and verified quarterly by the laboratory according to DoD QSM v5.0 requirements; therefore, these values are subject to change. Any deviations from LODs and LOQs presented in this QAPP will be captured during validation and presented in the data usability analysis of the project reports. The laboratory will adhere to the most current and verified values. Where available, investigation results (for VOCs, SVOCs, PAHs, pesticides, polychlorinated biphenyl [PCBs], explosives and propellants, perchlorate, nitrocellulose, nitrate+nitrite [N+N], metals, hexavalent chromium [Cr(VI)], free cyanide, and total cyanide) will be compared to the May 2016 USEPA RSLs for tap water and the USEPA maximum contaminant levels (MCLs). The PAL is defined as either the USEPA RSL or the USEPA MCL, whichever standard is lower. If a chemical concentration is equal to or greater than its RSL or MCL, then the chemical is considered to be an exceedance of screening criteria. If a detected chemical does not have either an RSL or MCL, a cleanup goal may need to be developed in coordination with Ohio EPA.

The LOD goal is set equal to the PAL. Because the calculation of EPA RSLs does not account for current technology capabilities, a few target analytes will not meet the PAL by commercial environmental laboratories. These analytes are shown in the table as bolded values. Analytes shaded grey indicate instances where the Camp Ravenna Project Reporting Limit, as defined in Table 4-3 of the Facility-Wide Quality Assurance Project Plan (FWQAPP) (SAIC, 2011b), is less than the LOD. Where DoD QSM LCS control limits are not available, the laboratory's in-house control limits are provided.

Tables 15-1 through **15-18** provide the VOCs, SVOCs, PAHs, pesticides, PCBs, explosives and propellants, perchlorate, nitrocellulose, N+N, metals, Cr(VI), free cyanide, total cyanide, hydrazine, and alkalinity target analyte lists for this investigation; these will be reported as definitive level data. Considered screening level data, **Table 15-19**, lists the natural attenuation parameters. Neither a PAL nor a LOD goal is applicable to screening level data; however, the laboratory-specific LOD, LOQ, and LCS control limits are provided. Note that the LOD is considered to be a qualitative result with 99% confidence it is a detection and will be reported as an estimated concentration (assigned a “J” flag). The LOQ is the smallest concentration that produces a quantitative result with known precision and bias and will be reported within the calibration range of the analytical instrument. Per the UFP-QAPP Manual (2005), the PAL is ideally 3 to 10 times lower than the LOQ to allow for variances in uncertainty factors such as calibration and spike recoveries.

Table 15-1. Reference Limits and Evaluation Table for VOCs

Matrix	Water
Analytical Group	VOCs
Analytical Method	8260B

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
1,1,1-Trichloroethane	71-55-6	200	800	200	USEPA MCL	200	1	0.4	1	74	131
1,1,2,2-Tetrachloroethane	**79-34-5**	**--**	**0.076**	**0.076**	**USEPA RSL**	**0.076**	**1**	**0.8**	**1**	**71**	**121**
1,1,2-Trichloroethane	**79-00-5**	**5**	**0.041**	**0.041**	**USEPA RSL**	**0.041**	**1**	**0.8**	**1**	**80**	**119**
1,1-Dichloroethane	75-34-3	--	2.8	2.8	USEPA RSL	2.8	1	0.8	1	77	125
1,1-Dichloroethene	75-35-4	7	28	7	USEPA MCL	7	1	0.8	1	71	131
1,2-Dibromoethane	**106-93-4**	**0.05**	**0.0075**	**0.0075**	**USEPA RSL**	**0.0075**	**1**	**0.4**	**1**	**77**	**121**
1,2-Dichloroethane	**107-06-2**	**5**	**0.17**	**0.17**	**USEPA RSL**	**0.17**	**1**	**0.4**	**1**	**73**	**128**
1,2-Dichloroethene (total)	540-59-0	--	--	--	--	--	1	0.2	1	79	121
1,2-Dichloropropane	78-87-5	5	0.44	0.44	USEPA RSL	0.44	1	0.4	1	78	122
2-Butanone (MEK)[4]	78-93-3	--	560	560	USEPA RSL	560	10	4	6	56	143
2-Hexanone	**591-78-6**	**--**	**3.8**	**3.8**	**USEPA RSL**	**3.8**	**10**	**4**	**5**	**57**	**139**
4-Methyl-2-pentanone	108-10-1	--	630	630	USEPA RSL	630	10	3.2	5	67	130
Acetone[4]	67-64-1	--	1400	1400	USEPA RSL	1400	10	6.4	10	39	160
Benzene	71-43-2	5	0.46	0.46	USEPA RSL	0.46	1	0.4	1	79	120
Bromochloromethane	74-97-5	--	8.3	8.3	USEPA RSL	8.3	1	0.2	1	78	123
Bromodichloromethane	**75-27-4**	**--**	**0.13**	**0.13**	**USEPA RSL**	**0.13**	**1**	**0.4**	**1**	**79**	**125**
Bromoform	75-25-2	--	3.3	3.3	USEPA RSL	3.3	1	0.4	1	66	130
Bromomethane	**74-83-9**	**--**	**0.75**	**0.75**	**USEPA RSL**	**0.75**	**1**	**0.8**	**2**	**53**	**141**
Carbon Disulfide[4]	75-15-0	--	81	81	USEPA RSL	81	1	1.6	2	64	133
Carbon Tetrachloride	56-23-5	5	0.46	0.46	USEPA RSL	0.46	1	0.4	2	72	136
Chlorobenzene	108-90-7	100	7.8	7.8	USEPA RSL	7.8	1	0.4	1	82	118
Chloroethane	75-00-3	--	2100	2100	USEPA RSL	2100	1	1.6	2	60	138
Chloroform	**67-66-3**	**--**	**0.22**	**0.22**	**USEPA RSL**	**0.22**	**1**	**0.4**	**1**	**79**	**124**
Chloromethane	74-87-3	--	19	19	USEPA RSL	19	1	0.8	2	50	139
cis-1,3-Dichloropropene	10061-01-5	--	--	--	--	--	1	0.4	1	75	124
Dibromochloromethane	124-48-1	--	0.87	0.87	USEPA RSL	0.87	1	0.4	1	74	126
Ethylbenzene	100-41-4	700	1.5	1.5	USEPA RSL	1.5	1	0.4	1	79	121
Methylene Chloride[4]	75-09-2	5	11	5	USEPA MCL	5	1	0.8	5	74	124

Matrix	Water										
Analytical Group	**VOCs**										
Analytical Method	**8260B**										
		USEPA MCL	**USEPA RSL**	**PAL**	**PAL**	**LOD Goal**	**PRL**	**LOD**	**LOQ**	**LCS**	**LCS**
Analyte	**CAS Number**	**(µg/L)**	**(µg/L)**	**(µg/L)[1]**	**Reference[1]**	**(µg/L)[2]**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**Lower**	**Upper**
Styrene	100-42-5	100	120	100	USEPA MCL	100	1	0.4	1	78	123
Tetrachloroethene	127-18-4	5	4.1	4.1	USEPA RSL	4.1	1	0.4	1	74	129
Toluene	108-88-3	1000	110	110	USEPA RSL	110	1	0.4	1	80	121
trans-1,3-Dichloropropene	10061-02-6	--	--	--	--	--	1	0.4	1	73	127
Trichloroethene	**79-01-6**	**5**	**0.28**	**0.28**	**USEPA RSL**	**0.28**	**1**	**0.4**	**1**	**79**	**123**
Vinyl Chloride	**75-01-4**	**2**	**0.019**	**0.019**	**USEPA RSL**	**0.019**	**1**	**0.2**	**1.5**	**58**	**137**
Xylenes (total)	1330-20-7	10000	19	19	USEPA RSL	19	2	0.8	2	79	121

Table 15-2. Reference Limits and Evaluation Table for SVOCs

Matrix	Water
Analytical Group	**SVOCs**
Analytical Method	**8270D**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
1,2,4-Trichlorobenzene	**120-82-1**	**70**	**0.4**	**0.4**	**USEPA RSL**	**0.4**	**10**	**1**	**10**	**29**	**116**
1,2-Dichlorobenzene	95-50-1	600	30	30	USEPA RSL	30	10	0.5	10	32	111
1,3-Dichlorobenzene	541-73-1	--	--	--	--	--	10	1	10	28	110
1,4-Dichlorobenzene	**106-46-7**	**75**	**0.48**	**0.48**	**USEPA RSL**	**0.48**	**1**	**1**	**10**	**29**	**112**
1,4-Dioxane	**123-91-1**	**--**	**0.46**	**0.46**	**USEPA RSL**	**0.46**	**--**	**4.4**	**18**	**47**	**120**
2,4,5-Trichlorophenol	95-95-4	--	120	120	USEPA RSL	120	25	1	20	53	123
2,4,6-Trichlorophenol	88-06-2	--	1.2	1.2	USEPA RSL	1.2	5	1	20	50	125
2,4-Dichlorophenol	120-83-2	--	4.6	4.6	USEPA RSL	4.6	10	2	10	47	121
2,4-Dimethylphenol	105-67-9	--	36	36	USEPA RSL	36	10	2	10	31	124
2,4-Dinitrophenol	**51-28-5**	**--**	**3.9**	**3.9**	**USEPA RSL**	**3.9**	**25**	**30**	**80**	**23**	**143**
2-Chloronaphthalene	91-58-7	--	75	75	USEPA RSL	75	10	1	10	40	116
2-Chlorophenol	95-57-8	--	9.1	9.1	USEPA RSL	9.1	10	4.4	10	38	117
2-Methylnaphthalene	91-57-6	--	3.6	3.6	USEPA RSL	3.6	10	1	10	40	121
2-Methylphenol	95-48-7	--	93	93	USEPA RSL	93	10	2	10	30	117
2-Nitroaniline	88-74-4	--	19	19	USEPA RSL	19	25	4.4	50	55	127
2-Nitrophenol	88-75-5	--	--	--	--	--	10	1	20	47	123
3 & 4-Methylphenol	108-39-4/ 106-44-5	--	--	--	--	--	10	0.5	20	29	110
3,3'-Dichlorobenzidine	**91-94-1**	**--**	**0.13**	**0.13**	**USEPA RSL**	**0.13**	**5**	**4.4**	**50**	**27**	**129**
3-Nitroaniline	99-09-2	--	--	--	--	--	25	4.4	50	41	128
4,6-Dinitro-2-methylphenol	**534-52-1**	**--**	**0.15**	**0.15**	**USEPA RSL**	**0.15**	**25**	**8.8**	**80**	**44**	**137**
4-Bromophenyl phenyl ether	101-55-3	--	--	--	--	--	10	1	10	55	124
4-Chloro-3-methylphenol	59-50-7	--	140	140	USEPA RSL	140	10	5	20	52	119
4-Chloroaniline	**106-47-8**	**--**	**0.37**	**0.37**	**USEPA RSL**	**0.37**	**10**	**4.4**	**25**	**33**	**117**
4-Chlorophenyl phenyl ether	7005-72-3	--	--	--	--	--	10	4.4	10	53	121
4-Nitroaniline	**100-01-6**	**--**	**3.8**	**3.8**	**USEPA RSL**	**3.8**	**25**	**4.4**	**50**	**70**	**120**
4-Nitrophenol	100-02-7	--	--	--	--	--	25	4	50	59	129
Benzoic Acid[3]	65-85-0	--	7500	7500	USEPA RSL	7500	25	30	80	41	120
Benzyl Alcohol	100-51-6	--	200	200	USEPA RSL	200	10	0.5	25	31	112

Matrix	Water										
Analytical Group	SVOCs										
Analytical Method	8270D										
		USEPA MCL	USEPA RSL	PAL	PAL	LOD Goal	PRL	LOD	LOQ	LCS	LCS
Analyte	CAS Number	(µg/L)	(µg/L)	(µg/L)[1]	Reference[1]	(µg/L)[2]	(µg/L)	(µg/L)	(µg/L)	Lower	Upper
Bis(2-Chloroethyl)ether	**111-44-4**	**--**	**0.014**	**0.014**	**USEPA RSL**	**0.014**	**1**	**1**	**20**	**43**	**118**
Bis(2-Chloroethoxy)methane	111-91-1	--	5.9	5.9	USEPA RSL	5.9	10	2	10	48	120
Bis(2-Chloroisopropyl)ether	108-60-1	--	71	71	USEPA RSL	71	10	1	10	37	130
Bis(2-Ethylhexyl)phthalate[4]	117-81-7	6	5.6	5.6	USEPA RSL	5.6	--	2	10	55	135
Butyl benzyl phthalate[4]	85-68-7	--	16	16	USEPA RSL	16	10	2	20	53	134
Carbazole	86-74-8	--	--	--	--	--	10	1	10	60	122
Di-n-butyl phthalate[4]	84-74-8	--	--	--	--	--	10	4.4	20	59	127
Di-n-octyl phthalate[4]	117-84-0	--	20	20	USEPA RSL	20	10	1	20	51	140
Dibenzofuran	**132-64-9**	**--**	**0.79**	**0.79**	**USEPA RSL**	**0.79**	**10**	**1**	**10**	**53**	**118**
Diethyl phthalate	84-66-2	--	1500	1500	USEPA RSL	1500	10	1	20	56	125
Dimethyl phthalate	131-11-3	--	--	--	--	--	10	0.5	20	45	127
Hexachlorobenzene	**118-74-1**	**1**	**0.0098**	**0.0098**	**USEPA RSL**	**0.0098**	**0.2**	**2**	**10**	**53**	**125**
Hexachlorobutadiene	**87-68-3**	**--**	**0.14**	**0.14**	**USEPA RSL**	**0.14**	**1**	**10**	**30**	**22**	**124**
Hexachlorocyclopentadiene[3]	**77-47-4**	**50**	**0.041**	**0.041**	**USEPA RSL**	**0.041**	**10**	**30**	**50**	**10**	**120**
Hexachloroethane	**67-72-1**	**--**	**0.33**	**0.33**	**USEPA RSL**	**0.33**	**10**	**4.4**	**10**	**21**	**115**
Isophorone	78-59-1	--	78	78	USEPA RSL	78	10	0.5	10	42	124
n-Nitroso-di-n-propylamine	**621-64-7**	**--**	**0.011**	**0.011**	**USEPA RSL**	**0.011**	**10**	**1**	**20**	**49**	**119**
n-Nitroso-diphenylamine	86-30-6	--	12	12	USEPA RSL	12	10	1	10	51	123
Pentachlorophenol	**87-86-5**	**1**	**0.041**	**0.041**	**USEPA RSL**	**0.041**	**5**	**60**	**80**	**35**	**138**
Phenol	108-95-2	--	580	580	USEPA RSL	580	10	4.4	10	61	120

Table 15-3. Reference Limits and Evaluation Table for PAHs

Matrix	**Water**
Analytical Group	**PAHs**
Analytical Method	**8270D SIM**

Analyte	**CAS Number**	**USEPA MCL (µg/L)**	**USEPA RSL (µg/L)**	**PAL (µg/L)[1]**	**PAL Reference[1]**	**LOD Goal (µg/L)[2]**	**PRL (µg/L)**	**LOD (µg/L)**	**LOQ (µg/L)**	**LCS Lower**	**LCS Upper**
Acenaphthene	83-32-9	--	53	53	USEPA RSL	53	10	0.04	0.1	48	114
Acenaphthylene	208-96-8	--	--	--	--	--	10	0.04	0.1	35	121
Anthracene	120-12-7	--	180	180	USEPA RSL	180	10	0.04	0.1	53	119
Benzo(a)anthracene	56-55-3	--	0.012	0.012	USEPA RSL	0.012	0.2	0.012	0.1	59	120
Benzo(a)pyrene	**50-32-8**	**0.2**	**0.0034**	**0.0034**	**USEPA RSL**	**0.0034**	**0.2**	**0.012**	**0.1**	**53**	**120**
Benzo(b)fluoranthene	205-99-2	--	0.034	0.034	USEPA RSL	0.034	0.2	0.012	0.1	53	126
Benzo(g,h,i)perylene	191-24-2	--	--	--	--	--	10	0.012	0.1	44	128
Benzo(k)fluoranthene	207-08-9	--	0.34	0.34	USEPA RSL	0.34	0.2	0.012	0.1	54	125
Chrysene	218-01-9	--	3.4	3.4	USEPA RSL	3.4	10	0.012	0.1	57	120
Dibenz(a,h)anthracene	**53-70-3**	**--**	**0.0034**	**0.0034**	**USEPA RSL**	**0.0034**	**0.2**	**0.012**	**0.1**	**44**	**131**
Fluoranthene	206-44-0	--	80	80	USEPA RSL	80	10	0.012	0.1	58	120
Fluorene	86-73-7	--	29	29	USEPA RSL	29	10	0.04	0.1	50	118
Indeno(1,2,3-cd)pyrene	**193-39-5**	**--**	**0.034**	**0.034**	**USEPA RSL**	**0.034**	**0.2**	**0.04**	**0.1**	**48**	**130**
Naphthalene	91-20-3	--	0.17	0.17	USEPA RSL	0.17	10	0.012	0.1	43	114
Phenanthrene	85-01-8	--	--	--	--	--	10	0.02	0.1	53	115
Pyrene	129-00-0	--	12	12	USEPA RSL	12	10	0.02	0.1	53	121

Table 15-4. Reference Limits and Evaluation Table for Pesticides

Matrix	**Water**
Analytical Group	**Pesticides**
Analytical Method	**8081B**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Alpha-BHC	**319-84-6**	**--**	**0.0072**	**0.0072**	**USEPA RSL**	**0.0072**	**0.03**	**0.019**	**0.05**	**54**	**138**
Beta-BHC	**319-85-7**	**--**	**0.025**	**0.025**	**USEPA RSL**	**0.025**	**0.05**	**0.04**	**0.05**	**56**	**136**
Delta-BHC	319-86-8	--	--	--	--	--	0.05	0.024	0.05	52	142
Gamma-BHC (Lindane)	58-89-9	0.2	0.042	0.042	USEPA RSL	0.042	0.05	0.031	0.05	59	134
Heptachlor	**76-44-8**	**0.4**	**0.0014**	**0.0014**	**USEPA RSL**	**0.0014**	**0.03**	**0.05**	**0.05**	**54**	**130**
Aldrin	**309-00-2**	**--**	**0.00092**	**0.00092**	**USEPA RSL**	**0.00092**	**0.03**	**0.021**	**0.05**	**45**	**134**
Heptachlor Epoxide	**1024-57-3**	**0.2**	**0.0014**	**0.0014**	**USEPA RSL**	**0.0014**	**0.03**	**0.036**	**0.05**	**61**	**133**
Endosulfan I	959-98-8	--	--	--	--	--	0.05	0.022	0.05	62	126
Dieldrin	**60-57-1**	**--**	**0.0018**	**0.0018**	**USEPA RSL**	**0.0018**	**0.03**	**0.016**	**0.05**	**60**	**136**
4,4'-DDE	72-55-9	--	0.046	0.046	USEPA RSL	0.046	0.05	0.022	0.05	57	135
4,4'-DDD	**72-54-8**	**--**	**0.032**	**0.032**	**USEPA RSL**	**0.032**	**0.05**	**0.05**	**0.05**	**56**	**143**
Endrin	72-20-8	2	0.23	0.23	USEPA RSL	0.23	0.05	0.024	0.05	60	138
Endosulfan Sulfate	1031-07-8	--	--	--	--	--	0.05	0.018	0.05	62	133
Endosulfan II	33213-65-9	--	--	--	--	--	0.05	0.04	0.05	52	135
4,4'-DDT	50-29-3	--	0.23	0.23	USEPA RSL	0.23	0.05	0.014	0.05	51	143
Methoxychlor	72-43-5	40	3.7	3.7	USEPA RSL	3.7	0.1	0.036	0.1	54	145
Endrin Ketone	53494-70-5	--	--	--	--	--	0.05	0.035	0.05	58	134
Endrin Aldenhyde	7421-93-4	--	--	--	--	--	0.05	0.04	0.05	51	132
alpha-Chlordane	5103-71-9	--	--	--	--	--	0.05	0.029	0.05	60	129
gamma-Chlrodane	5103-75-2	--	--	--	--	--	0.05	0.03	0.05	56	136
Toxaphene	**8001-35-2**	**3**	**0.071**	**0.071**	**USEPA RSL**	**0.071**	**2**	**1.9**	**2**	**33**	**134**

Table 15-5. Reference Limits and Evaluation Table for PCBs

Matrix	Water
Analytical Group	PCBs
Analytical Method	8082A

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Arochor-1016	12674-11-2	--	0.14	0.14	USEPA RSL	0.14	0.2	0.1	0.15	46	129
Arochor-1221	**11104-28-2**	**--**	**0.0047**	**0.0047**	**USEPA RSL**	**0.0047**	**0.2**	**0.1**	**0.15**	**--**	**--**
Arochor-1232	**11141-16-5**	**--**	**0.0047**	**0.0047**	**USEPA RSL**	**0.0047**	**0.2**	**0.1**	**0.15**	**--**	**--**
Arochor-1242	**53469-21-9**	**--**	**0.0078**	**0.0078**	**USEPA RSL**	**0.0078**	**0.2**	**0.1**	**0.15**	**--**	**--**
Arochor-1248	**12672-29-6**	**--**	**0.0078**	**0.0078**	**USEPA RSL**	**0.0078**	**0.2**	**0.1**	**0.15**	**--**	**--**
Arochor-1254	**11097-69-1**	**--**	**0.0078**	**0.0078**	**USEPA RSL**	**0.0078**	**0.2**	**0.1**	**0.15**	**--**	**--**
Arochor-1260	**11096-82-5**	**--**	**0.0078**	**0.0078**	**USEPA RSL**	**0.0078**	**0.2**	**0.1**	**0.15**	**45**	**134**

Table 15-6. Reference Limits and Evaluation Table for Explosives and Propellants

Matrix	**Water**
Analytical Group	**Explosives and Propellants**
Analytical Method	**8330B**

Analyte	**CAS Number**	**USEPA MCL (µg/L)**	**USEPA RSL (µg/L)**	**PAL (µg/L)[1]**	**PAL Reference[1]**	**LOD Goal (µg/L)[2]**	**PRL (µg/L)**	**LOD (µg/L)**	**LOQ (µg/L)**	**LCS Lower**	**LCS Upper**
2-Amino-4,6-dinitrotoluene	35572-78-2	--	3.9	3.9	USEPA RSL	3.9	0.2	0.12	0.2	79	120
4-Amino-4,6-dinitrotoluene	19406-51-0	--	3.9	3.9	USEPA RSL	3.9	0.2	0.12	0.2	76	125
1,3-Dinitrobenzene	99-65-0	--	0.2	0.2	USEPA RSL	0.2	0.2	0.2	0.4	78	120
2,4-Dinitrotoluene	121-14-2	--	0.24	0.24	USEPA RSL	0.24	0.1	0.2	0.4	78	120
2,6-Dinitrotoluene	**606-20-2**	**--**	**0.049**	**0.049**	USEPA RSL	**0.049**	**0.1**	**0.2**	**0.2**	**77**	**127**
HMX	2691-41-0	--	100	100	USEPA RSL	100	0.5	0.2	0.4	65	135
Nitrobenzene	**98-95-3**	**--**	**0.14**	**0.14**	**USEPA RSL**	**0.14**	**0.2**	**0.2**	**0.4**	**65**	**134**
2-Nitrotoluene	88-72-2	--	0.31	0.31	USEPA RSL	0.31	0.2	0.2	0.4	70	127
3-Nitrotoluene	**99-08-1**	**--**	**0.17**	**0.17**	**USEPA RSL**	**0.17**	**0.2**	**0.2**	**0.4**	**73**	**125**
4-Nitrotoluene	99-99-0	--	4.3	4.3	USEPA RSL	4.3	0.2	0.4	1	71	127
RDX	121-82-4	--	0.7	0.7	USEPA RSL	0.7	0.5	0.12	0.2	68	130
Tetryl	479-45-8	--	3.9	3.9	USEPA RSL	3.9	0.2	0.2	0.24	64	128
1,3,5-Tinitrobenzene	99-35-4	--	59	59	USEPA RSL	59	0.2	0.4	1	73	125
2,4,6-Trinitrotoluene	118-96-7	--	0.98	0.98	USEPA RSL	0.98	0.2	0.2	0.4	71	123
PETN	78-11-5	--	3.9	3.9	USEPA RSL	3.9	3	1.2	2	73	127
Nitroglycerin	**55-63-0**	**--**	**0.2**	**0.2**	**USEPA RSL**	**0.2**	**3**	**2**	**3**	**74**	**127**

Table 15-7. Reference Limits and Evaluation Table for Nitroguanidine

Matrix	**Water**
Analytical Group	**Explosives and Propellants**
Analytical Method	**8330B Modified**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Nitroguanidine	556-88-7	--	200	200	USEPA RSL	200	20	6	20	73	117

Table 15-8. Reference Limits and Evaluation Table for Perchlorate

Matrix	**Water**
Analytical Group	**Perchlorate**
Analytical Method	**6860**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Perchlorate (6860)	14797-73-0	15	1.4	1.4	USEPA RSL	1.4	0.1	0.01	0.05	84	119

Table 15-9. Reference Limits and Evaluation Table for Nitrocellulose

Matrix	**Water**
Analytical Group	**Nitrocellulose**
Analytical Method	**MCAWW Colorimetric Cadmium Reduction 353.2**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Nitrocellulose	9004-70-0	--	6000000	6000000	USEPA RSL	6000000	500	0.001	0.002	26	144

Table 15-10. Reference Limits and Evaluation Table for Nitrate +Nitrite

Matrix	**Water**
Analytical Group	**Nitrate + Nitrite**
Analytical Method	**MCAWW 353.2**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Nitrate + Nitrite	STL00217	10000	--	--	USEPA MCL	10000	--	50	100	90	110

Table 15-11. Reference Limits and Evaluation Table for Total and Dissolved Metals (6010C)

Matrix	**Water**
Analytical Group	**Metals**
Analytical Method	**6010C**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Aluminum	7429-90-5	--	2000	2000	USEPA RSL	2000	50	70	300	86	115
Calcium	7440-70-2	--	--	--	--	--	100	135	1000	87	113
Iron[4]	7439-89-6	--	1400	1400	USEPA RSL	1400	100	85	100	87	115
Magnesium	7439-95-4	--	--	--	--	--	100	40	500	85	113
Potassium	7440-09-7	--	--	--	--	--	200	940	3000	86	114
Sodium	7440-23-5	--	--	--	--	--	200	350	5000	87	115

Table 15-12. Reference Limits and Evaluation Table for Total and Dissolved Metals (6020A)

Matrix	**Water**
Analytical Group	**Metals**
Analytical Method	**6020A**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Antimony	**7440-36-0**	**6**	**0.78**	**0.78**	**USEPA RSL**	**0.78**	**2**	**1**	**6**	**85**	**117**
Arsenic	**7440-38-2**	**10**	**0.052**	**0.052**	**USEPA RSL**	**0.052**	**5**	**1**	**5**	**84**	**116**
Barium	7440-39-3	2000	380	380	USEPA RSL	380	10	0.95	3	86	114
Beryllium	7440-41-7	4	2.5	2.5	USEPA RSL	2.5	1	0.3	1	83	121
Cadmium	**7440-43-9**	**5**	**0.92**	**0.92**	**USEPA RSL**	**0.92**	**0.5**	**1**	**1**	**87**	**115**
Chromium	7440-47-3	100	--	100	USEPA MCL	100	5	1.8	10	85	116
Cobalt	7440-48-4	--	0.6	0.6	USEPA RSL	0.6	5	0.2	1	86	115
Copper	7440-50-8	1300	80	1300	USEPA RSL	80	5	1.8	2	85	118
Lead	7439-92-1	15	15	15	USEPA RSL	15	3	0.7	3	88	115
Manganese	7439-96-5	--	43	43	USEPA RSL	43	10	0.95	3.5	87	115
Nickel	7440-02-0	--	39	39	USEPA RSL	39	10	1	3	85	117
Selenium	7782-49-2	50	10	50	USEPA RSL	10	5	2	5	80	120
Silver	7440-22-4	--	9.4	9.4	USEPA RSL	9.4	5	0.1	5	85	116
Thallium	**7440-28-0**	**2**	**0.02**	**2**	**USEPA RSL**	**0.02**	**1**	**0.2**	**1**	**82**	**116**
Vanadium	7440-62-2	--	8.6	8.6	USEPA RSL	8.6	10	2	6	86	115
Zinc[4]	7440-66-6	--	600	600	USEPA RSL	600	10	8	20	83	119

Table 15-13. Reference Limits and Evaluation Table for Total and Dissolved Mercury

Matrix	**Water**
Analytical Group	**Metals**
Analytical Method	**7470A**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Mercury	7439-97-6	2	0.063	0.063	USEPA RSL	0.063	0.2	0.08	0.2	82	119

Table 15-14. Reference Limits and Evaluation Table for Hexavalent Chromium

Matrix	**Water**
Analytical Group	**Cr(VI)**
Analytical Method	**7196A**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Hexavalent Chromium	18540-29-9	--	0.035	0.035	USEPA RSL	0.035	20	4	20	90	111

Table 15-15. Reference Limits and Evaluation Table for Free Cyanide

Matrix	**Water**
Analytical Group	**Free Cyanide**
Analytical Method	**SM 4500 CN I**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Cyanide, Free	**STL00131**	**200**	**0.15**	**0.15**	**USEPA RSL**	**0.15**	**--**	**N/A**	**10**	**75**	**120**

Table 15-16. Reference Limits and Evaluation Table for Total Cyanide

Matrix	**Water**
Analytical Group	**Total Cyanide**
Analytical Method	**9012B**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Cyanide, Total	57-12-5	--	--	--	--	--	10	5	10	83	116

Table 15-17. Reference Limits and Evaluation Table for Hydrazine

Matrix	**Water**
Analytical Group	**Hydrazine**
Analytical Method	**8315A Modified**

Analyte	CAS Number	USEPA MCL (µg/L)	USEPA RSL (µg/L)	PAL (µg/L)[1]	PAL Reference[1]	LOD Goal (µg/L)[2]	PRL (µg/L)	LOD (µg/L)	LOQ (µg/L)	LCS Lower	LCS Upper
Hydrazine	302-01-2	--	0.0011	0.0011	USEPA RSL	0.0011	--	0.2	0.2	83	130

Table 15-18. Reference Limits and Evaluation Table for Alkalinity

Matrix	**Water**										
Analytical Group	**Alkalinity**										
Analytical Method	**2320B**										
		USEPA MCL	**USEPA RSL**	**PAL**	**PAL**	**LOD Goal**	**PRL**	**LOD**	**LOQ**	**LCS**	**LCS**
Analyte	CAS Number	**(µg/L)**	**(µg/L)**	**(µg/L)[1]**	**Reference[1]**	**(µg/L)[2]**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**Lower**	**Upper**
Alkalinity	STL00171	--	--	--	--	--	--	0.0032	0.005	90	110

Table 15-19. Reference Limits and Evaluation Table for Natural Attenuation Parameters

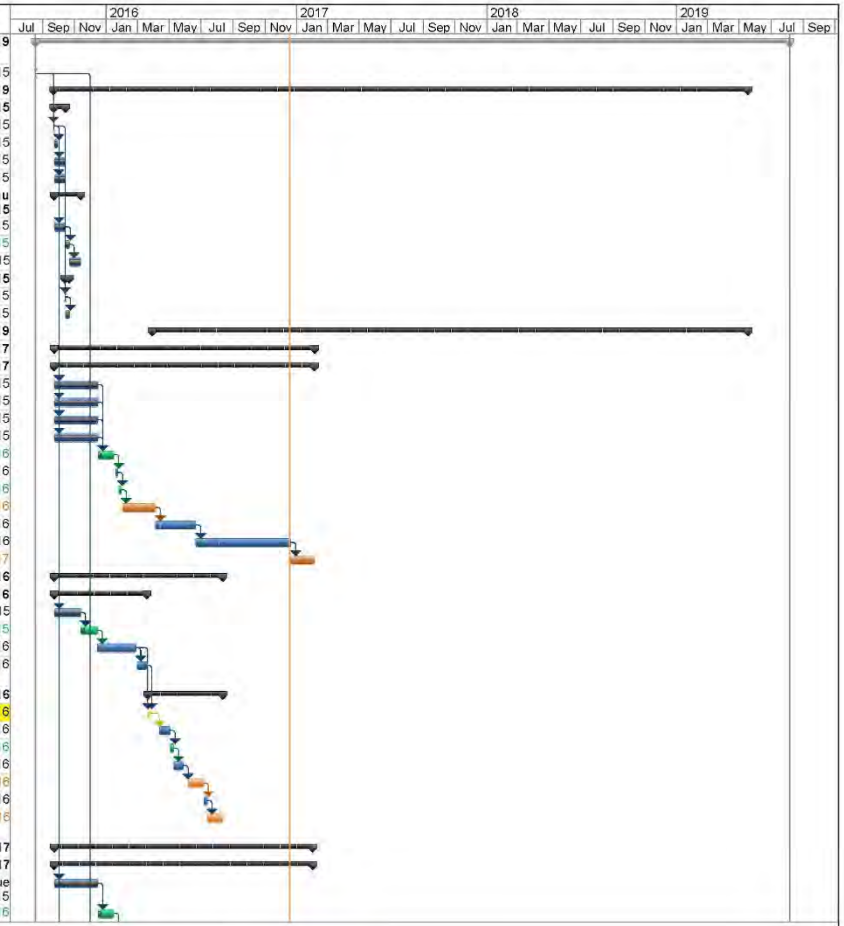
Matrix	**Water**										
Analytical Group	**Natural Attenuation Parameters**										
Analytical Method	**See Worksheet #12**										
		USEPA MCL	**USEPA RSL**	**PAL**	**PAL**	**LOD Goal**	**PRL**	**LOD**	**LOQ**	**LCS**	**LCS**
Analyte	**CAS Number**	**(µg/L)**	**(µg/L)**	**(µg/L)[1]**	**Reference[1]**	**(µg/L)[2]**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**Lower**	**Upper**
Alkalinity (SM 2320B)	STL00171	N/A	N/A	N/A	N/A	N/A	5000	3200	5000	90	110
Ammonia as N (MCAWW 350.1)	7664-41-7	N/A	N/A	N/A	N/A	N/A	2000	50	100	90	110
Orthophosphate as P (SW-846 9056A)	STL00599	N/A	N/A	N/A	N/A	N/A	500	200	500	80	116
Chloride	16887-00-6	N/A	N/A	N/A	N/A	N/A	100	500	3000	87	111
Sulfate	14808-79-8	N/A	N/A	N/A	N/A	N/A	1000	500	5000	87	112
Phosphorus	7723-14-0	N/A	N/A	N/A	N/A	N/A	100	50	3000	88	113
Sulfide	18496-25-8	N/A	N/A	N/A	N/A	N/A	1000	1890	4000	50	106
Chemical Oxygen Demand	STL00070	N/A	N/A	N/A	N/A	N/A	20000	10000	20000	90	110
Total Organic Carbon	7440-44-0	N/A	N/A	N/A	N/A	N/A	1000	500	1000	88	112
Total Recoverable Phenols	64743-03-9	N/A	N/A	N/A	N/A	N/A	40	20	10	90	110
Methane	74-82-8	N/A	N/A	N/A	N/A	N/A	--	803	5000	73	125
Ethane (RSK 175)	74-84-0	N/A	N/A	N/A	N/A	N/A	--	1500	5000	74	131
Ethene (RSK 175)	74-85-1	N/A	N/A	N/A	N/A	N/A	--	1400	5000	72	133
pH	N/A	N/A	N/A	N/A	N/A	N/A	--	0.1[5]	0.1[5]	N/A	N/A

Notes for all Worksheet #15 tables:

Grey shading = indicates analytes where the PRL is less than the LOD.
Bolded text = indicates analytes where the LOD is greater than the PAL.
[1]PAL is the lower value between the USEPA RSL and USEPA MCL.
[2]The LOD goal is equal to the PAL.
[3]Indictes analytes that are known poor (minimum recovery less than 10%) performers
[4]Indicates analytes that are common lab contaminants
[5]Units for pH measurements are dimensionless.
µg/L = microgram per liter
CAS No. = Chemical Abstract Service Number
Cr(V1) = Chromium hexavalent
EPA = United States Environmental Protection Agency
LCS = Laboratory control sample
LOD = Limit of detection
LOQ = Limit of quantitation
MCAWW = Methods for Chemical Analysis of Water and Wastes
MCL = Maximum Contaminant Level
N/A = Not applicable
PAH = Polycyclic Aromatic Hydrocarbon
PAL = Project action level
PCB = Polychlorinated Biphenyl
PRL = Project Reporting Level, as defined in Table 4-3 of the FWQAPP (SAIC, 2011)
RSL = Regional screening level (tap water standard)
SM = Standard Method
SVOC = Semi-Volatile Organic Compound
SW-846 = Test Methods for Evaluating Solid Waste, Physical/Chemical Methods
VOC = Volatile Organic Compound

16.0 PROJECT SCHEDULE/TIMELINE (QAPP WORKSHEET #16)

ID	Task	Task Name	Calendar Days	Start	Finish
0		**Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna**	**1449 days**	**Tue 8/18/15**	**Mon 8/5/19**
1		Contract Award	1 day	Tue 8/18/15	Tue 8/18/15
2	**1**	**Project Management Plan**	**1334 days**	**Tue 9/22/15**	**Fri 5/17/19**
3	**1.01**	**Kickoff Meeting**	**23 days**	**Tue 9/22/15**	**Ved 10/14/15**
4	1.01	Project Kickoff Meeting	1 day	Tue 9/22/15	Tue 9/22/15
5	1.01	Prepare Project Kickoff Meeting Minutes	7 days	Wed 9/23/15	Tue 9/29/15
6	1.01	Initial Personnel Security/Access Training	22 days	Wed 9/23/15	Ved 10/14/15
7	1.01	Written Notification of PM and APM	22 days	Wed 9/23/15	Ved 10/14/15
8	**1.02**	**Project Management Plan (PMP) and Quality Control Plan (QCP)**	**51 days**	**Wed 9/23/15**	**Thu 11/12/15**
9	1.02	Prepare Preliminary Draft PMP and QCP	22 days	Wed 9/23/15	Ved 10/14/15
10	1.02	ARNG Review and Comment	7 days	Thu 10/15/15	Ved 10/21/15
11	1.02	Prepare Final PMP and QCP for ARNG Approval	22 days	Thu 10/22/15	Thu 11/12/15
12	**1.03**	**Initial Scoping Meeting**	**8 days**	**Ved 10/14/15**	**Ved 10/21/15**
13	1.03	Initial Project Scoping Meeting	1 day	Ved 10/14/15	Ved 10/14/15
14	1.03	Prepare Initial Project Scoping Meeting Minutes (Vista)	7 days	Thu 10/15/15	Ved 10/21/15
15	**1.04**	**RAB Meeting Attendance**	**1145 days**	**Tue 3/29/16**	**Fri 5/17/19**
38	**2**	**Remedial Investigation (RI) Work Plan**	**500 days**	**Wed 9/23/15**	**Fri 2/3/17**
39	**2.01**	**Remedial Investigation (RI) Work Plan**	**500 days**	**Wed 9/23/15**	**Fri 2/3/17**
40	2.02	Prepare Conceptual Site Model (CSM)	84 days	Wed 9/23/15	Tue 12/15/15
41	2.03	Analyze Well Data and Network	84 days	Wed 9/23/15	Tue 12/15/15
42	2.04	Prepare Background Study	84 days	Wed 9/23/15	Tue 12/15/15
43	2.01	Prepare Preliminary Draft RI Work Plan	84 days	Wed 9/23/15	Tue 12/15/15
44	2.01	ARNG Review and Comment	31 days	Ved 12/16/15	Fri 1/15/16
45	2.01	Prepare RTCs and Draft RI Work Plan	4 days	Tue 1/19/16	Fri 1/22/16
46	2.01	ARNG Review and Comment	5 days	Mon 1/25/16	Fri 1/29/16
47	2.01	Regulator Review Draft RI Work Plan	64 days	Mon 2/1/16	Mon 4/4/16
48	2.01	Prepare RTCs	77 days	Tue 4/5/16	Mon 6/20/16
49	2.01	Prepare Final RI Work Plan	183 days	Tue 6/21/16	Tue 12/20/16
50	2.01	Receive ARNG and Regulatory Approval of RI Work Plan	45 days	Ved 12/21/16	Fri 2/3/17
51	**3**	**Phase I Archaeological Survey**	**324 days**	**Wed 9/23/15**	**Thu 8/11/16**
52	**3.01**	**Phase I Archaeological Survey Work Plan**	**178 days**	**Wed 9/23/15**	**Fri 3/18/16**
53	3.01	Prepare Survey Work Plan	51 days	Wed 9/23/15	Thu 11/12/15
54	3.01	ARNG Review Survey Work Plan	32 days	Fri 11/13/15	Mon 12/14/15
55	3.01	Prepare RTCs and Finalize Survey Work Plan	74 days	Tue 12/15/15	Fri 2/26/16
56	3.01	Receive ARNG and Regulatory Approval of Phase 1 Archaeological Survey Work Plan	19 days	Mon 2/29/16	Fri 3/18/16
57	**3.02**	**Phase I Archaeological Survey Report**	**144 days**	**Mon 3/21/16**	**Thu 8/11/16**
58	3.02	Conduct Phase I Archaeological Survey	4 days	Mon 3/21/16	Thu 3/24/16
59	3.02	Prepare Preliminary Draft Phase I Archaeological Survey Report	21 days	Tue 4/12/16	Mon 5/2/16
60	3.02	ARNG Review and Comment	7 days	Tue 5/3/16	Mon 5/9/16
61	3.02	Prepare RTCs and Draft Phase I Archaeological Survey Report	18 days	Tue 5/10/16	Fri 5/27/16
62	3.02	Regulator Review Draft Phase I Archaeological Survey Report	30 days	Mon 6/6/16	Tue 7/5/16
63	3.02	Prepare RTCs and Final Phase I Archaeological Survey Report	7 days	Wed 7/6/16	Tue 7/12/16
64	3.02	Receive ARNG and Regulatory Approval of Phase 1 Archaeological Survey Report	30 days	Wed 7/13/16	Thu 8/11/16
65	**4**	**Sampling and Analysis Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
66	**4.01**	**Sampling and Analysis Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
67	4.01	Prepare Preliminary Draft Field Sampling Plan (FSP)/UFP-QAPP	84 days	Wed 9/23/15	Tue 12/15/15
68	4.01	ARNG Review and Comment	31 days	Ved 12/16/15	Fri 1/15/16



Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
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Task | Summary | Field Work Activities (Yellow)
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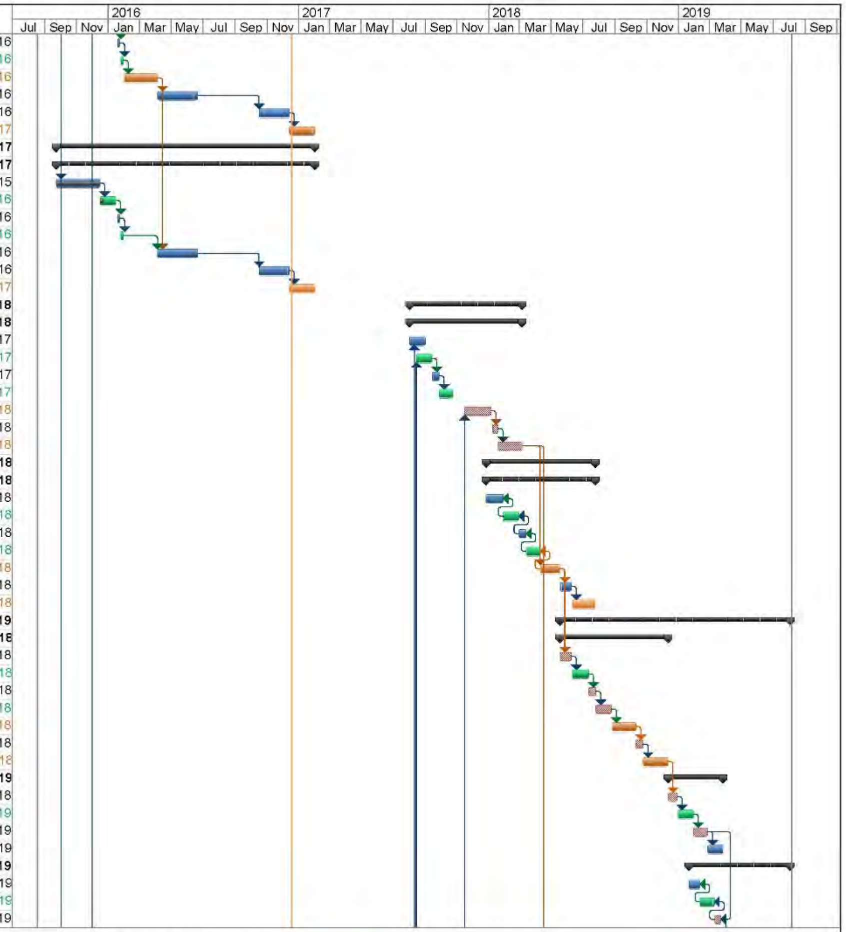
ID	Task	Task Name	Calendar Days	Start	Finish
69	4.01	Prepare RTCs and Draft FSP/UFP-QAPP	4 days	Tue 1/19/16	Fri 1/22/16
70	4.01	ARNG Review and Comment	5 days	Mon 1/25/16	Fri 1/29/16
71	4.01	Regulator Review Draft FSP/UFP-QAPP	64 days	Mon 2/1/16	Mon 4/4/16
72	4.01	Prepare RTCs	77 days	Tue 4/5/16	Mon 6/20/16
73	4.01	Prepare Final FSP/UFP-QAPP	58 days	Mon 10/17/16	Tue 12/13/16
74	4.01	Receive ARNG and Regulatory Approval of FSP/UFP-QAPP	49 days	Ved 12/14/16	Tue 1/31/17
75	**5**	**Health and Safety Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
76	**5.01**	**Health and Safety Plan**	**497 days**	**Wed 9/23/15**	**Tue 1/31/17**
77	5.01	Prepare Preliminary Draft Health and Safety Plan (HSP)	84 days	Wed 9/23/15	Tue 12/15/15
78	5.01	ARNG Review and Comment	31 days	Ved 12/16/15	Fri 1/15/16
79	5.01	Prepare RTCs and Draft Health and Safety Plan (HSP)	4 days	Tue 1/19/16	Fri 1/22/16
80	5.01	ARNG Review and Comment	5 days	Mon 1/25/16	Fri 1/29/16
81	5.01	Prepare RTCs	77 days	Tue 4/5/16	Mon 6/20/16
82	5.01	Prepare Final HSP for ARNG Approval	58 days	Mon 10/17/16	Tue 12/13/16
83	5.01	Receive ARNG Approval of HSP	49 days	Ved 12/14/16	Tue 1/31/17
84	**6**	**Remedial Investigation Report**	**216 days**	**Wed 8/2/17**	**Mon 3/5/18**
85	**6.01**	**Remedial Investigation (RI) Report**	**216 days**	**Wed 8/2/17**	**Mon 3/5/18**
86	6.01	Prepare Preliminary Draft Report	30 days	Wed 8/2/17	Thu 8/31/17
87	6.01	ARNG Review and Comment	30 days	Tue 8/15/17	Wed 9/13/17
88	6.01	Prepare RTCs and Draft Report	14 days	Thu 9/14/17	Wed 9/27/17
89	6.01	ARNG Review and Comment	26 days	Thu 9/28/17	Mon 10/23/17
90	6.01	Regulator Review Draft Report	51 days	Thu 11/16/17	Fri 1/5/18
91	6.01	Prepare RTCs and Final Report	11 days	Mon 1/8/18	Thu 1/18/18
92	6.01	Receive ARNG and Regulatory Approval of RI Report	46 days	Fri 1/19/18	Mon 3/5/18
93	**7**	**Feasibility Study (FS) Report**	**210 days**	**Ved 12/27/17**	**Tue 7/24/18**
94	**7.01**	**Feasibility Study (FS) Report**	**210 days**	**Ved 12/27/17**	**Tue 7/24/18**
95	7.01	Prepare Preliminary Draft Report	33 days	Ved 12/27/17	Mon 1/29/18
96	7.01	ARNG Review and Comment	30 days	Mon 1/29/18	Wed 2/28/18
97	7.01	Prepare RTCs and Draft Report	14 days	Wed 2/28/18	Wed 3/14/18
98	7.01	ARNG Review and Comment	27 days	Wed 3/14/18	Tue 4/10/18
99	7.01	Regulator Review Draft Report	38 days	Tue 4/10/18	Thu 5/17/18
100	7.01	Prepare RTCs and Final Report	22 days	Fri 5/18/18	Fri 6/8/18
101	7.01	Receive ARNG and Regulatory Approval of FS Report	44 days	Mon 6/11/18	Tue 7/24/18
102	**8**	**Proposed Plan (PP)/Record of Decision (ROD)**	**442 days**	**Fri 5/18/18**	**Fri 8/2/19**
103	**8.01**	**Proposed Plan (PP)**	**208 days**	**Fri 5/18/18**	**Tue 12/11/18**
104	8.01	Prepare Preliminary Draft PP	22 days	Fri 5/18/18	Fri 6/8/18
105	8.01	ARNG Review	31 days	Mon 6/11/18	Wed 7/11/18
106	8.01	Prepare RTCs and Draft PP	14 days	Thu 7/12/18	Wed 7/25/18
107	8.01	ARNG Review	30 days	Thu 7/26/18	Fri 8/24/18
108	8.01	Regulator Review Draft PP	45 days	Mon 8/27/18	Ved 10/10/18
109	8.01	Prepare RTCs and Final PP	14 days	Thu 10/11/18	Ved 10/24/18
110	8.01	Receive Regulatory Approval of PP	48 days	Thu 10/25/18	Tue 12/11/18
111	**8.02**	**Proposed Plan Public Meeting**	**105 days**	**Ved 12/12/18**	**Tue 3/26/19**
112	8.02	Prepare Draft Public Meeting Submittals	17 days	Ved 12/12/18	Fri 12/28/18
113	8.02	ARNG Review & Approve Public Meeting Submittals	29 days	Mon 12/31/18	Mon 1/28/19
114	8.02	Public Meeting and Comment Period	28 days	Tue 1/29/19	Mon 2/25/19
115	8.02	ARNG Review Public Meeting Minutes and Comments	29 days	Tue 2/26/19	Tue 3/26/19
116	**8.03**	**Record of Decision (ROD)**	**194 days**	**Mon 1/21/19**	**Fri 8/2/19**
117	8.03	Prepare Preliminary Draft ROD	21 days	Mon 1/21/19	Mon 2/11/19
118	8.03	ARNG Review	28 days	Mon 2/11/19	Mon 3/11/19
119	8.03	Prepare RTCs and Draft ROD	12 days	Mon 3/11/19	Fri 3/22/19



Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
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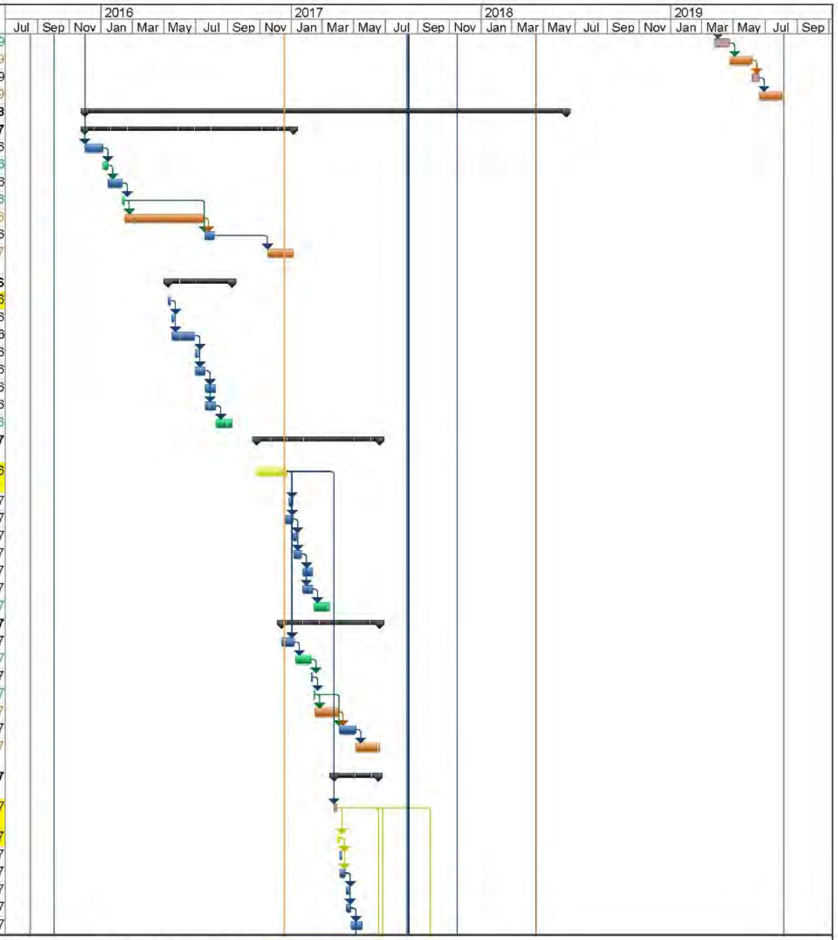
ID	Task	Task Name	Calendar Days	Start	Finish
120	8.03	ARNG Review	30 days	Mon 3/25/19	Tue 4/23/19
121	8.03	Regulator Review Draft ROD	43 days	Wed 4/24/19	Wed 6/5/19
122	8.03	Prepare RTCs and Final ROD	14 days	Thu 6/6/19	Wed 6/19/19
123	8.03	Receive ARNG and Regulatory Approval of ROD	44 days	Thu 6/20/19	Fri 8/2/19
124	**9**	**Routine Groundwater Sampling**	**926 days**	**Tue 12/1/15**	**Wed 6/13/18**
125	**9.01**	**2015 Annual Groundwater Sampling Report**	**401 days**	**Tue 12/1/15**	**Wed 1/4/17**
126	9.01	Prepare Preliminary Draft Report and IDW Report	35 days	Tue 12/1/15	Mon 1/4/16
127	9.01	ARNG Review and Comment	9 days	Tue 1/5/16	Wed 1/13/16
128	9.01	Prepare RTCs and Draft Report and IDW Report	28 days	Thu 1/14/16	Wed 2/10/16
129	9.01	ARNG Review and Comment	4 days	Thu 2/11/16	Sun 2/14/16
130	9.01	Regulator Review Draft Report	152 days	Mon 2/15/16	Fri 7/15/16
131	9.01	Prepare RTCs and Final Report and IDW Report	19 days	Mon 7/18/16	Fri 8/5/16
132	9.01	Receive ARNG and Regulatory Approval of Groundwater Sampling Report #1 and IDW Report	50 days	Wed 11/16/16	Wed 1/4/17
133	**9.02**	**Semi-Annual Groundwater Sampling #1 (Existing Wells)**	**123 days**	**Mon 5/9/16**	**Thu 9/8/16**
134	9.02	Semi-Annual GW Sampling #1	5 days	Mon 5/9/16	Fri 5/13/16
135	9.02	Field Work Completion Notice	5 days	Mon 5/16/16	Fri 5/20/16
136	9.02	Sample Analysis	45 days	Mon 5/16/16	Wed 6/29/16
137	9.02	Analytical Raw Data Submission	8 days	Thu 6/30/16	Thu 7/7/16
138	9.02	Data Validation	19 days	Thu 6/30/16	Mon 7/18/16
139	9.02	Database Upload	21 days	Tue 7/19/16	Mon 8/8/16
140	9.02	Prepare Sampling Event Tech Memo	21 days	Tue 7/19/16	Mon 8/8/16
141	9.02	ARNG Review and Approve Sampling Event Tech Memo	31 days	Tue 8/9/16	Thu 9/8/16
142	**9.02/9.04**	**Semi-Annual Groundwater Sampling #2 and Quarterly GW Sampling #1 (Existing/New Wells)**	**237 days**	**Wed 10/26/16**	**Mon 6/19/17**
143	9.02/9.04	Semi-Annual Groundwater Sampling #2 and Quarterly GW Sampling #1	59 days	Wed 10/26/16	Fri 12/23/16
144	9.02/9.04	Field Work Completion Notice	8 days	Tue 12/27/16	Tue 1/3/17
145	9.02/9.04	Sample Analysis	16 days	Mon 12/19/16	Tue 1/3/17
146	9.02/9.04	Analytical Raw Data Submission	7 days	Wed 1/4/17	Tue 1/10/17
147	9.02/9.04	Data Validation	15 days	Fri 1/6/17	Fri 1/20/17
148	9.02/9.04	Database Upload	19 days	Mon 1/23/17	Fri 2/10/17
149	9.02/9.04	Prepare Sampling Event Tech Memo	19 days	Mon 1/23/17	Fri 2/10/17
150	9.02/9.04	ARNG Review and Approve Sampling Event Tech Memo	31 days	Mon 2/13/17	Wed 3/15/17
151	**9.05**	**2016 Annual Groundwater Sampling Report**	**189 days**	**Tue 12/13/16**	**Mon 6/19/17**
152	9.05	Prepare Preliminary Draft Report and IDW Report	25 days	Tue 12/13/16	Fri 1/6/17
153	9.05	ARNG Review and Comment	30 days	Mon 1/9/17	Tue 2/7/17
154	9.05	Prepare RTCs and Draft Report and IDW Report	3 days	Wed 2/8/17	Fri 2/10/17
155	9.05	ARNG Review and Comment	2 days	Mon 2/13/17	Tue 2/14/17
156	9.05	Regulator Review Draft Report	45 days	Wed 2/15/17	Fri 3/31/17
157	9.05	Prepare RTCs and Final Report and IDW Report	32 days	Mon 4/3/17	Thu 5/4/17
158	9.05	Receive ARNG and Regulatory Approval of Groundwater Sampling Report #1 and IDW Report	46 days	Fri 5/5/17	Mon 6/19/17
159	**9.04**	**Semi-Annual Groundwater Sampling #3 and Quarterly GW Sampling #2 (New Wells)**	**85 days**	**Fri 3/24/17**	**Fri 6/16/17**
160	9.04/9.07	Semi-Annual Groundwater Sampling #3 and Quarterly GW Sampling #2	6 days	Fri 3/24/17	Wed 3/29/17
161	9.04/9.07	Additional RI Sampling	5 days	Thu 3/30/17	Mon 4/3/17
162	9.04/9.07	Field Work Completion Notice	4 days	Tue 4/4/17	Fri 4/7/17
163	9.04/9.07	Sample Analysis	11 days	Tue 4/4/17	Fri 4/14/17
164	9.04/9.07	Analytical Raw Data Submission	5 days	Mon 4/17/17	Fri 4/21/17
165	9.04/9.07	Data Validation	9 days	Mon 4/17/17	Tue 4/25/17
166	9.04/9.07	Database Upload	21 days	Wed 4/26/17	Tue 5/16/17



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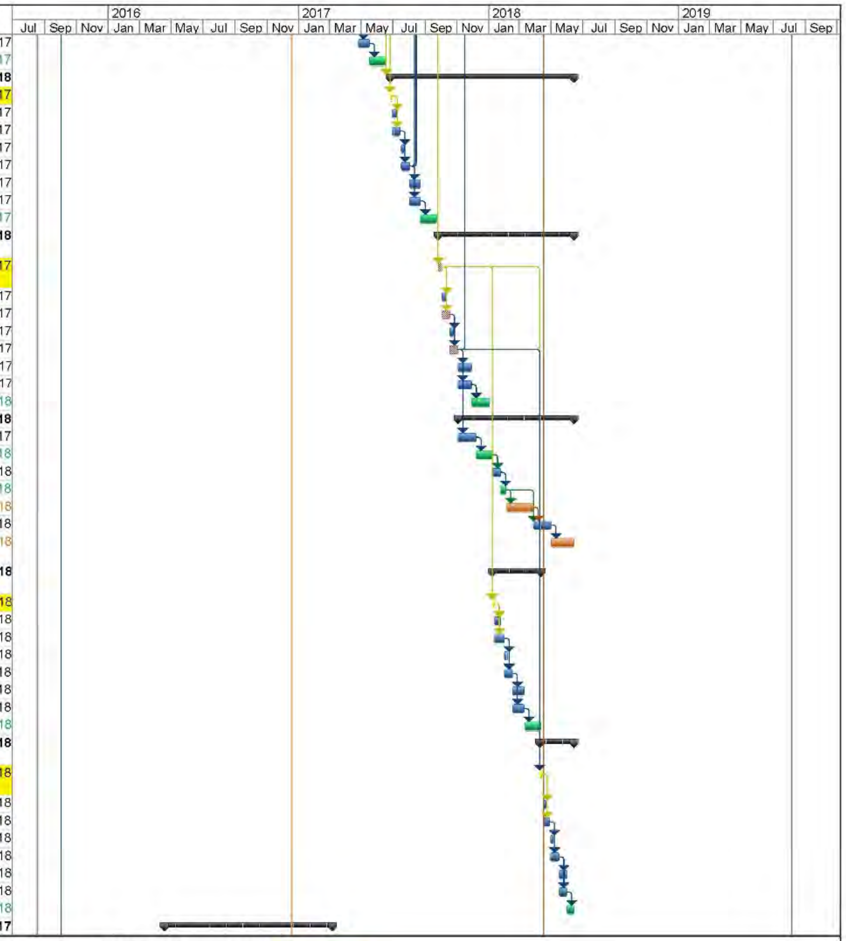
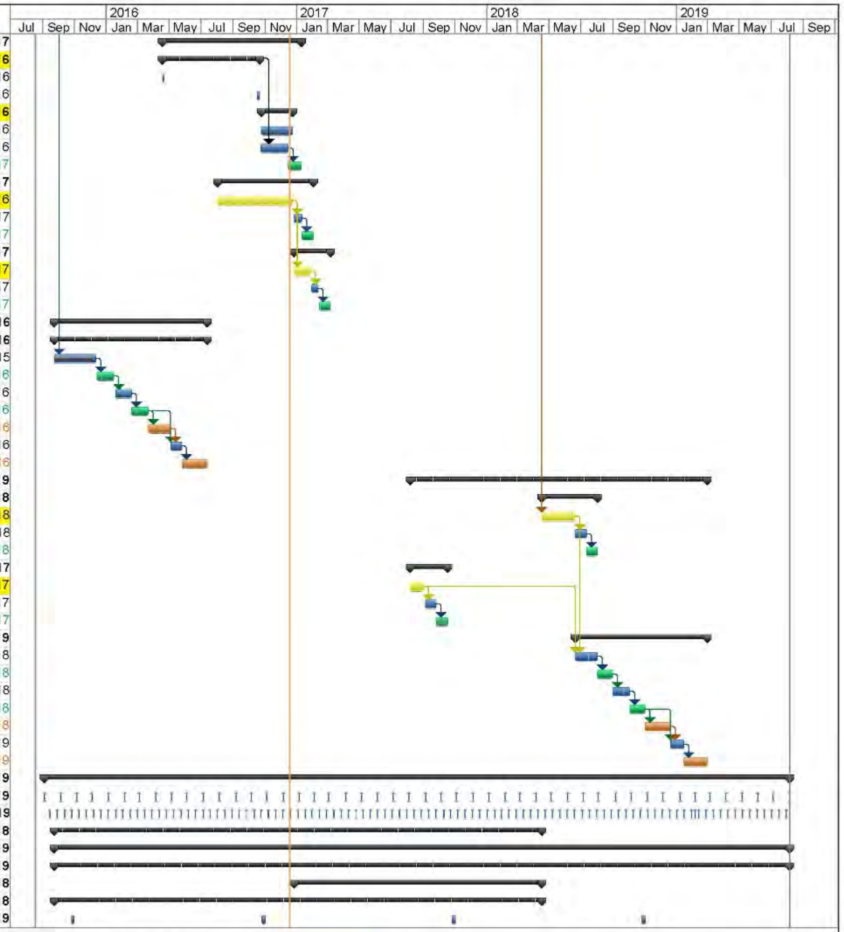
ID	Task	Task Name	Calendar Days	Start	Finish
167	9.04/9.07	Prepare Sampling Event Tech Memo	21 days	Wed 4/26/17	Tue 5/16/17
168	9.04/9.07	ARNG Review and Approve Sampling Event Tech Memo	31 days	Wed 5/17/17	Fri 6/16/17
169	**9.06**	**Quarterly Groundwater Sampling #3 (New Wells)**	**353 days**	**Mon 6/26/17**	**Wed 6/13/18**
170	9.06	Quarterly GW Sampling #3	4 days	Mon 6/26/17	Thu 6/29/17
171	9.06	Field Work Completion Notice	8 days	Fri 6/30/17	Fri 7/7/17
172	9.06	Sample Analysis	15 days	Fri 6/30/17	Fri 7/14/17
173	9.06	Analytical Raw Data Submission	5 days	Mon 7/17/17	Fri 7/21/17
174	9.06	Data Validation	16 days	Mon 7/17/17	Tue 8/1/17
175	9.06	Database Upload	21 days	Wed 8/2/17	Tue 8/22/17
176	9.06	Prepare Sampling Event Tech Memo	21 days	Wed 8/2/17	Tue 8/22/17
177	9.06	ARNG Review and Approve Sampling Event Tech Memo	31 days	Wed 8/23/17	Fri 9/22/17
178	**9.09**	**Semi-Annual Groundwater Sampling #4 and Quarterly GW Sampling #4 (New Wells)**	**261 days**	**Tue 9/26/17**	**Wed 6/13/18**
179	9.09	Semi-Annual Groundwater Sampling #4 and Quarterly GW Sampling #4	7 days	Tue 9/26/17	Mon 10/2/17
180	9.09	Field Work Completion Notice	8 days	Tue 10/3/17	Tue 10/10/17
181	9.09	Sample Analysis	15 days	Tue 10/3/17	Tue 10/17/17
182	9.09	Analytical Raw Data Submission	7 days	Wed 10/18/17	Tue 10/24/17
183	9.09	Data Validation	16 days	Wed 10/18/17	Thu 11/2/17
184	9.09	Database Upload	26 days	Fri 11/3/17	Tue 11/28/17
185	9.09	Prepare Sampling Event Tech Memo	26 days	Fri 11/3/17	Tue 11/28/17
186	9.09	ARNG Review and Approve Sampling Event Tech Memo	35 days	Wed 11/29/17	Tue 1/2/18
187	**9.05**	**2017 Annual Groundwater Sampling Report**	**223 days**	**Fri 11/3/17**	**Wed 6/13/18**
188	9.05	Prepare Preliminary Draft Report and IDW Report	35 days	Fri 11/3/17	Thu 12/7/17
189	9.05	ARNG Review and Comment	32 days	Fri 12/8/17	Mon 1/8/18
190	9.05	Prepare RTCs and Draft Report and IDW Report	15 days	Tue 1/9/18	Tue 1/23/18
191	9.05	ARNG Review and Comment	10 days	Wed 1/24/18	Fri 2/2/18
192	9.05	Regulator Review Draft Report	51 days	Mon 2/5/18	Tue 3/27/18
193	9.05	Prepare RTCs and Final Report and IDW Report	34 days	Wed 3/28/18	Mon 4/30/18
194	9.05	Receive ARNG and Regulatory Approval of Groundwater Sampling Report #1 and IDW Report	44 days	Tue 5/1/18	Wed 6/13/18
195	**9.06**	**Quarterly Groundwater Sampling #5 (New Wells)**	**93 days**	**Mon 1/8/18**	**Tue 4/10/18**
196	9.06	Quarterly GW Sampling #5	4 days	Mon 1/8/18	Thu 1/11/18
197	9.06	Field Work Completion Notice	12 days	Fri 1/12/18	Tue 1/23/18
198	9.06	Sample Analysis	19 days	Fri 1/12/18	Tue 1/30/18
199	9.06	Analytical Raw Data Submission	7 days	Wed 1/31/18	Tue 2/6/18
200	9.06	Data Validation	16 days	Wed 1/31/18	Thu 2/15/18
201	9.06	Database Upload	22 days	Fri 2/16/18	Fri 3/9/18
202	9.06	Prepare Sampling Event Tech Memo	22 days	Fri 2/16/18	Fri 3/9/18
203	9.06	ARNG Review and Approve Sampling Event Tech Memo	30 days	Mon 3/12/18	Tue 4/10/18
204	**9.11**	**Semi-Annual Groundwater Sampling #5 (Existing/New Wells) and Quarterly GW Sampling #6**	**66 days**	**Mon 4/9/18**	**Wed 6/13/18**
205	9.11	Semi-Annual GW Sampling #5 and Quarterly GW Sampling #6 (Pending New Wells)	5 days	Mon 4/9/18	Fri 4/13/18
206	9.11	Field Work Completion Notice	5 days	Mon 4/16/18	Fri 4/20/18
207	9.11	Sample Analysis	12 days	Mon 4/16/18	Fri 4/27/18
208	9.11	Analytical Raw Data Submission	5 days	Mon 4/30/18	Fri 5/4/18
209	9.11	Data Validation	16 days	Mon 4/30/18	Tue 5/15/18
210	9.11	Database Upload	15 days	Wed 5/16/18	Wed 5/30/18
211	9.11	Prepare Sampling Event Tech Memo	15 days	Wed 5/16/18	Wed 5/30/18
212	9.11	ARNG Review and Approve Sampling Event Tech Memo	14 days	Thu 5/31/18	Wed 6/13/18
213	**10**	**Well Redevelopment and Reconstruction**	**323 days**	**Mon 4/18/16**	**Mon 3/6/17**



Groundwater and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant/Camp Ravenna
Date: Mon 12/19/16

Task	Summary	Field Work Activities (Yellow)	
Milestone	Critical	Progress	

ID	Task	Task Name	Calendar Days	Start	Finish
214	**10.01**	**Install Bladder Pumps in Wells**	**267 days**	**Mon 4/18/16**	**Mon 1/9/17**
215	**10.01**	**Install Bladder Pumps in Existing Wells**	**187 days**	**Mon 4/18/16**	**Fri 10/21/16**
216	10.01	May 2016 Sampling Event	3 days	Mon 4/18/16	Wed 4/20/16
217	10.01	October 2016 Sampling Event	5 days	Mon 10/17/16	Fri 10/21/16
218		**Install Bladder Pumps in New Wells**	**60 days**	**Tue 10/25/16**	**Fri 12/23/16**
219	10.01	Quarterly #1 Sampling Event	60 days	Tue 10/25/16	Fri 12/23/16
220	10.01	Prepare Tech Memo	53 days	Mon 10/24/16	Thu 12/15/16
221	10.01	ARNG Approve Tech Memo	25 days	Fri 12/16/16	Mon 1/9/17
222	**10.02**	**Install New Wells**	**184 days**	**Tue 8/2/16**	**Wed 2/1/17**
223	10.02	Install and Develop New Wells	144 days	Tue 8/2/16	Fri 12/23/16
224	10.02	Prepare Tech Memo and IDW Report	15 days	Tue 12/27/16	Tue 1/10/17
225	10.02	ARNG Approve Tech Memo and IDW Report	22 days	Wed 1/11/17	Wed 2/1/17
226	**10.03**	**Well Redevelopment and Reconstruction**	**70 days**	**Tue 12/27/16**	**Mon 3/6/17**
227	10.03	Well Redevelopment and Reconstruction	32 days	Tue 12/27/16	Fri 1/27/17
228	10.03	Prepare Tech Memo and IDW Report	12 days	Mon 1/30/17	Fri 2/10/17
229	10.03	ARNG Approve Tech Memo and IDW Report	22 days	Mon 2/13/17	Mon 3/6/17
230	**11**	**Well Abandonment Work Plan**	**294 days**	**Wed 9/23/15**	**Tue 7/12/16**
231	**11.01**	**Well Abandonment Work Plan**	**294 days**	**Wed 9/23/15**	**Tue 7/12/16**
232	11.01	Prepare Preliminary Draft Well Abandonment Work Plan	80 days	Wed 9/23/15	Fri 12/11/15
233	11.01	ARNG Review and Comment	33 days	Mon 12/14/15	Fri 1/15/16
234	11.01	Prepare RTCs and Draft Work Plan	31 days	Tue 1/19/16	Thu 2/18/16
235	11.01	ARNG Review and Comment	32 days	Fri 2/19/16	Mon 3/21/16
236	11.01	Regulator Review Draft Work Plan	43 days	Tue 3/22/16	Tue 5/3/16
237	11.01	Prepare RTCs and Final Work Plan	21 days	Wed 5/4/16	Tue 5/24/16
238	11.01	Receive ARNG and Regulatory Approval of Well Abandonment Work Plan	49 days	Wed 5/25/16	Tue 7/12/16
239	**12**	**Well Sealing Report**	**571 days**	**Mon 8/7/17**	**Thu 2/28/19**
240	**12.01**	**Abandon Monitoring Wells**	**107 days**	**Tue 4/17/18**	**Wed 8/1/18**
241	12.01	Abandon Monitoring Wells	64 days	Tue 4/17/18	Tue 6/19/18
242	12.01	Prepare Tech Memo and IDW Report	22 days	Wed 6/20/18	Wed 7/11/18
243	12.01	ARNG Approve Tech Memo and IDW Report	21 days	Thu 7/12/18	Wed 8/1/18
244	**12.02**	**Abandon Production Wells**	**72 days**	**Mon 8/7/17**	**Tue 10/17/17**
245	12.02	Abandon Production Wells	26 days	Mon 8/7/17	Fri 9/1/17
246	12.02	Prepare Tech Memo and IDW Report	21 days	Tue 9/5/17	Mon 9/25/17
247	12.02	ARNG Approve Tech Memo and IDW Report	22 days	Tue 9/26/17	Tue 10/17/17
248	**12.03**	**Well Sealing Report**	**254 days**	**Wed 6/20/18**	**Thu 2/28/19**
249	12.03	Prepare Preliminary Draft Well Sealing Report	43 days	Wed 6/20/18	Wed 8/1/18
250	12.03	ARNG Review and Comment	29 days	Thu 8/2/18	Thu 8/30/18
251	12.03	Prepare RTCs and Draft Well Sealing Report	33 days	Fri 8/31/18	Tue 10/2/18
252	12.03	ARNG Review and Comment	29 days	Wed 10/3/18	Wed 10/31/18
253	12.03	Regulator Review Draft Well Sealing Report	49 days	Thu 11/1/18	Wed 12/19/18
254	12.03	Prepare RTCs and Final Well Sealing Report	26 days	Thu 12/20/18	Mon 1/14/19
255	12.03	Receive ARNG and Regulatory Approval of Well Sealing Report	45 days	Tue 1/15/19	Thu 2/28/19
256	**13.01**	**Monthly Status Report**	**1432 days**	**Fri 9/4/15**	**Mon 8/5/19**
257	**13.01**	**Monthly Reports**	**1432 days**	**Fri 9/4/15**	**Mon 8/5/19**
318		**Biweekly Calls**	**1416 days**	**Mon 9/14/15**	**Tue 7/30/19**
424		**Coordination with REIMS Contractor**	**937 days**	**Wed 9/23/15**	**Mon 4/16/18**
427		**Periodic Progress/Technical Meetings**	**1413 days**	**Wed 9/23/15**	**Mon 8/5/19**
430		**Public Relations and Regulatory Support**	**1413 days**	**Wed 9/23/15**	**Mon 8/5/19**
433		**Management of IDW**	**476 days**	**Tue 12/27/16**	**Mon 4/16/18**
436		**Ongoing Personnel Security/Access Training**	**937 days**	**Wed 9/23/15**	**Mon 4/16/18**
439	**14**	**Manpower Reporting**	**1377 days**	**Mon 10/26/15**	**Fri 8/2/19**



Groundwater and Environmental Investigation Services
at the Former Ravenna Army Ammunition Plant/Camp Ravenna
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Task | Summary | Field Work Activities (Yellow)
Milestone | Critical | Progress

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17.0 SAMPLING DESIGN AND RATIONALE (QAPP WORKSHEET #17)

This information is contained in Section 3.0 of the WP.

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18.0 SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS (QAPP WORKSHEET #18)

Sample locations and methods are presented in Section 3.0 of the WP. SOP requirements are contained in Section 5.0 of the FWSAP.

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19.0 ANALYTICAL SOP REQUIREMENTS (QAPP WORKSHEET #19)

Table 19-1. Analytical SOP Requirements

Matrix	**Analytical Group/ Analytical Method**	**Laboratory SOP Reference**[1]	**Containers** (number, size, and type)	**Minimum Sample Volume**[3]	**Preservation Requirements** (chemical, temperature, light protected)	**Maximum Holding Time**[2] (preparation/analysis)
Water	VOCs (8260B)	DV-MS-0010	3 x 40 mL glass VOA vials	40 mL glass VOA vial	HCl, pH <2; Cool $\leq$ 6°C	14 days
Water	SVOCs (8270D)	DV-MS-0012	2 x 1 L, amber glass	1000 mL	Cool $\leq$ 6°C	7 days to extract 40 days to analyze
Water	PAHs (8270D SIM)	DV-MS-0012	2 x 1 L, amber glass	1000 mL	Cool $\leq$ 6°C	7 days to extract 40 days to analyze
Water	Pesticides (8081B)	DV-GC-0020	2 x 1 L, amber glass	1000 mL	Cool $\leq$ 6°C	7 days to extract 40 days to analyze
Water	PCBs (8082A)	DV-GC-0021	2 x 1 L, amber glass	1000 mL	Cool $\leq$ 6°C	1 year to extract 40 days to analyze
Water	Explosives and Propellants (8330B)	DV-LC-0002	2 x500 mL, amber	500 mL	Cool $\leq$ 6°C	7 days to extract 40 days to analyze
Water	Nitroguanidine (8330B)	WS-LC-0010	2 x 1 L, amber	1000 mL	Cool $\leq$ 6°C	7 days to extract 40 days to analyze
Water	Perchlorate (6860)	DV-LC-0024	1 x125 mL, HDPE, Sterile, Field filtered (0.2 µm), Headspace (1/3 bottle)	10 mL	Cool $\leq$ 6°C	28 days
Water	Nitrocellulose (Colorimetric Cadmium Reduction 353.2)	WS-WC-0020	1 x 500 mL amber glass jar	250 mL	H_2SO_4, pH < 2; Cool $\leq$ 6°C	28 days
Water	Nitrate + Nitrite (353.2)	DV-WC-0007	1 x 500 mL amber glass jar	250 mL	H_2SO_4, pH < 2; Cool $\leq$ 6°C	28 days
Water	Total and Dissolved Metals (6020A/6020A/7470A)	DV-MT-0022 DV-MT-0021 DV-MT-0017	1 x 500 mL, HDPE Dissolved metals are field filtered	100 mL	HNO_3, pH < 2; Cool $\leq$ 6°C	28 days (7470A) 180 days (6010C/6020A)
Water	Chromium VI (7196A)	DV-WC-0021	1 x125 mL, HDPE	50 mL	Cool $\leq$ 6°C	24 hours
Water	Free Cyanide (SM 4500 CN I)	DV-WC-0083	1 x 250mL, HDPE	100 mL	NaOH, pH >12; Cool $\leq$ 6°C	14 days
Water	Total Cyanide(9012B)	DV-WC-0083	1 x 250mL, HDPE	100 mL	NaOH, pH >12; Cool $\leq$ 6°C	14 days

Matrix	Analytical Group/ Analytical Method	Laboratory SOP Reference[1]	Containers (number, size, and type)	Minimum Sample Volume[3]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[2] (preparation/analysis)
Water	Hydrazine (8315A)	SOP 37-7	2 x 40 mL amber glass	40 mL	Acetate buffer; Cool $\leq$ 6°C	10 days/28 days
Water	Ammonia as N (350.1)	DV-WC-0089	1 x 250 mL amber glass jar	250 mL	H_2SO_4, pH < 2; Cool $\leq$ 6°C	28 days
Water	Anions (9056A)	DV-WC-0020	1 x 50mL, HDPE	15 mL	Cool $\leq$ 6°C	48 hours (nitrate, nitrite, orthophosphate)/ 28 days (fluoride, chlorine, bromide, sulfate)
Water	Phosphorus (6010C)	DV-MT-0021	1 x 500 mL, HDPE	100 mL	HNO_3, pH < 2; Cool $\leq$ 6°C	180 days
Water	Sulfide (9034)	DV-WC-0042	1 x 500 mL, HDPE	250 mL	NaOH/Zn Acetate pH >9; Cool $\leq$ 6°C	7 days
Water	Chemical Oxygen Demand (410.4)	DV-WC-0018	1 x 500mL amber glass jar	250 mL	H_2SO_4, pH < 2; Cool $\leq$ 6°C	28 days
Water	Total Organic Carbon (9060A)	DV-WC-0006	1 x 250mL amber glass jar	100 mL	H_2SO_4, pH < 2; Cool < 6°C	28 days
Water	Methane, Ethene, Ethane (RSK 175)	DV-WC-0084	3 x 40 mL glass VOA vials	40 mL	HCl, pH < 2; Cool $\leq$ 6°C	14 days
Water	pH	DV-WC-0031	1 x 100 mL HDPE	25 mL	Cool $\leq$ 6°C	Immediately (48 hours from receipt at lab)
Water IDW	TCLP VOCs (8260B)	DV-MS-0010	3 x 40 mL glass VOA vials	40 mL	Cool $\leq$ 6°C	7 days to TLCP extract 14 days to analyze
Water IDW	TLCP SVOCs (8270D) TCLP Herbicides (8151A) TCLP Pesticides (8081B)	DV-MS-0012 DV-GC-0022 DV-GC-0020	3 x 1 L amber glass jar	1000 mL	Cool $\leq$ 6°C	7 days to TCLP extract 7 days to extract 14 days to analyze
Water IDW	TCLP metals (6010C/6020A/7470A)	DV-MT-0022 DV-MT-0021 DV-MT-0017	1 x 1 L amber glass jar	1000 mL	Cool $\leq$ 6°C	180 days to TCLP extraction; 180 days to analysis; 28 days to TCLP mercury extraction; 28 days to mercury analysis
Water IDW	Sulfide (9034)	DV-WC-0042	1 x 500 mL, HDPE	250 mL	NaOH/Zn Acetate pH >9; Cool $\leq$ 6°C	7 days

Matrix	Analytical Group/ Analytical Method	Laboratory SOP Reference[1]	Containers (number, size, and type)	Minimum Sample Volume[3]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[2] (preparation/analysis)
Water IDW	Total Cyanide (9012B)	DV-WC-0083	1 x 250mL, HDPE	100 mL	NaOH, pH >12; Cool ≤ 6°C	14 days
Water IDW	Corrosivity (pH)	DV-WC-0031	1 x 100 mL HDPE	25 mL	Cool ≤ 6°C	Immediately (48 hours from receipt at lab)
Water IDW	Flashpoint	DV-WC-0075	1 x 250 mL, amber	140 mL	Cool ≤ 6°C	N/A
Soil IDW	TCLP VOCs	DV-IP-0012	2 x 4 oz. glass jar, minimize headspace	50 grams	Cool ≤ 6°C	14 days to ZHE extraction; 14 days to analysis
Soil IDW	TCLP SVOCs, TCLP Pesticides, TCLP Herbicides	DV-IP-0012	2 x 4 oz. glass jars	100 grams	Cool ≤ 6°C	14 days to TCLP extraction; 14 days to extraction; 40 days to analysis
Soil IDW	TCLP Metals	DV-IP-0012	2 x 4 oz. glass jars	100 grams	Cool ≤ 6°C	180 days to TCLP extraction; 180 days to analysis; 28 days to TCLP mercury extraction; 28 days to mercury analysis
Soil IDW	Total Sulfide	DV-WC-0042	1, 8oz, glass jar	150 grams	Cool ≤ 6°C	7 days
Soil IDW	Total Cyanide	DV-WC-0083	1, 4oz, glass jar	2 grams	Cool ≤ 6°C	14 days
Soil IDW	pH	DV-WC-0001	1, 4oz, glass jar	80 grams	Cool ≤ 6°C	28 days (same day as extracted)
Water	Carbonate and Bicarbonate Alkalinity	DV-WC-0025	1 x 250 mL, HDPE	250 mL	Cool ≤ 6°C	14 days

Notes:

[1] Refer to the Analytical SOP References table (Worksheet #23).

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

[3] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory Matrix Spike/Matrix Spike Duplicate sample analysis.

< = less than
> = greater than
≤ = less than or equal to
% = percent
°C = degrees Celsius
HNO3 = nitric acid
H2SO4 = sulfuric acid
HDPE = High density polyethylene
IDW = investigation-derived waste
L = liter
LCMS = Liquid Chromatography Mass Spectrometry
mL = milliliters
N/A = not applicable
NaOH= sodium hydroxide
Na2S2O3 = sodium thiosulfate
PCB = Polychlorinated Biphenyls
PAH = Polycyclic Aromatic Hydrocarbon
pH = Measures acidity/basicity in aqueous solution
SIM = selective ion monitoring
SOP = standard operating procedure
SVOC = semi-volatile organic compound
TCLP = toxicity characteristic leaching procedure
VOA = volatile organic analysis
VOC = volatile organic compound

20.0 FIELD QUALITY CONTROL SAMPLE SUMMARY (QAPP WORKSHEET #20)

The frequency and location of field quality control samples (e.g. field duplicates, MS/MSD samples, etc.) are specified in Section 3.0 of the WP.

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21.0 PROJECT SAMPLING SOP REFERENCES (QAPP WORKSHEET #21)

Project sampling SOPs are presented in the FSP.

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22.0 FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING AND INSPECTION (QAPP WORKSHEET #22)

Information in this section is contained in Section 7.0 of the FWQAPP.

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23.0 ANALYTICAL SOP REFERENCES (QAPP WORKSHEET #23)

Table 23-1. Analytical SOP References

Lab SOP Number	**Title and/or Method Number**[1]	**Definitive or Screening Data**	**Matrix and Analytical Group**	**Instrument**	**Organization Performing Analysis**	**Modified for Project Work?** (Yes/No)
DV-GC-0020	Chlorinated Pesticides (SW-846 Method 8081A and 8081B)	Definitive	Pesticides	GC	TestAmerica	No
DV-GC-0021	PCBs by GC/ECD (SW-846 Method 8082 and 8082A)	Definitive	PCBs	GC	TestAmerica	No
DV-IP-0010	Acid Digestion of Aqueous Samples for Metals Analysis by ICP	Preparation	Metals	N/A	TestAmerica	No
DV-IP-0014	Acid Digestion of Aqueous Samples for Analysis by ICP-MS (SW-846 3005A, 3020A, 3050B, and EPA 200.8)	Preparation	Metals	N/A	TestAmerica	No
DV-MT-0017	Mercury in Water by Cold Vapor Atomic Absorption (CVAA) (SW-846 7470A)	Definitive	Mercury	CVAA	TestAmerica	No
DV-LC-0002	Nitroaromatic and Nitramine Explosive Compounds by HPLC (SW-846 8330A and 8330B)	Definitive	Explosives and Propellants	HPLC	TestAmerica	No
DV-LC-0024	Perchlorate in Water and Solids by IC/MS/MS [SW-846 Method 6860]	Definitive	Perchlorate	IC/MS/MS	TestAmerica	No
DV-MS-0002	Polynuclear Aromatic Hydrocarbons by GC/MS SIM [SW-846 Method 8270C and 8270D]	Definitive	PAHs	GCMS	TestAmerica	No
DV-MS-0010	Determination of Volatile Organics by GC/MS (SW-846 8260B and EPA 624)	Definitive	VOCs	GCMS	TestAmerica	No
DV-MS-0012	GC/MS Analysis Based on Method 8270D	Definitive	SVOCs	GCMS	TestAmerica	No
DV-MT-0021	ICP Analysis for Trace Elements by SW-846 Method 6010C	Definitive	Total and Dissolved Metals by 6010C	ICP	TestAmerica	No
DV-MT-0022	ICPMS for Trace Element Analysis by SW-846 Method 6020A	Definitive	Total and Dissolved Metals by 6020A	ICPMS	TestAmerica	No
DV-OP-0006	Extraction of Aqueous Samples by Separatory Funnel, SW-846 3510C and EPA 600 Series	Preparation	Organic Prep	N/A	TestAmerica	No
DV-OP-0007	Concentration and Clean-up of Organic Extracts (SW-846 3510C, 3520C, 3540C, 3546, 3550B, 3550C, 3620C, 3660B, 3665A, and EPA 600 series)	Preparation	Organic Prep	N/A	TestAmerica	No
DV-OP-0008	Extraction of Aqueous Samples by CLLE by Method SW-846 3520C and Method 625	Preparation	Organic Prep	N/A	TestAmerica	No
DV-OP-0017	Solid Phase Extraction of Nitroaromatic and Nitroamine Explosive Compounds and Picric Acid from Water Samples (SW-846 3535A)	Preparation	Organic Prep	N/A	TestAmerica	No

Lab SOP Number	Title and/or Method Number[1]	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
WS-LC-0010	Determination of Nitroguanidine Based on Method 8330, SW-846; Rev 3.6; Effective 8/28/2015	Definitive	Nitroguanidine	HPLC/UV	TestAmerica	No
WS-WC-0020	Preparation and Analysis of Nitrocellulose in Aqueous and Soil/Sediment Samples by Colorimetric Autoanalyser; Revision 4.1, Effective 8/28/2015	Definitive	Nitrocellulose	Spectrophotometer	TestAmerica	No
DV-WC-0007	Nitrate, Nitrite by Automated Cadmium Reduction (EPA 353.2)	Definitive	Nitrate-Nitrite, Nitrate by calculation	Colorimetric	TestAmerica	No
DV-WC-0021	Chromium (VI) [7196A, 3500-Cr B and 3500-Cr D]	Definitive	Chromium VI	Spectrophotometer	TestAmerica	No
DV-WC-0083	Total and Amenable Cyanide by SM 4500-CN B, 4500-CN C, 4500-CN E, 4500-CN G, SW-846 9012A, 9012B, and Weak Acid Dissociable Cyanide by 4500-Cn I	Definitive	Cyanide	Colorimetric	TestAmerica	No
DV-IP-0010	Acid Digestion of Aqueous Samples for Metals Analysis by ICP	Preparation	Metals	N/A	TestAmerica	No
DV-MT-0021	ICP Analysis for Trace Elements by SW-846 Method 6010C	Definitive	Phosphorous	ICP	TestAmerica	No
DV-WC-0006	Carbon in Water (TOC, TIC, DOC, and TC) [SM 5310B, SW 9060, and SW 9060A]	Screening[2]	Total Organic Carbon	Shimadzu	TestAmerica	No
DV-WC-0018	Chemical Oxygen Demand by Method 410.4	Screening[2]	Chemical Oxygen Demand	Spectrophotometer	TestAmerica	No
DV-WC-0020	Anions by Ion Chromatography (EPA 300.0, SW 9056 and 9056A)	Screening[2]	Anions	Ion Chromatograph	TestAmerica	No
DV-WC-0042	Total Sulfide Sample Preparation and Titration [SW 9030B/ SW 9034]	Screening[2]	Sulfide	N/A	TestAmerica	No
DV-WC-0084	Total Phenols, Automated Methods (EPA 420.4, SW-846 9066)	Screening[2]	Phenols	Colorimetric	TestAmerica	No
DV-WC-0089	Ammonia Nitrogen by Gas Diffusion and Flow Injection Analysis (EPA 350.1)	Screening[2]	Ammonia as N	Auto-Analyzer	TestAmerica	No
DV-WC-0085	Alkalinity by Manual Titration [2320B]	Definitive	Alkalinity	Burette	TestAmerica	No
37-7	1-P-QM-WI-9015095 Determination of Hydrazine, Monomethylhydrazine and 1,1-Dimethylhydrazine in Aqueous Samples by LC/MS/MS Rev 7 10/28/2013	Definitive	Hydrazines	LC/MS/MS	ELLE	No
37-10	1-P-QM-PRO-9018268 Maintenance and Tuning for Thermo Scientific TSQ Quantum Access Tandem Mass Spectrometer with a Thermo Electron Accela HPLC System (LC/MS/MS) Rev 1 1/28/2010	N/A	Hydrazines	LC/MS/MS	ELLE	No

Notes: [1]SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.

[2] The analytical methods report definitive data; however, the results will not be validated and will be submitted as screening level data for this project.

CLLE = Continuous liquid-liquid extraction
DOC = Dissolved organic carbon
ELLE = Eurofins Lancaster Laboratories Environmental
GC-ECD = Gas chromatograph electron capture detector
HPLC = High performance liquid chromatography
IC = Ion chromatography
ICP = Inductively coupled plasma
MS = Mass spectrometry
N/A = Not applicable
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated biphenyls
SIM = Selective ion monitoring
SOP = Standard operating procedure
SVOC = Semi-volatile organic compound
TC = Total carbon
TIC = Total inorganic carbon
TOC = Total organic carbon
EPA = United States Environmental Protection Agency
VOC = Volatile organic compound

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24.0 ANALYTICAL INSTRUMENT CALIBRATION (QAPP WORKSHEET #24)

Table 24-1. Analytical Instrument Calibration VOCs (8260B)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Check of mass spectral ion intensities (tuning procedure) using BFB	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Analyst/Section Supervisor	DV-MS-0010
GC/MS	Minimum five-point ICAL for target analytes for linear or six-point for quadratic; lowest concentration standard at or below the reporting limit.	ICAL prior to sample analysis	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Verify standard solutions still valid, perform instrument maintenance as needed, then repeat the ICAL.	Analyst/Section Supervisor	DV-MS-0010
GC/MS	ICV	Second source standard, once after each ICAL.	All reported analytes within ± 20% of true value. If analyte identified as a poor performer in Worksheet #15, use criteria of ± 30% of true value.[3]	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat ICAL	Analyst/Section Supervisor	DV-MS-0010
GC/MS	Retention Time Window Position Establishment	Once per ICAL, and at the beginning of the analytical sequence for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Section Supervisor	DV-MS-0010

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Daily calibration verification	Daily, prior to sample analysis and after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within ± 20% of true value. If analyte identified as a poor performer in Worksheet #15, use criteria of ± 30% of true value. All reported analytes (except poor performers identified in Worksheet 15) and surrogates within ± 50% for end of analytical batch CCV.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. For closing CCVs, if compounds are not identified as critical compounds of concern report results with qualifiers. For closing CCVs, if the compound is identified as a critical compound of concern, then recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-MS-0010
GC/MS	IS	During acquisition of calibration standard.	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Analyst/Section Supervisor	DV-MS-0010

Table 24-2. Analytical Instrument Calibration SVOCs (8270D)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS	Tune Check - Check of mass spectral ion intensities (tuning procedure) using DFTPP	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method/SOP for specific ion criteria.	Retune instrument and verify.	Analyst/Section Supervisor	DV-MS-0012
GC/MS	Performance Check	At the beginning of each 12-hour period, prior to sample analysis	Degradation ≤20% for DDT. Benzidine and Pentachlorophenol present at their normal responses, and tailing factor for each < 2.	Correct problem (inspect/change liner, clip front end of column, or other maintenance as indicated), then repeat the performance check.	Analyst/Section Supervisor	DV-MS-0012
GC/MS	ICAL Minimum five-point ICAL for target analytes, lowest concentration standard at or near the reporting limit.	ICAL prior to sample analysis	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Verify standard solutions still valid, perform instrument maintenance as needed, then repeat the ICAL.	Analyst/Section Supervisor	DV-MS-0012
GC/MS	ICV	Second source standard once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 20% of true value. If analyte identified as a poor performer in Worksheet #15, use criteria of ± 30% of true value.[3]	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat ICAL.	Analyst/Section Supervisor	DV-MS-0012
GC/MS	Retention Time Window Position Establishment	Once per ICAL, and at the beginning of the analytical sequence for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Section Supervisor	DV-MS-0012

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS	CCV	Daily, prior to sample analysis and after every 12 hours of analysis time; and at the end of the analytical batch.	All reported analytes and surrogates within ± 20% of true value. If analyte identified as a poor performer in Worksheet #15, use criteria of ± 30% of true value.[3] All reported analytes (except poor performers identified in Worksheet #15) and surrogates within ± 50% for end of analytical batch CCV. Poor performers will meet 65% for the ending CCV.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. For closing CCVs, if compounds are not identified as critical compounds of concern report results with qualifiers. For closing CCVs, if the compound is identified as a critical compound of concern, then recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-MS-0012
GC/MS	IS	During acquisition of calibration standard.	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL. EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Analyst/Section Supervisor	DV-MS-0012

Table 24-3. Analytical Instrument Calibration PAHs (8270D SIM)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS	Tune Check - Check of mass assignments using PFTBA autotune	Prior to ICAL and daily	Acceptable mass assignments using auto tune function	Retune instrument and verify.	Analyst/Section Supervisor	DV-MS-0002
GC/MS	ICAL. Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit.	Initial calibration prior to sample analysis	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.	Verify standard solutions still valid, perform instrument maintenance as needed, then repeat the ICAL.	Analyst/Section Supervisor	DV-MS-0002
GC/MS	ICV	Second source standard, once after each ICAL.	All reported analytes within ± 20% of true value. If analyte identified as a poor performer use criteria of ± 25% of true value.[3]	Correct problem, and verify second source standard. Rerun verification. If still fails, repeat initial calibration.	Analyst/Section Supervisor	DV-MS-0002
GC/MS	Retention Time Window Position Establishment	Once per ICAL, and at the beginning of the analytical sequence for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Section Supervisor	DV-MS-0002

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC/MS	CCV	Daily, prior to sample analysis and after every 12 hours of analysis time; and at the end of the analytical batch.	All reported analytes and surrogates within ± 20% of true value. If analyte identified as a poor performer in Worksheet #15, use criteria of ± 30% of true value.[3] All reported analytes (except poor performers identified in Worksheet #15) and surrogates within ± 50% for end of analytical batch CCV. Poor performers will meet 65% for the ending CCV.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. For closing CCVs, if compounds are not identified as critical compounds of concern report results with qualifiers. For closing CCVs, if the compound is identified as a critical compound of concern, then recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-MS-0002
GC/MS	Internal Standards	During acquisition of calibration standard.	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Analyst/Section Supervisor	DV-MS-0002

Table 24-4. Analytical Instrument Calibration Pesticides (8081B)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC-ECD	Breakdown Check	Prior to analysis of samples and at the beginning of each 12-hour period.	Degradation ≤ 15% for both DDT and Endrin	Evaluate standard, chromatography, and detector response. If problem (e.g., active sites on column, dirty inlet) indicated, correct as appropriate, then repeat breakdown check.	Analyst/Lab Manager	DV-GC-0020
GC-ECD	ICAL. Minimum five-point initial calibration for target analytes	ICAL prior to sample analysis.	Acceptance Criteria options: Option 1: RSD for each analyte ≤ 20%. Option 2: Linear least squares regression: $r^2 \geq 0.99$ ($r>0.995$) Option 3: Non-linear regression: COD: $r^2 \geq 0.99$.	Any problems must be corrected and ICAL repeated. Quantitation for multi-component analytes, such as chlordane and toxaphene, must be performed using a 5-point calibration. Results may not be quantitated using a single point. TestAmerica will analyze a single point for chlordane and toxaphene for pattern recognition and perform the 5-point calibration and reanalyze associated samples for the identified analyte.[3]	Analyst/Lab Manager	DV-GC-0020
GC-ECD	Retention Time Window Position Establishment	Once per ICAL and at the beginning of the analytical sequence, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Lab Manager	DV-GC-0020

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC-ECD	Retention Time Window Width	Perform 72-hour study at method set-up and after major maintenance (e.g., column change) to calculate the RT window width for each analyte and surrogate.	RT width is ± 3 times the standard deviation for each analyte RT from the 72 hour study.	N/A	Analyst/Lab Manager	DV-GC-0020
GC-ECD	ICV	Second source standard immediately following ICAL	All project analytes within ± 20% of the expected value from the ICAL	Evaluate data. If problem (e.g., concentrated standard, plugged injector needle) found, correct, then repeat second source verification. If still fails, repeat ICAL.	Analyst/Lab Manager	DV-GC-0020
GC-ECD	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the sequence with the exception of CCVs for Pesticides multi-component analytes, which are only required before sample analysis.	All project analytes within ± 20% of the expected value from the ICAL and within retention time windows	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze once all affected samples since the last acceptable CCV. If CCV still fails, consult client before reporting.	Analyst/Lab Manager	DV-GC-0020

Table 24-5. Analytical Instrument Calibration PCBs (8082A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC-ECD	ICAL. Minimum five-point initial calibration for target analytes	Prior to sample analysis.	Acceptance Criteria options: Option 1: RSD for each analyte ≤ 20%. Option 2: Linear least squares regression: $r^2 \geq 0.99$ ($r>0.995$) Option 3: Non-linear regression: COD: $r^2 \geq 0.99$.	Evaluate standards, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat ICAL An ICAL using a minimum of 5 levels will be performed using Aroclors 1016 and 1260. Single point calibrations will be performed for the remaining Aroclors.	Analyst/Lab Manager	DV-GC-0021
GC-ECD	Retention Time Window Position Establishment	Once per ICAL and at the beginning of the analytical sequence, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Lab Manager	DV-GC-0021
GC-ECD	ICV	Second source standard, immediately following ICAL	All project analytes within ± 20% of the expected value from the ICAL	Evaluate data. If problem (e.g., concentrated standard, plugged injector needle) found, correct, then repeat second source verification. If still fails, repeat ICAL.	Analyst/Lab Manager	DV-GC-0021
GC-ECD	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the sequence with the exception of CCVs for Pesticides multi-component analytes, which are only required before sample analysis.	All project analytes within ± 20% of the expected value from the ICAL	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze once all affected samples since the last acceptable CCV. If CCV still fails, consult client before reporting.	Analyst/Lab Manager	DV-GC-0021

Table 24-6. Analytical Instrument Calibration Explosives and Propellants (8330B)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
HPLC – 8330B	ICAL. Minimum five-point initial calibration for all target analytes.	ICAL prior to sample analysis and after ICV or CCV failures. Perform instrument re-calibration once per year minimum.	Acceptance Criteria options: Option 1: RSD for each analyte ≤ 20%. Option 2: Linear least squares regression: $r^2 \geq 0.99$ (r>0.995) Option 3: Non-linear regression: COD: $r^2 \geq 0.99$.	Correct problem then repeat ICAL	Analyst/Lab Manager	DV-LC-0002
HPLC – 8330B	ICV	Second source standard immediately following ICAL	All analytes within 20% of expected value	Correct problem. Repeat ICV. If that fails, repeat ICAL	Analyst/Lab Manager	DV-LC-0002
HPLC – 8330B	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 20% of expected value	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. Only a single reanalysis is performed. If it is determined through reanalysis that project samples are the cause of CCV failures consult with client before reporting.	Analyst/Lab Manager	DV-LC-0002

Table 24-7. Analytical Instrument Calibration Nitroguanidine (8330B)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
HPLC/UV	ICAL. Minimum five-point initial calibration; lowest standard at or below the LOQ.	ICAL prior to sample analysis and after ICV or CCV failures. Perform instrument re-calibration once per year minimum.	Acceptance Criteria options: Option 1: RSD for each analyte ≤ 20%. Option 2: Linear least squares regression: $r^2 \geq 0.99$ ($r>0.995$) Option 3: Non-linear regression: COD: $r^2 \geq 0.99$.	Correct problem then repeat ICAL	Analyst/Lab Manager	WS-LC-0010
HPLC/UV	ICV	Second source standard immediately following ICAL	All analytes within 15% of expected value	Correct problem. Repeat ICV. If that fails, repeat ICAL	Analyst/Lab Manager	WS-LC-0010
HPLC/UV	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 15% of expected value	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. Only a single reanalysis is performed. If it is determined through reanalysis that project samples are the cause of CCV failures consult with client before reporting.	Analyst/Lab Manager	WS-LC-0010

Table 24-8. Analytical Instrument Calibration Perchlorate (6860)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
IC/MS/MS - 6860	Tune Check	Prior to ICAL and after any mass calibration or maintenance is performed.	Tuning standards must span the mass range of the analytes of interest and meet acceptance criteria outlined in the lab SOP.	If the tune check fails, retune instrument and verify. If the tune check will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone. No samples shall be analyzed without an acceptable tune check.	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	ICAL. Seven point initial calibration for target analyte	After ICV or CCV failure or after maintenance or major changes such as IC column type.	Acceptance Criteria options: Option 1: RSD for each analyte $\leq$ 15% Option 2: Linear least squares regression for each analyte: $r^2 \geq 0.995$	Instrument and standards are checked. Correct problem. Continue once ICAL meets criteria	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	ICV	Second source standard, immediately following ICB and immediately following ICAL; second source standard	85 -115% recovery of perchlorate	Correct problem then repeat ICAL.	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	CCV	On days an ICAL is performed, after every 10 field samples and end of analytical sequence. On days an ICAL is not performed, at the beginning of the sequence, after every 10 field samples and at the end of the analytical run.	Mid-range 85 - 115% recovery	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Lab Manager	DV-LC-0024

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
IC/MS/MS - 6860	Isotope Ratio. $^{35}CI/^{37}CI$ (If tandem MS, this monitors both the parent ion at masses 99/101 and the daughter ion at masses 83/85)	All samples, spiked samples, standards and method blanks	2.3 - 3.8	If criteria not met, the sample must be rerun. If the sample was not pretreated, the sample must be extracted using cleanup procedures. If after cleanup, the ratio still fails, use alternative techniques to confirm presence of perchlorate, e.g., a post spike sample or dilution to reduce any interference. If acceptance criteria still not met, data must be qualified with a Q-flag and explained in the case narrative. Any procedures used to eliminate the interference must be described in the case narrative.	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	IS	^{18}O-labeled perchlorate must be added to all field samples, QC samples (batch and instrument) and standards as an internal standard.	Measured ^{18}O IS area must be within + 50% for the average of the IS area counts of the ICAL and the RRT of the perchlorate ion must be 0.98-1.02. If peak is not within retention time window, presence is not confirmed.	Rerun sample at increasing dilutions until the criteria are met. If dilution does not resolve the problem the sample must be re-prepped using additional pretreatment steps. If these additional steps fail, apply Q-flag and explain in the case narrative. Flagging is not appropriate for failed standards.	Analyst/Lab Manager	DV-LC-0024

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
IC/MS/MS - 6860	ICS	Each batch	80-120%	Check the calibration standards and instrument conditions (may need to replace column). Repeat ICAL. If poor recovery form the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed. No sample may be reported that are associated with a failing ICS.	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	LRB	Immediately prior to ICAL	No perchlorate >1/2 LOQ	Repeat until no carryover and reanalyze samples in associated batch.	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	Interference Threshold Study	At initial setup and when major changes occur in methods operating procedures	Threshold = concentration of common suppressors where perchlorate recover outside 80-120%	N/A	Analyst/Lab Manager	DV-LC-0024
IC/MS/MS - 6860	Mass calibration with PEG or other appropriate material bracketing mass calibration range	As needed (failed tune criteria), after major maintenance, minimum of annually.	+/- 0.5 amu	Re-calibrate	Analyst/Lab Manager	DV-LC-0024

Table 24-9. Analytical Instrument Calibration Nitrocellulose (353.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Colorimetric Analyzer - EPA 353.2	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit	Daily calibration prior to sample analysis	Linear least squares regression: r ≥ 0.995	Evaluate standards, and spectrophotometer response. If problem found with above, correct as appropriate, then repeat initial calibration	Analyst/Lab Manager	WS-WC-0020
Colorimetric Analyzer - EPA 353.2	ICV, second source	Immediately following ICAL	±10%	Evaluate data. If problem (e.g., concentrated standard, incorrectly prepared standard) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Analyst/Lab Manager	WS-WC-0020
Colorimetric Analyzer - EPA 353.2	CCV	After every 10 field samples, and at the end of the sequence.	± 10%	Evaluate failure and impact on samples. Rerun affected samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required.	Analyst/Lab Manager	WS-WC-0020
Colorimetric Analyzer - EPA 353.2	ICB/CCB	Immediately following ICV (ICB) and immediately following CCV (CCB).	No analyte > LOQ	Rerun affected samples	Analyst/Lab Manager	WS-WC-0020

Table 24-10. Analytical Instrument Calibration Nitrate + Nitrite (353.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Colorimetric Analyzer - EPA 353.2	ICAL. Minimum 5-point calibration	ICAL. Perform instrument re-calibration once per year minimum.	$r^2 \geq 0.99$	Recalibrate	Analyst/Lab Manager	DV-WC-0007
Colorimetric Analyzer - EPA 353.2	ICV, second source	Immediately following ICAL	±10%	Recalibrate	Analyst/Lab Manager	DV-WC-0007
Colorimetric Analyzer - EPA 353.2	CCV	Each use, beginning, every 10 samples, end of batch	±10%	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Lab Manager	DV-WC-0007
Colorimetric Analyzer - EPA 353.2	CCB	Immediately following CCB, every 10 samples, end of batch	No analyte > LOQ	Rerun affected samples	Analyst/Lab Manager	DV-WC-0007

Table 24-11. Analytical Instrument Calibration Metals (Total and Dissolved) (6020A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-MS	Tuning	Prior to ICAL	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10$ peak height.	Retune instrument and verify	Analyst/Section Supervisor	DV-MT-0021
ICP-MS	ICAL. Minimum of one high standard and a calibration blank[3]	Prior to sample analysis.	N/A	N/A	Analyst/Section Supervisor	DV-MT-0021
ICP-MS	ICV	Second source standard immediately following ICAL	All reported analytes ± 10% of expected value.	Correct any problems and rerun ICV. If that fails, correct problem and repeat ICAL. No samples shall be analyzed until the second-source calibration verification is successful.	Analyst/Section Supervisor	DV-MT-0021
ICP-MS	Low-Level Calibration Check Standard ≤ LOQ (Low-level ICV)	Daily after one-point ICAL[3]	All reported analytes must be within ± 20% of expected value.	Correct any problems, then reanalyze or repeat ICAL. Results cannot be reported without a valid low-level calibration check standard.	Analyst/Section Supervisor	DV-MT-0021
ICP-MS	ICS	After ICAL and prior to sample analysis	ICS-A: Absolute value of concentration for all non-spiked project analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within + 20% of true value. (Not needed if instrument can read negative responses.)	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	Analyst/Section Supervisor	DV-MT-0021

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-MS	CCV	After every 10 field samples and at the end of the sequence.	All reported analytes ± 10% of expected value.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-MT-0021
ICP-MS	ICB and CCB	Before analyzing samples, after every 10 field samples, and at the end of the analysis sequence.	No analytes detected > ½ LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct any problems and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed. CCB failures due to carryover may not require an ICAL.	Analyst/Section Supervisor	DV-MT-0021

Table 24-12. Analytical Instrument Calibration Metals (Total and Dissolved) (6010C)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES	ICAL. Minimum of one high standard and a calibration blank[3]	Prior to sample analysis.	N/A	N/A	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	ICV	Second source standard immediately following ICAL	All reported analytes ± 10% of expected value.	Correct any problems and rerun ICV. If that fails, correct problem and repeat ICAL. No samples shall be analyzed until the second-source calibration verification is successful.	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	Low-Level Calibration Check Standard $\leq$ LOQ (Low-level ICV)	Daily after one-point ICAL[3]	All reported analytes must be within ± 20% of expected value.	Correct any problems, then reanalyze or repeat ICAL. Results cannot be reported without a valid low-level calibration check standard.	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	ICS	After ICAL and prior to sample analysis	ICS-A: Absolute value of concentration for all non-spiked project analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within + 20% of true value. (Not needed if instrument can read negative responses.)	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	Analyst/Section Supervisor	DV-MT-0021

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES	CCV	After every 10 field samples and at the end of the sequence.	All reported analytes ± 10% of expected value.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	ICB and CCB	Before analyzing samples, after every 10 field samples, and at the end of the analysis sequence.	No analytes detected > ½ LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct any problems and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed. CCB failures due to carryover may not require an ICAL.	Analyst/Section Supervisor	DV-MT-0021

Table 24-13. Analytical Instrument Calibration Mercury (7470A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
CVAA – 7470A	Initial calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis.	$r^2 \geq 0.99$	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.	Analyst/Lab Manager	DV-MT-0017
	Initial calibration verification (ICV)	Run second-source standard once after each ICAL and prior to sample analysis.	Analytes within $\pm$10% of expected value	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.	Analyst/Lab Manager	DV-MT-0017
	Continuing calibration verification (CCV)	After every 10 field samples, and at the end of the analysis sequence	All analytes within 10% of expected value	Repeat calibration and re-analyze all samples since last successful calibration	Analyst/Lab Manager	DV-MT-0017
	Calibration blank (ICB/CCB)	Before beginning a sample run, after every continuing calibration verification	No analytes detected > LOD	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. If samples non-detect for analytes which have a high bias, report non-detect results with case narrative comment with written approval from the client. or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Lab Manager	DV-MT-0017

Table 24-14. Analytical Instrument Calibration Hexavalent Chromium (7196A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Spectrophotometer - 7196A	ICAL. Minimum 5-point calibration	ICAL. Perform instrument re-calibration once per year minimum.	$r^2 \geq 0.99$	Recalibrate	Analyst/Section Supervisor	DV-WC-0021
Spectrophotometer - 7196A	ICV, second source	Immediately following ICAL	± 10%	Recalibrate	Analyst/Section Supervisor	DV-WC-0021
Spectrophotometer - 7196A	CCV	Each use, beginning, every 10 samples, end of batch	± 10%	If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, recalibrate and rerun affected samples since last acceptable CCV. or Immediately analyze two additional consecutive CCVs. If both pass, do not need to reanalyze.	Analyst/Section Supervisor	DV-WC-0021

Table 24-15. Analytical Instrument Calibration Free Cyanide (SM 4500 CN I)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Colorimetric Analyzer SM4500-CN-I	Initial calibration (minimum five point calibration)	Initial daily calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	$r^2 \geq 0.99$ ($r \geq 0.995$ for linear regression)	Correct problem then repeat initial calibration	Analyst/Lab Manager	DV-WC-0083
Colorimetric Analyzer	Distillation Verification	Prepared per prep batch.	±10% of undistilled standard value for high distilled standard, ±15% of undistilled standard value for low distilled standard	Re-distill and re-analyze all associated samples	Analyst/Lab Manager	DV-WC-0083
SM4500-CN-I	Second-source ICV	Immediately following initial daily calibration	±10% of true value	Correct problem then repeat initial calibration	Analyst/Lab Manager	DV-WC-0083
Colorimetric Analyzer	CCV	After every 10 field samples and at the end of the analysis sequence	±10% of true value	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, do not need to reanalyze.	Analyst/Lab Manager	DV-WC-0083

Table 24-16. Analytical Instrument Calibration Total Cyanide (9012B)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Colorimetric Analyzer	Initial calibration (minimum five point calibration)	Initial daily calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	$r^2 \geq 0.99$ ($r \geq 0.995$ for linear regression)	Correct problem then repeat initial calibration	Analyst/Lab Manager	DV-WC-0083
Colorimetric Analyzer	Distillation Verification	Prepared per prep batch.	±10% of undistilled standard value for high distilled standard, ±15% of undistilled standard value for low distilled standard	Re-distill and reanalyze all associated samples	Analyst/Lab Manager	DV-WC-0083
Colorimetric Analyzer	ICV, second source	Immediately following initial daily calibration	±10% of true value	Correct problem then repeat initial calibration	Analyst/Lab Manager	DV-WC-0083
Colorimetric Analyzer	CCV	After every 10 field samples and at the end of the analysis sequence	±10% of true value	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, do not need to reanalyze.	Analyst/Lab Manager	DV-WC-0083

Table 24-17. Analytical Instrument Calibration Hydrazine (8315A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
LC/MS/MS	Initial calibration (minimum six point calibration)	Initial daily calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	$r^2 \geq 0.99$ (r $\geq$ 0.995 for linear regression)	Correct problem, perform instrument maintenance. If calibration does not meet method criteria, then recalibrate	Analyst/Lab Manager	37-7
LC/MS/MS	ICV, second source	Immediately following initial daily calibration	±30% of true value	Correct problem then repeat initial calibration	Analyst/Lab Manager	37-7
LC/MS/MS	CCV	After every 10 field samples and at the end of the analysis sequence	±30% of true value	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, perform instrument maintenance. If calibration does not meet method criteria, recalibrate.	Analyst/Lab Manager	37-7

Table 24-18. Analytical Instrument Calibration Ammonia as N (350.1)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Colorimetric Analyzer - USEPA 350.1	ICAL curve – Minimum 5-point calibration	Initial calibration. Perform instrument re-calibration once per year minimum.	$r^2 \geq 0.99$	Recalibrate	Analyst/Lab Manager	DV-WC-0089
Colorimetric Analyzer - USEPA 350.1	ICV, second source	Immediately following initial calibration	±10%	Recalibrate	Analyst/Lab Manager	DV-WC-0089
Colorimetric Analyzer - USEPA 350.1	CCV	Each use, beginning, every 10 samples, end of batch	± 10%	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, do not need to reanalyze.	Analyst/Lab Manager	DV-WC-0089
Colorimetric Analyzer - USEPA 350.1	ICB/CCB	Before beginning a sample run (Immediately following CCV), every 10 field samples, end of analysis sequence (After ICV and each CCV)	No analyte > LOQ, or 1/10 the amount measured in any sample, or 1/10 the regulatory limit, whichever is greater.	Rerun affected samples	Analyst/Lab Manager	DV-WC-0089

Table 24-19. Analytical Instrument Calibration Anions (9056A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Ion Chromatography	ICAL - Minimum five-point initial calibration for target analytes, lowest concentration standard at or below the reporting limit	Initial calibration prior to sample analysis.	Linear least squares regression: $r^2 \geq 0.99$ ($r \geq 0.995$)	Evaluate standards, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat initial calibration	Analyst/Section Supervisor	DV-WC-0020
Ion Chromatography	Retention Time Window Position Establishment	Once per ICAL	Set position for each analyte using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Section Supervisor	DV-WC-0020
Ion Chromatography	Retention Time Window Width	Perform 24-hour study at method set-up and after major maintenance (e.g., column change)	RT width is ± 3 times the standard deviation for each analyte RT from the 24 hour study	N/A	Analyst/Section Supervisor	DV-WC-0020
Ion Chromatography	Second-source ICV	Immediately following ICAL	All reported analytes ± 10% of expected value. All reported analytes within established RT window.	Correct any problems and rerun ICV. If that fails, correct problem and repeat ICAL. No samples shall be analyzed until the second-source calibration verification is successful.	Analyst/Section Supervisor	DV-WC-0020

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Ion Chromatography	Daily continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the sequence.	All reported analytes ± 10% of expected value. All reported analytes within established RT window.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-WC-0020

Table 24-20. Analytical Instrument Calibration Phosphorus (6010C)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES	ICAL - Minimum of one high standard and a calibration blank [3]	Prior to sample analysis.	N/A	N/A	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	ICV	Second source standard immediately following ICAL	All reported analytes ± 10% of expected value.	Correct any problems and rerun ICV. If that fails, correct problem and repeat ICAL. No samples shall be analyzed until the second-source calibration verification is successful.	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	Low-Level Calibration Check Standard ≤ LOQ (Low-level ICV)	Daily after one-point ICAL [3]	All reported analytes must be within ± 20% of expected value.	Correct any problems, then reanalyze or repeat ICAL. Results cannot be reported without a valid low-level calibration check standard.	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	ICS	After ICAL and prior to sample analysis	ICS-A: Absolute value of concentration for all non-spiked project analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within + 20% of true value. (Not needed if instrument can read negative responses.)	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.	Analyst/Section Supervisor	DV-MT-0021

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES	CCV	After every 10 field samples and at the end of the sequence.	All reported analytes ± 10% of expected value.	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-MT-0021
ICP-AES	ICB/CCB	Before analyzing samples, after every 10 field samples, and at the end of the analysis sequence.	No analytes detected > ½ LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct any problems and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed. CCB failures due to carryover may not require an ICAL.	Analyst/Section Supervisor	DV-MT-0021

Table 24-21. Analytical Instrument Calibration Sulfide (9034)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Distillation -- iodometric titration	Standardization of titrant	Initial daily standardization prior to sample analysis.	N/A – See method SOP for standardization procedure	N/A	Analyst/Section Supervisor	DV-WC-0042

Table 24-22. Analytical Instrument Calibration Chemical Oxygen Demand (USEPA 410.4)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria1	Corrective Action (CA)	Person Responsible for CA	SOP Reference2
Spectrophotometer - USEPA 410.4	ICAL – Minimum 5-point calibration	Initial calibration. Perform instrument re-calibration once per year minimum.	r2 ≥ 0.99, r ≥ 0.995.	Recalibrate	Lab Manager/Analyst	DV-WC-0018
Spectrophotometer - USEPA 410.4	ICV, second source	Immediately following initial calibration	±10%	Recalibrate	Lab Manager/Analyst	DV-WC-0018
Spectrophotometer - USEPA 410.4	CCV	Each use, beginning, every 10 samples, end of batch	± 10%	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, do not need to reanalyze.	Lab Manager/Analyst	DV-WC-0018
Spectrophotometer - USEPA 410.4	CCB	Immediately following CCB, every 10 samples, end of batch	No analyte > LOQ	Rerun affected samples	Analyst/Lab Manager	DV-WC-0018

Table 24-23. Analytical Instrument Calibration Total Organic Carbon (9060A)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Total Organic Carbon	ICAL – Minimum 5-point calibration	Initial calibration. Perform instrument re-calibration once per year minimum.	$r \geq 0.995$ ($r^2 >\geq 0.99$)	Recalibrate	Analyst/Section Supervisor	DV-WC-0006
Total Organic Carbon	ICV	Second source standard, immediately following initial calibration	±10%	Recalibrate	Analyst/Section Supervisor	DV-WC-0006
Total Organic Carbon	CCV	Each use, beginning, every 10 samples, end of batch	± 10%	Evaluate failure and impact on samples. If calibration verification is recovered outside control limits biased high, and the associated sample results are not detected, no further CA is required. Otherwise, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-WC-0006

Table 24-24. Analytical Instrument Calibration Total Recoverable Phenols (9066)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Colorimetric Analyzer - 9066	ICAL – Minimum 5-point calibration	Initial calibration. Perform instrument re-calibration once per year minimum.	RSD ± 10%, $r^2 \geq 0.99$, $r \geq 0.995$.	Recalibrate	Lab Manager/Analyst	DV-WC-0084
Colorimetric Analyzer - 9066	ICV, second source	Immediately following initial calibration	±10%	Recalibrate	Lab Manager/Analyst	DV-WC-0084
Colorimetric Analyzer - 9066	CCV	Each use, beginning, every 10 samples, end of batch	± 10%	Rerun affected samples	Lab Manager/Analyst	DV-WC-0084

Table 24-25. Analytical Instrument Calibration Dissolved Gasses (RSK-175)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
GC-FID	ICAL – minimum five point calibration	Initial calibration prior to sample analysis.	Acceptance Criteria options: Option 1: RSD for each analyte ≤ 20% Option 2: Linear least squares regression: r ≥ 0.995 Option 3: Non-linear regression: COD (r^2) ≥ 0.99, minimum of 6 points for second order.	Evaluate standards, chromatography, and detector response. If problem found with above, correct as appropriate, then repeat initial calibration	Analyst/Section Supervisor	DV-GC-0025
GC-FID	Retention Time Window Position Establishment	Once per ICAL and at the beginning of the analytical sequence, for each analyte and surrogate.	Set position using the mid-point standard of the ICAL when ICAL is performed. On days when ICAL is not performed, use initial CCV.	N/A	Analyst/Section Supervisor	DV-GC-0025
GC-FID	ICV	Second-source standard, immediately following ICAL	All project analytes within ± 20% of the expected value from the ICAL	Evaluate data. If problem (e.g., concentrated standard, plugged injector needle) found, correct, then repeat second source verification. If still fails, repeat initial calibration.	Analyst/Section Supervisor	DV-GC-0025
GC-FID	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the sequence with the exception of CCVs for Pesticides multi-component analytes, which are only required before sample analysis.	All project analytes within ± 20% of the expected value from the ICAL	Evaluate failure and impact on samples. Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	Analyst/Section Supervisor	DV-GC-0025

Table 24-26. Analytical Instrument Calibration Alkalinity

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria[1]	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
Titrimetric Analyzer	Standardization of titrant	Initial daily standardization prior to sample analysis.	N/A – See method SOP for standardization procedure	N/A	Analyst/Section Supervisor	DV-WC-0025
	CCV	Analyzed every 10 samples.	±10%	Re-titrate all associated samples	Analyst/Section Supervisor	DV-WC-0025

Notes for all Worksheet #24 tables:

[1] This is a summary of the acceptance criteria; refer to the method SOP for specific or more information.

[2] SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.

[3] Deviation from the FWSAP (SAIC 2011), however, is approved as part of TA’s DoD ELAP accreditation.

> = Greater than

< = Less than

≥ = Greater than or equal to

≤ = Less than or equal to

% = Percent

± = plus or minus

amu = atomic mass units

BFB = 4-bromofluoro-benzene

CA = Corrective action

CCB = Continuing calibration blank

CCV = Continuing calibration verification

COD = Coefficient of determination

DDT = Dichlorodiphenyltrichloroethane

DFTPP = Decafluorotriphenylphosphine

EICP = Extracted ion current profile

GC-ECD = Gas chromatograph electron capture detector

GC/MS= Gas chromatograph mass spectrometry

HPLC = High performance liquid chromatography

ICAL = Initial calibration

ICB = Initial calibration blank

ICS - Interference check solutions

IC/MS/MS = Ion chromatograph coupled with tandem mass spectrometry

ICP-AES = Inductively coupled plasma atomic emission spectroscopy

ICS = Interference check standard

ICS-A = Interference check standard A

ICS-AB = Interference check standard AB

ICV = Initial calibration verification

IS = Internal standards

LOD = Limit of Detection

LOQ = Limit of quantitation

LRB = Laboratory reagent blank

r^2 = coefficient of determination

RSD = Root square deviation

RRT = Relative retention time

RT = Retention time

N/A = Not applicable

ND = Non detect

PAH = Polycyclic aromatic hydrocarbon

PCB = Polychlorinated biphenyls

PEG = Polyethylene glycol

PFTBA = Perfluorotributylamine

QC = Quality control

SOP = Standard operating procedure

SVOC = Semi-volatile organic compound

USEPA = United States Environmental Protection Agency

UV = Ultraviolet

VOC = Volatile organic compound

25.0 ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING AND INSPECTION (QAPP WORKSHEET #25)

Table 25-1. Analytical Instrument and Equipment Maintenance

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
ICP	Replace pump windings and gas tanks, check standard and sample flow	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	Analyst	Quality Assurance Manual – Section 20
Colorimetric	Replace disposable, flush lines, clean autosampler and pump rollers	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	Quality Assurance Manual – Section 20
Spectrophotometer	Replace disposable, flush lines, and clean autosampler. Replace lamp and/or fuse. Wavelength calibration.	Analytical standards; Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	Quality Assurance Manual – Section 20; WS-WC-0020
Ion Chromatograph	Replace disposables, check for leaks and eluent levels, change columns and bed supports as needed, clean conductivity cell	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	Quality Assurance Manual – Section 20
Shimadzu	Replace disposables, check for leaks, change copper and tin as needed, clean purging cell	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	Quality Assurance Manual – Section 20
KONE	Replace disposable, flush lines, clean autosampler	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	Quality Assurance Manual – Section 20
HPLC/UV	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	WS-LC-0010

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC	Change septum, clean injection port, change or clip column, install new liner, replace column, filters and seals	Detector signals and chromatogram review	Instrument performance and sensitivity	As needed	CCV passes criteria	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst	QA Manual – Section 20
GC/MS	Clean sources, maintain vacuum pumps	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed	Tune and CCV pass criteria	Recalibrate instrument	Analyst	QA Manual – Section 20
GC/MS	Change septum, clean injection port, change or clip column, install new liner, change trap	Response factors and chromatogram review	Instrument performance and sensitivity	As needed	Tune and CCV pass criteria	Re-inspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst	QA Manual – Section 20
HPLC	Replace columns, DAD flow cell windows and ball-valve cartridges as needed, clean/change filters, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	QA Manual – Section 20
ICPMS	Replace disposables, clean/change nebulizer, torch, and cones	Tuning	Instrument performance and sensitivity	Daily or as needed	Tune and CCV pass criteria	Recalibrate	Analyst	QA Manual – Section 20
LC/MS	Replace columns as needed, change filters and seals, clean lenses and needles, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	QA Manual – Section 20

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
LC/MS/MS	Replace columns as needed, check eluent reservoirs	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	WS-LC-0025
LC/MS/MS	Backflush of column, injection port and pre-columns, cleaning of ion spray cone, adjustment of collision energies, others as needed	Calibration Check	Visual	As Needed	Initial calibration or calibration verification passes method specifications	Perform additional maintenance prior to instrument calibration or calibration verification	Analyst	37-10

Notes: [1] Laboratory SOPs are listed in Worksheet #23.
[2] SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.
CCV = Continuing calibration verification
GC = Gas Chromatograph
GC/MS = Gas Chromatograph Mass Spectrometry
ICP = Inductively Coupled Plasma
ICPMS = Inductively Coupled Plasma Mass Spectrometry
ISTD = Internal standard
LC/MS = Liquid Chromatography Mass Spectrometry
LC/MS/MS = Liquid Chromatography Mass Spectrometry Mass Spectrometry
HPLC/UV = High performance liquid chromatography/Ultraviolet
SOP = Standard Operating Procedure

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26.0 SAMPLE HANDLING SYSTEM (QAPP WORKSHEET #26)

This worksheet lists all personnel who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to laboratory delivery, to sample disposal. Additional information regarding sample packaging and shipping requirements is presented in Section 7.0 of the FWQAPP.

Table 26-1. Sample Handling System

	Responsible Person	Organization
SAMPLE COLLECTION, PACKAGING, AND SHIPMENT		
Sample Collection (Personnel/Organization):	Field Team Leader (or designee)	TEC-Weston JV
Sample Packaging (Personnel/Organization):	Field Team Leader (or designee)	TEC-Weston JV
Coordination of Shipment (Personnel/Organization):	Field Team Leader (or designee)	TEC-Weston JV
Type of Shipment/Carrier:	FedEx, UPS, or Courier Service	
SAMPLE RECEIPT AND ANALYSIS		
Sample Receipt (Personnel/Organization):	Laboratory Project Manager	TestAmerica
Sample Custody and Storage (Personnel/Organization):	Laboratory Project Manager	TestAmerica
Sample Preparation (Personnel/Organization):	Laboratory Project Manager	TestAmerica
Sample Determinative Analysis (Personnel/Organization):	Laboratory Project Manager	TestAmerica
SAMPLE ARCHIVING		
Field Sample Storage (Number of days from sample collection):	N/A	N/A
Sample Extract/Digestate Storage (Number of days from extraction/digestion):	Laboratory Project Manager	TestAmerica
Biological Sample Storage (Number of days from sample collection):	N/A	N/A
SAMPLE DISPOSAL		
Personnel/Organization:	Laboratory Project Manager	TestAmerica
Number of Days from Analysis:	60 days	

Notes: Project personnel are identified in Worksheet #7.
N/A = Not Applicable
TEC-Weston JV = TEC-Weston Joint Venture

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27.0 SAMPLE CUSTODY REQUIREMENTS (QAPP WORKSHEET #27)

Information in this section is contained in Section 6.0 of the FWQAPP.

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28.0 LABORATORY QC SAMPLES (QAPP WORKSHEET #28)

This worksheet identifies the QC samples and their respective acceptance limits for commonly-used analytical groups. Values provided in this table were derived from the DoD QSM v5.0.

Table 28-1. Laboratory QC Samples for VOCs

Matrix	**Water**					
Analytical Group	**VOCs**					
Analytical Method/ SOP Reference[2]	**EPA 8260B/ DV-MS-0010**					
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**[1]	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
IS	Each calibration standard, sample and QC sample	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning in accordance with DoD QSM requirements. If field samples still outside criteria, qualify data and explain in case narrative.	Analyst/Section Supervisor	N/A	USEPA method requirements
MB	One per preparatory batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater). No common lab contaminants >RL.	If sufficient sample is available, re-prep and reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ; no common lab contaminants > LOQ.

Matrix	Water
Analytical Group	VOCs
Analytical Method/ SOP Reference[2]	EPA 8260B/ DV-MS-0010

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparatory batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published.	Reanalyze LCS once. If acceptable, report. Otherwise, if exceedance is not a critical chemical of concern as identified by the project team, evaluate for SME. If acceptable, report with case narrative comment. If not acceptable for SME, evaluate samples for detections, and LCS for high bias. If LCS has high bias, and associated samples are non-detect, report with case narrative comment. If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits
MS/MSD	One MS/MSD per preparatory batch (20 samples)	Recovery: QSM limits (if available) or current in-house limits if no QSM limits published. RPD: RPD between MS and MSD < 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or Laboratory % Recovery/RPD Control Limits
Surrogates	Every field and QC sample	QSM limits (if available) or current in-house limits if no QSM limits published.	Evaluate data, if samples non-detect and surrogate recovery is above upper limits, report with case narrative comment. If obvious chromatographic interference is present, report with narrative comment. Otherwise, re-extract and reanalyze.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits

Table 28-2. Laboratory QC Samples for SVOCs

Matrix	**Water**
Analytical Group	**SVOCs**
Analytical Method/ SOP Reference[2]	**USEPA 8270D / DV-MS-0012**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
IS	Each calibration standard, sample and QC sample	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning in accordance with DoD QSM requirements. If field samples still outside criteria, qualify data and explain in case narrative.	Analyst/Section Supervisor	N/A	USEPA method requirements
MB	One per preparatory batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater). No common lab contaminants >LOQ.	If sufficient sample is available, re-prep and reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ; no common lab contaminants > LOQ.

Matrix	**Water**
Analytical Group	**SVOCs**
Analytical Method/ SOP Reference[2]	**USEPA 8270D / DV-MS-0012**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparatory batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published.	Reanalyze LCS once. If acceptable, report. Otherwise, if exceedance is not a critical chemical of concern as identified by the project team, evaluate for SME. If acceptable, report with case narrative comment. If not acceptable for SME, evaluate samples for detections, and LCS for high bias. If LCS has high bias, and associated samples are non-detect, report with case narrative comment. If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits
MS/MSD	One MS/MSD per preparatory batch (20 samples)	Recovery: QSM limits (if available) or current in-house limits if no QSM limits published. RPD: RPD between MS and MSD $\leq$ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or Laboratory % Recovery/RPD Control Limits
Surrogates	Every field and QC sample	QSM limits (if available) or current in-house limits if no QSM limits published.	Evaluate data, if samples non-detect and surrogate recovery is above upper limits, report with case narrative comment. If obvious chromatographic interference is present, report with narrative comment. Otherwise, reextract and reanalyze.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits

Table 28-3. Laboratory QC Samples for PAHs

Matrix	Water
Analytical Group	**PAHs**
Analytical Method/ SOP Reference[2]	**USEPA 8270D SIM/DV-MS-0012**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
IS	Each calibration standard, sample and QC sample	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within - 50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning in accordance with DoD QSM requirements. If field samples still outside criteria, qualify data and explain in case narrative.	Analyst/Section Supervisor	N/A	USEPA method requirements
MB	One per preparatory batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater). No common lab contaminants >LOQ.	If sufficient sample is available, re-prep and reanalyze samples. Qualify data as needed.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ; no common lab contaminants > LOQ.

Matrix	**Water**
Analytical Group	**PAHs**
Analytical Method/ SOP Reference[2]	**USEPA 8270D SIM/DV-MS-0012**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	One per preparatory batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published.	Reanalyze LCS once. If acceptable, report. Otherwise, if exceedance is not a critical chemical of concern as identified by the project team, evaluate for SME. If acceptable, report with case narrative comment. If not acceptable for SME, evaluate samples for detections, and LCS for high bias. If LCS has high bias, and associated samples are non-detect, report with case narrative comment. If LCS has low bias, or if there are detections for critical chemicals of concern, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits
MS/MSD	One MS/MSD per preparatory batch (20 samples)	Recovery: QSM limits (if available) or current in-house limits if no QSM limits published. RPD: RPD between MS and MSD $\leq$ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or Laboratory % Recovery/RPD Control Limits
Surrogates	Every field and QC sample	QSM limits (if available) or current in-house limits if no QSM limits published.	Evaluate data, if samples non-detect and surrogate recovery is above upper limits, report with case narrative comment. If obvious chromatographic interference is present, report with narrative comment. Otherwise, reextract and reanalyze.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits

Table 28-4. Laboratory QC Samples for Pesticides

Matrix	Water					
Analytical Group	Pesticides					
Analytical Method/ SOP Reference[2]	USEPA 8081B/ DV-GC-0020					
QC Sample	**Frequency/ Number**	**Acceptance Limits[1]**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
MB	1/Batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater).	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ
LCS	1/Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published (single analyte spikes only – 9Spik)	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. Otherwise, correct any problems then re-prep and reanalyze the LCS and all associated samples for failed analytes. If insufficient sample, then apply Q-flag to specific analyte(s) in all samples in the associated prep batch. Flagging is only appropriate when samples cannot be reanalyzed unless written approval is provided by the client.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published. RPD: $\leq$ 30%	For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative. The MS is for matrix evaluation only. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Matrix	Water
Analytical Group	Pesticides
Analytical Method/ SOP Reference[2]	USEPA 8081B/ DV-GC-0020

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Surrogates	Every field sample and QC samples	QSM limits (if available) or current in-house limits if no QSM limits published.	For QC and field samples, correct any problems, then re-prep and reanalyze all failed samples for failed surrogates in the associated prep batch. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. If surrogate recoveries are above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. For samples with ND results, a high bias as evidenced in these situations is typically not an issue. Apply Q-flag to all associated analytes if acceptance criteria are not met. Explain in the case narrative. All surrogates analyzed must be reported.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	**Water**
Analytical Group	**Pesticides**
Analytical Method/ SOP Reference[2]	**USEPA 8081B/ DV-GC-0020**

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Second-column confirmation	All positive results	Calibration and QC criteria for the confirmation analysis are the same as for the primary column analysis. The RPD between results for the primary and secondary columns must be ≤ 40%.	Apply J-flag if RPD > 40% and discuss in case narrative. Use project-specific reporting requirements if available; otherwise use method requirements if available; otherwise report the result from the primary column unless there is a scientifically valid and documented reason for not doing so and is approved by the client. If it is not possible to confirm a result due to interference, these unconfirmed results must be identified in the test report, using appropriate data qualifier flags and explained in the case narrative. Analyte presence is indicated only if both original and confirmation signals are positive or if confirmation signal cannot be discerned from interference.	Analyst/Section Supervisor	Accuracy/Bias	Same as for initial or primary column analysis

Table 28-5. Laboratory QC Samples for PCBs

Matrix	**Water**
Analytical Group	**PCBs**
Analytical Method/ SOP Reference[2]	**USEPA 8082A/ DV-GC-0021**

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater).	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ
LCS	1/Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. Otherwise, correct any problems then re-prep and reanalyze the LCS and all associated samples for failed analytes. If insufficient sample, then apply Q-flag to specific analyte(s) in all samples in the associated prep batch. Flagging is only appropriate when samples cannot be reanalyzed unless written approval is provided by the client.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	Water
Analytical Group	PCBs
Analytical Method/ SOP Reference[2]	USEPA 8082A/ DV-GC-0021

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	1/Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published. RPD: < 30%	For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative. The MS is for matrix evaluation only. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits
Surrogates	Every field sample and QC samples	QSM limits (if available) or current in-house limits if no QSM limits published.	For QC and field samples, correct any problems, then re-prep and reanalyze all failed samples for failed surrogates in the associated prep batch. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. If surrogate recoveries are above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. For samples with ND results, a high bias as evidenced in these situations is typically not an issue. Apply Q-flag to all associated analytes if acceptance criteria are not met. Explain in the case narrative. All surrogates analyzed must be reported.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	Water
Analytical Group	PCBs
Analytical Method/ SOP Reference[2]	USEPA 8082A/ DV-GC-0021

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Second-column confirmation	All positive results	Calibration and QC criteria for the confirmation analysis are the same as for the primary column analysis. The RPD between results for the primary and secondary columns must be ≤ 40%.	Apply J-flag if RPD > 40% and discuss in case narrative. Use project-specific reporting requirements if available; otherwise use method requirements if available; otherwise report the result from the primary column unless there is a scientifically valid and documented reason for not doing so and is approved by the client. If it is not possible to confirm a result due to interference, these unconfirmed results must be identified in the test report, using appropriate data qualifier flags and explained in the case narrative. Analyte presence is indicated only if both original and confirmation signals are positive or if confirmation signal cannot be discerned from interference.	Analyst/Section Supervisor	Accuracy/Bias	Same as for initial or primary column analysis

Table 28-6. Laboratory QC Samples for Explosives and Propellants

Matrix	**Water**					
Analytical Group	**Explosives and Propellants**					
Analytical Method/ SOP Reference[2]	**USEPA 8330B/ DV-LC-0002**					
QC Sample	**Frequency/ Number**	**Acceptance Limits[1]**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
MB	1/Batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater).	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
LCS	1/Batch (20 samples) (Spiked with all components of interest)	QSM limits (if available) or current in-house limits if no QSM limits published	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. Otherwise, correct any problems then re-prep and reanalyze the LCS and all associated samples for failed analytes. If insufficient sample, then apply Q-flag to specific analyte(s) in all samples in the associated prep batch. Flagging is only appropriate when samples cannot be reanalyzed unless written approval is provided by the client.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery Control Limits

Matrix	Water
Analytical Group	Explosives and Propellants
Analytical Method/ SOP Reference[2]	USEPA 8330B/ DV-LC-0002

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	1/Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published. RPD: $\leq$ 20%	For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative. The MS is for matrix evaluation only. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits
Surrogates	Every field sample and QC samples	QSM limits (if available) or current in-house limits if no QSM limits published.	For QC and field samples, correct any problems, then re-prep and reanalyze all failed samples for failed surrogates in the associated prep batch. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. If surrogate recoveries are above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. For samples with ND results, a high bias as evidenced in these situations is typically not an issue. Apply Q-flag to all associated analytes if acceptance criteria are not met. Explain in the case narrative. All surrogates analyzed must be reported.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	**Water**
Analytical Group	**Explosives and Propellants**
Analytical Method/ SOP Reference[2]	**USEPA 8330B/ DV-LC-0002**

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Second-column confirmation	All positive results	Calibration and QC criteria for the confirmation analysis are the same as for the primary column analysis. The RPD between results for the primary and secondary columns must be ≤ 40%.	Apply J-flag if RPD > 40% and discuss in case narrative. Use project-specific reporting requirements if available; otherwise use method requirements if available; otherwise report the result from the primary column unless there is a scientifically valid and documented reason for not doing so and is approved by the client. If it is not possible to confirm a result due to interference, these unconfirmed results must be identified in the test report, using appropriate data qualifier flags and explained in the case narrative. Analyte presence is indicated only if both original and confirmation signals are positive or if confirmation signal cannot be discerned from interference.	Analyst/Section Supervisor	Accuracy/Bias	Same as for initial or primary column analysis

Table 28-7. Laboratory QC Samples for Nitroguanidine

Matrix	**Water**
Analytical Group	**Nitroguanidine**
Analytical Method/ SOP Reference[2]	**USEPA 8330B/ WS-LC-0010**

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No Target Compounds> ½ LOQ and > 1/10 the amount in any sample or 1/10 the regulatory limit (whichever is greater).	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1 /2 LOQ
LCS	1/Batch (20 samples) (Does not go through grinding process; spiked with all components of interest)	QSM limits are not available; use current laboratory in-house limits; lab limits are subject to change.	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. Otherwise, correct any problems then re-prep and reanalyze the LCS and all associated samples for failed analytes. If insufficient sample, then apply Q-flag to specific analyte(s) in all samples in the associated prep batch. Flagging is only appropriate when samples cannot be reanalyzed unless written approval is provided by the client.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	**Water**
Analytical Group	**Nitroguanidine**
Analytical Method/ SOP Reference[2]	**USEPA 8330B/ WS-LC-0010**

QC Sample	Frequency/ Number	Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	1/Batch (20 samples)	QSM limits are not available; use current laboratory in-house limits. RPD: $\leq$ 20%	For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative. The MS is for matrix evaluation only. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias / Precision	Laboratory % Recovery/RPD Control Limits
Surrogates	Every field sample and QC samples	QSM limits (if available) or current in-house limits if no QSM limits published.	For QC and field samples, correct any problems, then re-prep and reanalyze all failed samples for failed surrogates in the associated prep batch. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. If surrogate recoveries are above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. For samples with ND results, a high bias as evidenced in these situations is typically not an issue. Apply Q-flag to all associated analytes if acceptance criteria are not met. Explain in the case narrative. All surrogates analyzed must be reported.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	Water					
Analytical Group	**Nitroguanidine**					
Analytical Method/ SOP Reference[2]	**USEPA 8330B/ WS-LC-0010**					
QC Sample	**Frequency/ Number**	**Acceptance Limits[1]**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
Second-column confirmation	All positive results	Calibration and QC criteria for the confirmation analysis are the same as for the primary column analysis. The RPD between results for the primary and secondary columns must be ≤ 40%.	Apply J-flag if RPD > 40% and discuss in case narrative. Use project-specific reporting requirements if available; otherwise use method requirements if available; otherwise report the result from the primary column unless there is a scientifically valid and documented reason for not doing so and is approved by the client. If it is not possible to confirm a result due to interference, these unconfirmed results must be identified in the test report, using appropriate data qualifier flags and explained in the case narrative. Analyte presence is indicated only if both original and confirmation signals are positive or if confirmation signal cannot be discerned from interference.	Analyst/Section Supervisor	Accuracy/Bias	Same as for initial or primary column analysis

Table 28-8. Laboratory QC Samples for Perchlorate

Matrix	Water					
Analytical Group	**Perchlorate**					
Analytical Method/ SOP Reference[2]	**USEPA 6860/ DV-LC-0024**					
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits[1]**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
MB	1/Batch (20 samples)	No analytes detected > ½ LOQ (RL) or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	If criteria not met, correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank. If reanalysis is not possible, apply B-flag to all results for the specific analyte(s) in all samples processed with the contaminated blank. Must be explained in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds> ½ LOQ
LCS	1/Batch (20 samples)	QSM Spike Limits	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, TestAmerica will report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project. Correct any problems then re-prep and reanalyze the LCS and all associated samples for failed analytes. If insufficient sample or corrective action fails, then apply Q-flag to specific analyte(s) in all samples in the associated prep batch. Must be explained in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	QSM Spike Limits RPD: $\leq$ 15%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-9. Laboratory QC Samples for Nitrocellulose and Nitrate + Nitrite

Matrix	**Water**
Analytical Group	**Nitrocellulose and Nitrate + Nitrite**
Analytical Method/ SOP Reference2	**USEPA 353.2/ DV-WC-0007**

QC Sample	Frequency/ Number	QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	One per preparation batch (20 samples)	No Target Compounds>1/2 LOQ	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
LCS	One per preparation batch (20 samples)	Lab determined historical limits	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	One per preparation batch (20 samples)	Lab determined historical limits	If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	% RPD Control Limits

Table 28-10. Laboratory QC Samples for Total and Dissolved Metals (6010C)

Matrix	**Water**
Analytical Group	**Metals (Dissolved and Total)**
Analytical Method/ SOP Reference2	**USEPA 6010C/ DV-MT-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Preparatory Batch (20 samples)	No Target Compounds> ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Common lab contaminants: no analytes detected > LOQ.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ
LCS	1/Preparatory Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published.	If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery/RPD Control Limits

Matrix	Water
Analytical Group	**Metals (Dissolved and Total)**
Analytical Method/ SOP Reference2	**USEPA 6010C/ DV-MT-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	1 pair/Preparatory Batch (20 samples)	Recovery: QSM limits (if available) or current in-house limits if no QSM limits published. RPD: RPD between MS and MSD $\leq$ 20%	If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or Laboratory % Recovery/RPD Control Limits
Dilution test	One per preparatory batch if MS or MSD fails. Only applicable for samples with concentrations >50 x LOQ.	Five-fold dilution must agree within $\pm$ 10% of the original determination	If dilution test fails analyze post digestion spike.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	N/A
Post digestion spike addition	When dilution test fails or analyte concentration of all samples < 50 x LOQ	Recovery within 80-120% of expected results	For specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst/Section Supervisor	Accuracy/Bias	N/A
Method of Standard Additions	When dilution test or post digestion spike fails and if required by the project	N/A	N/A	Analyst/Section Supervisor	N/A	N/A

Table 28-11. Laboratory QC Samples for Total and Dissolved Metals (6020A)

Matrix	**Water**
Analytical Group	**Metals (Dissolved and Total)**
Analytical Method/SOP Reference2	**USEPA 6020A/ DV-MT-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MC	1/Preparatory Batch (20 samples)	No Target Compounds> ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Common lab contaminants: no analytes detected > LOQ.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ
LCS	1/Preparatory Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published.	If LCS has high bias, and associated samples are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery/RPD Control Limits

Matrix	**Water**
Analytical Group	**Metals (Dissolved and Total)**
Analytical Method/SOP Reference2	**USEPA 6020A/ DV-MT-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MS/MSD	1 pair/ Preparatory Batch (20 samples)	Recovery: QSM limits (if available) or current in-house limits if no QSM limits published. RPD: RPD between MS and MSD $\leq$ 20%	If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or Laboratory % Recovery/RPD Control Limits
Dilution test	One per preparatory batch if MS or MSD fails. Only applicable for samples with concentrations >50 x LOQ.	Five-fold dilution must agree within $\pm$ 10% of the original determination	If dilution test fails analyze post digestion spike.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	N/A
Post digestion spike addition	When dilution test fails or analyte concentration of all samples < 50 x LOQ	Recovery within 80-120% of expected results	For specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst/Section Supervisor	Accuracy/Bias	N/A

Matrix	**Water**					
Analytical Group	**Metals (Dissolved and Total)**					
Analytical Method/SOP Reference2	**USEPA 6020A/ DV-MT-0021**					
QC Sample	**Frequency/ Number**	**Method/SOP QC Acceptance Limits[1]**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
Method of Standard Additions	When dilution test or post digestion spike fails and if required by the project	N/A	N/A	Analyst/Section Supervisor	N/A	N/A

Table 28-12. Laboratory QC Samples for Mercury

Matrix	**Water**
Analytical Group	**Mercury**
Analytical Method/SOP Reference2	**USEPA 7470A /DV-MT-0017**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Method Blank	1/Preparatory Batch (20 samples)	No Target Compounds> ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank. Report results if sample results >10x blank result or sample results ND. If reanalysis is not possible, apply B-flag to all results for the specific analyte(s) in all samples processed with the contaminated blank. Must be explained in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 RL
Laboratory Control Sample	1/Preparatory Batch (20 samples)	QSM limits	If the LCS recovery is above the project acceptance limits and there are no detections in the samples, report the non-detect results with a case narrative comment in addition to applying any data qualifier flags required by the project Correct any problems, then re-prep and reanalyze LCS and associated samples for failed analytes in all samples in the associated batch. If corrective action fails, apply Q-flag to specific analyte(s) in all samples in associated batch.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits

Matrix	Water
Analytical Group	**Mercury**
Analytical Method/SOP Reference2	**USEPA 7470A /DV-MT-0017**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Matrix Spike/Matrix Spike Duplicate	1/Preparatory Batch (20 samples)	QSM Limits RPD: $\leq$ 20%	If MS fails, consult project-specific DQOs and contact client to see if additional measures need to be taken. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-13. Laboratory QC Samples for Hexavalent Chromium

Matrix	**Water**
Analytical Group	**Hexavalent Chromium**
Analytical Method/SOP Reference2	**USEPA 7196A/DV-WC-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	1/Batch (20 samples)	No Target Compounds>1/2 LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Correct problem. If required re-prep and reanalyze MB and all samples processed with the contaminated blank. Report results if sample results ND. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for hexavalent chromium in all samples in the associated prep batch.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2RL
LCS	1/Batch (20 samples)	QSM Appendix C limits.	Correct problem. Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1 per 10 project samples	QSM Appendix C limits. RPD between MS/MSD $\leq$ 20%	Dilute and reanalyze sample; persistent interference indicates the need to use the method of standard addition or alternative method. Re-prep and reanalyze all samples in the prep batch. Determine root cause to assure not a lab error. If acceptance criteria are not met, flag MS/MSD data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-14. Laboratory QC Samples for Free Cyanide

Matrix	**Water**
Analytical Group	**Free Cyanide**
Analytical Method/SOP Reference[2]	**SM4500-CN-I /DV-WC-0083**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	One per preparatory batch	No Target Compounds>1/2 RL or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	If sufficient sample is available, reanalyze samples. Qualify data if reanalysis cannot be completed. Apply B-flag to all cyanide results in all samples in the associated preparatory batch	Analyst/Lab Manager	Accuracy/Bias-Contamination	No Target Compounds>1/2RL; no common lab contaminants >RL.
LCS	1/Batch (20 samples)	QSM Appendix C limits apply.	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Lab Manager	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	QSM Appendix C limits apply. RPD for MS/MSD must be $\leq$ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Lab Manager	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-15. Laboratory QC Samples for Total Cyanide

Matrix	**Water**
Analytical Group	**Total Cyanide**
Analytical Method/SOP Reference[2]	**USEPA 9012B/DV-WC-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MB	One per preparatory batch	No Target Compounds>1/2 RL or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	If sufficient sample is available, reanalyze samples. Qualify data if reanalysis cannot be completed. Apply B-flag to all cyanide results in all samples in the associated preparatory batch	Analyst/Lab Manager	Accuracy/Bias-Contamination	No Target Compounds>1/2RL; no common lab contaminants >RL.
LCS	1/Batch (20 samples)	QSM Appendix C limits apply.	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Lab Manager	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	QSM Appendix C limits apply. RPD for MS/MSD must be $\leq$ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Lab Manager	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-16. Laboratory QC Samples for Hydrazine

Matrix	**Water**
Analytical Group	**Hydrazine**
Analytical Method/SOP Reference[2]	**USEPA 8315A Modified/ 37-7**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
Surrogate Spike	Per sample (including MS/MSD, LCS, and blanks)	N/A	Re-extract sample. If the surrogate compound fails high and there are no positive detections, the sample can be reported.	Analyst/Lab Manager	Accuracy/Bias	% R within acceptance criteria.
MB	One per preparatory batch	No Target Compounds>1/2 RL or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	If sufficient sample is available, reanalyze samples. Qualify data if reanalysis cannot be completed. Apply B-flag to all cyanide results in all samples in the associated preparatory batch	Analyst/Lab Manager	Accuracy/Bias-Contamination	No Target Compounds>1/2 RL; no common lab contaminants >RL.
LCS	1/Batch (20 samples)	QSM Appendix C limits apply.	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Lab Manager	Accuracy/Bias	Laboratory % Recovery Control Limits (See Worksheet #15).
MS/MSD	1/Batch (20 samples)	QSM Appendix C limits apply. RPD for MS/MSD must be ≤ 20%	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Lab Manager	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits (78-120%, RPD ≤25%).

Table 28-17. Laboratory QC Samples for Ammonia as N

Matrix	**Water**
Analytical Group	**Ammonia as N**
Analytical Method/SOP Reference[2]	**USEPA 350.1/ DV-WC-0089**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	One per preparation batch (20 samples)	No Target Compounds>1/2 LOQ	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
LCS	One per preparation batch (20 samples)	Lab determined historical limits	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	One per preparation batch (20 samples)	Lab determined historical limits	If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	% RPD Control Limits

Table 28-18. Laboratory QC Samples for Anions

Matrix	**Water**
Analytical Group	**Anions**
Analytical Method/SOP Reference[2]	**USEPA 9056A / DV-WC-0020**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	1/Preparatory Batch (20 samples)	No Target Compounds>1/2 LOQ	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
LCS	1/Preparatory Batch (20 samples)	QSM limits	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM control limits
MS/MSD	1/Preparatory Batch (20 samples)	<u>Recovery</u>: QSM limits <u>RPD</u>: between MS and MSD $\leq$15%	If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM control limits
Laboratory Duplicate	1/Preparatory Batch (20 samples) if no MSD	RPD between duplicates $\leq$15%	For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative. Data shall be evaluated to determine the source of the difference.	Analyst/Section Supervisor	Precision	RPD $\leq$15%

Table 28-19. Laboratory QC Samples for Phosphorus

Matrix	Water
Analytical Group	Phosphorus
Analytical Method/SOP Reference[2]	USEPA 6010C/ DV-MT-0021

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	1/Preparatory Batch (20 samples)	No Target Compounds> ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Common lab contaminants: no analytes detected > LOQ.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ
LCS	1/Preparatory Batch (20 samples)	QSM limits (if available) or current in-house limits if no QSM limits published.	If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or Laboratory % Recovery/RPD Control Limits
MS/MSD	1 pair/ Preparatory Batch (20 samples)	Recovery: QSM limits (if available) or current in-house limits if no QSM limits published. RPD: RPD between MS and MSD < 20%	If MS fails, for specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or Laboratory % Recovery/RPD Control Limits

Matrix	**Water**
Analytical Group	**Phosphorus**
Analytical Method/SOP Reference[2]	**USEPA 6010C/ DV-MT-0021**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Dilution test	1/preparatory batch if MS or MSD fails. Only applicable for samples with concentration s >50 x LOQ.	Five-fold dilution must agree within + 10% of the original determination	If dilution test fails analyze post digestion spike.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	N/A
Post digestion spike addition	When dilution test fails or analyte concentration of all samples < 50 x LOQ	Recovery within 80-120% of expected results	For specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst/Section Supervisor	Accuracy/Bias	N/A
Method of Standard Additions	When dilution test or post digestion spike fails and if required by the project	N/A	N/A	Analyst/Section Supervisor	N/A	N/A

Table 28-20. Laboratory QC Samples for Sulfide

Matrix	**Water**
Analytical Group	**General Chemistry**
Analytical Method/SOP Reference[2]	**SW 9034 / DV-WC-0042**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	One per preparation batch (20 samples)	No Target Compounds>1/2 LOQ	If sufficient sample is available, re-prepare and reanalyze samples.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
LCS	One per preparation batch (20 samples)	Lab determined historical limits	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	One per preparation batch (20 samples)	Lab determined historical limits	If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-21. Laboratory QC Samples for Chemical Oxygen Demand

Matrix	**Water**
Analytical Group	**Chemical Oxygen Demand**
Analytical Method/ SOP Reference[2]	**USEPA 410.4/ DV-WC-0018**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	1/Batch (20 samples)	No Target Compounds > ½ RL	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds > ½ RL
LCS	1/Batch (20 samples)	Lab determined historical limits	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	Lab determined historical limits	If MS falls outside LCS limits, evaluate data to determine the source of the difference and to determine if there is a matrix effect or analytical error. For specific analyte(s) in parent sample, apply J-flag if acceptance criteria are not met. Explain in the case narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-22. Laboratory QC Samples for Total Organic Carbon

Matrix	**Water**
Analytical Group	**Total Organic Carbon**
Analytical Method/SOP Reference[2]	**USEPA 9060A/ DV-WC-0006**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	1/Preparatory Batch (20 samples)	No Target Compounds>1/2 LOQ	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
LCS	1/Preparatory Batch (20 samples)	Lab determined historical limits but no wider than 80-120%	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Preparatory Batch (20 samples)	Recovery: Lab determined historical limits but no wider than 80-120% RPD: Lab determined historical limits but no wider than 15%.	If not related to matrix interference, re-extract and reanalyze MS/MSD.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-23. Laboratory QC Samples for Total Recoverable Phenols

Matrix	**Water**
Analytical Group	**Total Recoverable Phenols**
Analytical Method/ SOP Reference[2]	**SW-846 9066/ DV-WC-0084**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	1/Batch (20 samples)	No Target Compounds>1/2RL	Correct problem then re-prep and analyze method blank and all samples processed with the contaminated blank. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 RL
LCS	1/Batch (20 samples)	Refer to the 9066 Attachment for LCS control limits.	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	Refer to 9066 Attachment for MS control limits.	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	Laboratory % Recovery/RPD Control Limits

Table 28-24. Laboratory QC Samples for Dissolved Gases

Matrix	Water
Analytical Group	Dissolved Gasses
Analytical Method/SOP Reference[2]	USEPA RSK-175 /DV-GC-0025

QC Sample[3]	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
MB	1/Preparatory Batch (20 samples)	No target analytes ≥ ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected >RL.	If sufficient sample is available, reprep and reanalyze samples.	Analyst/Section Supervisor	Accuracy/Bias-Contamination	No Target Compounds>1/2 LOQ; no common lab contaminants >LOQ.
LCS	1/Preparatory Batch (20 samples)	QSM limits (if available) current in-housel limits if no QSM limits published.	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and reprep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	QSM or laboratory statistically derived control limits
MS/MSD	1/Preparatory Batch (20 samples)	Recovery: QSM limits (if available) current in-housel limits if no QSM limits published. RPD: RPD between MS and MSD for all analytes ≤ 30%.	If not related to matrix interference, re-extract and reanalyze MS/MSD.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	QSM or laboratory statistically derived control limits

Table 28-25. Laboratory QC Samples for Alkalinity

Matrix	**Water**
Analytical Group	**Carbonate and Bicarbonate Alkalinity**
Analytical Method/SOP Reference[2]	**SM 2320B / DV-WC-0025**

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	1/Preparatory Batch (20 samples)	No Target Compounds>1/2 LOQ	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results ND.	Analyst/Section Supervisor	Contamination	No Target Compounds>1/2 LOQ
Laboratory Control Sample	1/Preparatory Batch (20 samples)	Lab determined historical limits	Reanalyze LCS once. If acceptable, report. If LCS has high bias, and associated sample results are non-detect, report with case narrative comment. If LCS has low bias, evaluate and re-prep and reanalyze the LCS and all samples in the associated prep batch for failed analytes, if sufficient sample material is available.	Analyst/Section Supervisor	Accuracy/Bias	Laboratory % Recovery Control Limits
Sample Duplicate	1/Preparatory Batch (20 samples)	Lab determined historical limits	Determine root cause; flag duplicate data; discuss in narrative.	Analyst/Section Supervisor	Accuracy/Bias/ Precision	% RPD Control Limits

Notes for all Worksheet #28 Tables:

[1] This is a summary of the acceptance criteria; refer to the method SOP for specific or more information.

[2] SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.

> = Greater than

≤ = Less than or equal to

% = Percent

± = plus or minus

CA = Corrective action

DoD = Department of Defense

DQI = Data quality indicator

DQO = Data quality objective

EICP = Extracted ion current profile

GC = Gas chromatograph

ICAL = Initial calibration

IS = Internal standards

LCS = Laboratory control sample

LOQ = Limit of quantitation

MB = Method blank

MS = Matrix spike

MSD = Matrix spike duplicate

N/A = Not applicable

ND = Non detect

PAH = Polycyclic aromatic hydrocarbon

PCB = Polychlorinated biphenyls

QC = Quality control

QSM = Quality Systems Manual

RL = Reporting limit

RPD = Relative percent difference

SIM = Selective ion monitoring

SME = Saturated Media Extract

SOP = Standard Operating Procedure

SVOC = Semi-volatile organic compound

VOC = Volatile organic compound

USEPA = United States Environmental Protection Agency

29.0 PROJECT DOCUMENTS AND RECORDS (QAPP WORKSHEET #29)

This worksheet identifies project documents and records that will be generated for every aspect of the project.

Table 29-1. Project Documents and Records

Sample Collection Documents and Records	Offsite Analysis Documents and Records	Data Assessment Documents and Records
Field data collection sheets	COC records	Field sampling audit checklists
COC records	Sample receipt forms and sample tracking forms	Analytical audit checklists
Airbills	Preparation and analysis forms and/or logbooks	Data review reports
Communication logs	Tabulated data summary forms and raw data for field samples, standards, QC checks, and QC samples	Telephone logs
Corrective action reports	Case narrative	Corrective action reports
Documentation of corrective action results	Sample chronology (time of receipt, extraction, and analysis)	Laboratory assessment
Documentation of deviation from methods	Identification of QC samples	Laboratory QA plan
	Communication logs	MDL study information
	Corrective action reports	DoD ELAP accreditation
	Definitions of laboratory qualifiers	Hard copy of analytical and raw data
	Documentation of corrective action results	Validated data
	Documentation of laboratory method deviations	
	Electronic data deliverables	
	Instrument calibration reports	
	Laboratory name	
	Laboratory sample identification numbers	
	Reporting forms, completed with actual results	
	Signatures for laboratory sign-off (e.g., laboratory QA manager)	
	Standards traceability records	

Notes: COC = Chain of Custody
DoD = Department of Defense
ELAP = Environmental Laboratory Accreditation Program
MDL = Method Detection Limit
QA = Quality Assurance
QC = Quality Control

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30.0 ANALYTICAL SERVICES (QAPP WORKSHEET #30)

This worksheet identifies the laboratories that will provide the analytical services for this project. The laboratories shown below are ELAP-accredited.

Table 30-1. Analytical Services

Matrix	**Analytical Group**	**Sample Locations/ ID Number**	**Analytical Method/SOP**	**Data Package Turnaround Time** (business days)	**Laboratory/ Organization** (name and address, contact person, and telephone number)	**Backup Laboratory/ Organization** (name and address, contact person and telephone number)
Water	VOCs, SVOCs, PAHs, Pesticides, PCBs, Explosives and Propellants, Perchlorate, Nitrate + Nitrite, Metals (dissolved and total), Cr(VI), Free Cyanide, Total Cyanide, Ammonia as N, Anions, Phosphorus, Sulfide, Chemical Oxygen Demand, Total Organic Carbon, Total Recoverable Phenols, and Dissolved Gasses.	See Worksheet #18	8260C, 8270D, 8270D SIM, 8081B, 8082A, 8330B, 6860, MCAWW 353.3, 6010C, 7196A, 4500 CN I, 9010C, 350.1, 9056A, 6020A, 9034, 410.4, 9060A, 9066, and RSK-175.	15 days	Patrick McEntee 303-736-0107 TestAmerica Denver 4955 Yarrow Street Arvada, CO 80002	Kathy Albertson 740-373-4071 Microbac 158 Starlite Drive, Marietta, Ohio 45750
Water	Nitroguanidine and Nitrocellulose.		8330 modified and MCAWW Colorimetric Cadmium Reduction 353.2		Patrick McEntee 303-736-0107 TestAmerica Sacramento 880 Riverside Pkwy, West Sacramento, CA 95605	

Notes:

Cr(VI) = Hexavalent Chromium
ELAP = Environmental Laboratory Accreditation Program
ID = Identifier
MCAWW = Methods for Chemical Analysis of Water and Wastes
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyls
SIM = Selective Ion Monitoring
SOP = Standard Operating Procedure/Practice
SVOC = Semi-Volatile Organic Compound
VOC = Volatile Organic Compound

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31.0 PLANNED PROJECT ASSESSMENTS (QAPP WORKSHEET #31)

This worksheet identifies the assessments/audits planned for the project.

Table 31-1. Planned Project Assessments

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Laboratory Verification	Prior to identifying a laboratory for the project	Internal	TEC-Weston JV	Project Chemist	Laboratory Project Manager or designee	Laboratory Quality Assurance Manager or designee	Project Chemist
Facility Notification	1 month and 48 hours prior to start of fieldwork	Internal	TEC-Weston JV	Field Team Leader (or designee)	N/A	N/A	N/A
Subcontractor Notifications	1 month and 48 hours prior to start of sampling	Internal	TEC-Weston JV	Project Manager	N/A	N/A	N/A
Field Audit	May occur during fieldwork	Internal	TEC-Weston JV	Quality Manager (or designee)	Field Team Leader	Field Team Leader	Field Team Leader and Project Manager
Health and Safety Audit	Daily during fieldwork	Internal	TEC-Weston JV	Field Team Leader (or designee)	Field Team Leader and Project Manager	Field Team Leader	Field Team Leader and Project Manager
Ohio EPA Notification	15 days prior to fieldwork	Internal	TEC-Weston JV	Field Team Leader (or designee)	Field Team Leader and Project Manager	Field Team Leader	Field Team Leader and Project Manager

Notes: CA = Corrective action
N/A = Not applicable
TEC-Weston JV = TEC-Weston Joint Venture

31.1 Laboratory Verification

Contracted laboratories must be DoD ELAP-accredited for each method specified. Laboratory verification consists of ensuring that ELAP certifications of primary and secondary laboratories have not expired. In addition, variances requested by the laboratories will be reviewed and verified that they are acceptable and meet the project quality objectives listed in this UFP-QAPP.

31.2 Facility Notification

At least 48 hours prior to the start of sampling, the ARNG Restoration Project Manager or his representative shall be notified of field activities and informed that all required access to enter the facility has been obtained.

31.3 Subcontractor Notification

Subcontractors will be notified of the start of fieldwork no later than one month before fieldwork commences. Where required, they will provide Health and Safety and specialty certifications no later than two weeks before fieldwork commences. Subcontractors will be provided with the WP for review and sign-off no later than two weeks before fieldwork commences. Subcontractors will provide a signature for all employees who will be working on the project that verifies that they have read and understand the requirements of the project.

31.4 Field Audits

Prior to the start of the project, a site visit will be conducted to verify site conditions. Throughout the duration of the project, field documentation and sample receipt forms will be reviewed as needed.

Project quality assurance will be a function of the Quality Manager (or designee), who is assigned the authority to inspect all activities and may stop work if activities detrimental to the quality of the work product are detected. Project personnel will evaluate compliance of the laboratory QA program and procedures with the DoD QSM v5.0 requirements. Oversight may include internal and external audits as needed, documentation of findings, and reports of corrective action. The Program Quality Manager will coordinate a management review of any deficiencies that are noted.

32.0 ASSESSMENT FINDING AND CORRECTIVE ACTION RESPONSES (QAPP WORKSHEET #32)

This worksheet describes the sequence of events that includes documentation of deficiencies, notification of findings, request for corrective action, implementation of corrective action, and follow-up assessment of the corrective action's effectiveness for each assessment/audit performed on the project. Additional information regarding corrective action procedures is presented in Section 14.0 of the FWQAPP.

Table 32-1. Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Audit	Logbook or nonconformance report	Project Manager (or designee)	24 hours after audit	Written Letter	Field Team Leader	24 hours after notification
Field Documentation Review	Nonconformance report	Quality Manager	24 hours after review document	Written Memorandum	Project Chemist Field Team Leader	24 hours after notification
Laboratory Assessment (if significant QA/QC issues are encountered)	Written audit report	Project Manager Quality Manager Installation Points of Contact or their representative Laboratory Project Manager	5 days after audit	Corrective Action Plan	Laboratory Project Manager	Two weeks after receiving notification

Notes: QA = Quality Assurance
QC = Quality Control

32.1 Field Sampling Audit

The Quality Manager may schedule surveillance of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. The Quality Manager (or designee) may conduct surveillance of field activities during a scheduled visit. Sampling operations may be reviewed and compared to the requirements listed in this UFP-QAPP. Use of proper sample containers, proper handling of samples, and adequate documentation of the sampling operation will be verified. The surveillance may include observations of the COC procedure, field documentations, instrument calibrations, and field measurements.

32.2 Field Documentation Audit

Field documents and COC records will be reviewed to ensure that all entries are printed or written in indelible black or blue ink, dated and signed. The COC will be reviewed daily for completeness by the Project Chemist. A copy of the COC form will be retained by the Project Chemist and kept in the project file until the completion of the project.

32.3 Laboratory Assessment

The primary and secondary laboratories selected for this project are current on the DoD ELAP accreditation. The TEC-Weston JV may conduct a laboratory assessment if warranted during the project. The scope of the laboratory assessment by the TEC-Weston JV will be determined based on the quality issues encountered.

32.4 Corrective Action Procedures

The Quality Manager or senior technical staff will document problems and the corrective actions to provide a complete record of QA activities and help identify necessary preventive actions. Non-conformances that affect the findings or recommendations of the project or that have impacts to work outside of the project will be reported to Installation Points of Contact or their representative and the Project Team.

If the laboratories encounter issues during the project that may impact data quality, the Laboratory Project Manager will notify the Project Chemist within one business day of discovery to discuss corrective actions. A written corrective action plan shall be provided in a timely manner and implemented immediately by the laboratory.

33.0 QC MANAGEMENT REPORTS (QAPP WORKSHEET #33)

33.1 QA Management Reports

This worksheet lists the periodic QA management reports ensuring that managers and stakeholders are updated on project status and the results of the QA assessments. Additional information regarding internal quality control checks is presented in Section 9.0 of the FWQAPP.

Table 33-1. Planned Project Assessments

Type of Report	**Frequency** (daily, weekly, monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation**	**Report Recipient(s)**
Daily Field Report	Daily/after start of sampling	Daily/after start of sampling	Field Team Leader	TEC-Weston JV Project Manager
Monthly Progress Report	Monthly	Monthly	Project Manager	ARNG Program Manager or their representative
Data Usability Assessment Report	After all data are generated and validated	Submitted with RI Report	Project Chemist	Quality Manager, Project Manager
Final RI Report	After the Risk Assessment Completed	Submitted with RI Report	Project Manager	Quality Manager, Project Manager

Notes: ARNG = Army National Guard
RI = Remedial Investigation
TEC-Weston JV = TEC-Weston Joint Venture

33.2 Final RI Reports

The Final RI Report will be submitted after the Risk Assessment has been completed. The Final RI Report will be subject to iterative review from project stakeholders and will be submitted in Preliminary Draft, Draft, and Final versions. The outline for the Final RI Report, which is derived from the *Submission Format Guidelines for the Ravenna Army Ammunition Plant Restoration Program, Version 21* (USACE, 2015), is shown below:

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- 7.0 Ecological Risk Assessment
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Appendices

34.0 VERIFICATION (STEP I) PROCESS (QAPP WORKSHEET #34)

This worksheet presents the Data Review Process for Verification (Step I). Verification is a completeness check that is performed prior to the data review process in order to determine whether the required measurements are collected and all data deliverables (the complete data package) are present. It involves a review of all data inputs to ensure that they are present. The column titled **Internal/External** is in relation to the data generator.

Table 34-1. Verification (Step I) Process

Verification Input	Description	Internal/ External	Responsible for Verification
COC forms	COC forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Internal	Field Team Leader
Audit reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the Project Manager will be notified to ensure action is taken.	Internal	Field Team Leader
Field notes/logbook	Field notes will be reviewed internally and placed in the project file. A copy of the field notes will be attached to the RI Report.	Internal	Field Team Leader
Sample Receipt	For samples shipped via courier or by air, the Project Chemist will verify receipt of samples by the laboratory.	Internal	Project Chemist
Sample login	Sample login information will be reviewed for completeness in accordance with the COC forms.	Internal	Field Team Leader
		External	Laboratory Project Manager
Laboratory data prior to release	Laboratory data will be reviewed and verified for completeness against analyses requested on the COC forms.	External	Laboratory Project Manager
Laboratory data due at turnaround time listed on COC	Laboratory data will be verified that the analyses reported are consistent with the analyses requested on the COC forms.	Internal	Project Chemist
Laboratory data packages	Laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	External	Laboratory Project Manager or designee

Verification Input	Description	Internal/ External	Responsible for Verification
Laboratory data packages	All received data packages will be verified externally by the data validator or Project Chemist for completeness. All screening level data and site evaluation/natural attenuation parameters will only undergo Verification (Step I), unless otherwise dictated by project requirements. All definitive data will be validated externally according to the data validation procedures specified in Worksheet #35 and in the method-specific Data Validation Evaluation Sheets (Attachment A).	External	Data Validator or Project Chemist
IDW Disposal Manifests	IDW Disposal Manifests will be reviewed for accuracy and included as an appendix in the RI Report.	Internal	Field Team Leader
Field and electronic data	One hundred percent of manual entries will be reviewed against the hardcopy information and 5 percent of electronic uploads will be checked against the hardcopy. The laboratory reports data from one master source for both hardcopy and electronic deliverables.	Internal	REIMS Data Manager

Notes: COC = Chain of Custody
IDW = Investigation-Derived Waste
REIMS = Ravenna Environmental Information Management System
RI = Remedial Investigation

35.0 VALIDATION (STEPS IIA AND IIB) PROCESS (QAPP WORKSHEET #35)

This worksheet presents the Data Review Process for Validation (Step IIa and IIb). Validation procedures and criteria ensure that data are evaluated properly, completely, and consistently for use in meeting project goals.

Step IIa Validation activities ensure compliance with methods, procedures, and contracts for both sampling and analytical data. Examples of Step IIa validation activities are as follows:

- Data Deliverables and UFP-QAPP
- Analytes
- COC
- Holding Times
- QC acceptance criteria (blanks, surrogates, LCS, MS/MSD, serial dilutions, post digestion spikes)
- Sampling Methods and Procedures
- Field Transcription
- Analytical Methods and Procedures
- Sample Handing
- Validation Flags
- Standards
- Communication
- Audits

Step IIb Validation activities ensure compliance with Measurement Performance Criteria in the UFP-QAPP for both sampling and analytical data. Data Validation Evaluation Sheets are provided in Attachment A. Some of the elements have both Step IIa and Step IIb validation activities. Examples of Step IIb validation activities are as follows:

- Data Deliverables and UFP-QAPP
- Deviations

- Sample Plan
- Co-located Field Duplicated
- Project LOQs
- Confirmatory Analyses
- Validation Flags

36.0 ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY (QAPP WORKSHEET #36)

TestAmerica Laboratory will provide USEPA Level III and IV data packages and EnviroData EDDs to:

- the TEC-Weston JV Project Chemist,
- the TEC-Weston JV validation team, and
- the TEC-Weston JV Database Manager.

The JV team is responsible for conducting manual review of the data packages for compliance with the established QC criteria. Validation will be performed in accordance with the method-specific Data Validation Evaluation Sheets (Attachment A), which are based on guidance from the DoD QSM v5.0, the analytical method, Section 10.2 of the FWQAPP, and the USEPA National Functional Guidelines (2014).

The JV validation team is responsible for conducting a data verification (Stage 2B [USEPA, 2009]) on 100% of the definitive data and data validation (Stage 3 [USEPA, 2009]) on 10% of the definitive level data. Screening level data will not be validated, unless significant deviations from expected values are observed.

Table 36-1. Analytical Data Validation (Steps IIa and IIb) Summary

Step IIa/ IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Water	VOCs	Method SW-846 8260B, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	JV validation team
IIa	Water	SVOCs	Method SW-846 8270D, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	JV validation team
IIa	Water	PAHs	Method SW-846 8270D, DoD QSM v5.0 (Table B-4), and USEPA CLP guidelines.	JV validation team
IIa	Water	Pesticides	Method SW-846 8081B, DoD QSM v5.0 (Table B-1), and USEPA CLP guidelines.	JV validation team
IIa	Water	PCBs	Method SW-846 8082A, DoD QSM v5.0 (Table B-1), and USEPA CLP guidelines.	JV validation team

Step IIa/ IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Water	Explosives and Propellants	Method SW-846 8330B, DoD QSM v5.0 (Table B-3), and USEPA CLP guidelines.	JV validation team
IIa	Water	Perchlorate	Method SW-846 6860, DoD QSM v5.0 (Table B-13), and USEPA CLP guidelines.	JV validation team
IIa	Water	Nitrocellulose	Method 353.2, and USEPA CLP guidelines.	JV validation team
IIa	Water	Nitrate + Nitrite	Method 353.2, and USEPA CLP guidelines.	JV validation team
IIa	Water	Total and Dissolved Metals by 6010C	Method SW-846 6010C, DoD QSM v5.0 (Table B-8), and USEPA CLP guidelines.	JV validation team
IIa	Water	Total and Dissolved Metals by 6020A	Method SW-846 6020A, DoD QSM v5.0 (Table B-9), and USEPA CLP guidelines.	JV validation team
IIa	Water	Mercury by 7470A	Method SW-846 6020A, DoD QSM v5.0 (Table B-7), and USEPA CLP guidelines.	JV validation team
IIa	Water	Chromium (VI)	Method SW-846 7196A, DoD QSM v5.0 (Table B-10), and USEPA CLP guidelines.	JV validation team
IIa	Water	Free Cyanide	Method SM 4500 CN I, and USEPA CLP guidelines.	JV validation team
IIa	Water	Total Cyanide	Method 9012B, DoD QSM v5.0 (Table B-11), and USEPA CLP guidelines.	JV validation team
IIa	Water	Hydrazine	Method 8315A Modified and USEPA CLP guidelines.	JV validation team
IIa	Water	Alkalinity	Method SM 2320B, and USEPA CLP guidelines.	JV validation team
IIb	Water	VOCs	Tables 12-1, 15-1, and 28-1 of this UFP-QAPP	JV validation team
IIb	Water	SVOCs	Tables 12-2, 15-2, and 28-2 of this UFP-QAPP	JV validation team
IIb	Water	PAHs	Tables 12-3, 15-3, and 28-3 of this UFP-QAPP	JV validation team
IIb	Water	Pesticides	Tables 12-4, 15-4, and 28-4 of this UFP-QAPP	JV validation team
IIb	Water	PCBs	Tables 12-5, 15-5, and 28-5 of this UFP-QAPP	JV validation team
IIb	Water	Explosives and Propellants	Tables 12-6, 15-6, and 28-6 of this UFP-QAPP	JV validation team
IIb	Water	Perchlorate	Tables 12-7, 15-7, and 28-7 of this UFP-QAPP	JV validation team
IIb	Water	Nitrocellulose	Tables 12-8, 15-8, and 28-8 of this UFP-QAPP	JV validation team
IIb	Water	Nitrate + Nitrite	Tables 12-9, 15-9, and 28-8 of this UFP-QAPP	JV validation team
IIb	Water	Total and Dissolved Metals by 6010C	Tables 12-10, 15-10, and 28-9 of this UFP-QAPP	JV validation team
IIb	Water	Total and Dissolved Metals by 6020A	Tables 12-11, 15-11, and 28-10 of this UFP-QAPP	JV validation team
IIb	Water	Mercury by 7470A	Tables 12-12, 15-13, and 28-12 of this UFP-QAPP	JV validation team
IIb	Water	Chromium (VI)	Tables 12-13, 15-14, and 28-13 of this UFP-QAPP	JV validation team
IIb	Water	Free Cyanide	Tables 12-14, 15-15, and 28-14 of this UFP-QAPP	JV validation team

Step IIa/ IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIb	Water	Total Cyanide	Tables 12-15, 15-16, and 28-15 of this UFP-QAPP	JV validation team
IIa	Water	Alkalinity	Tables 12-16, 15-18, and 28-25 of this UFP-QAPP	JV validation team
IIa	Water	Hydrazine	Tables 12-17, 15-17, and 28-16 of this UFP-QAPP	JV validation team

Notes:

CLP = Contract Laboratory Program
DoD = Department of Defense
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
QSM = Quality Systems Manual
SVOC = Semi-volatile Organic Compound
UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan
USEPA = United States Environmental Protection Agency
VOC = Volatile Organic Compound

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37.0 USABILITY ASSESSMENT (QAPP WORKSHEET #37)

The usability assessment is an evaluation of data based upon the results of data validation and verification for the decisions being made. In the usability step, reviewers assess whether the process execution and resulting data meet quality objectives based on criteria established in this UFP-QAPP. The usability assessment will consider data from sampling activity, onsite analytical, offsite laboratory, and validation reports. The usability assessment will be performed by the data assessment team and documented in the RI Report by the Project Chemist. The data assessment team will consist of the Project Manager, Quality Manager, Project Chemist, and Environmental Resources Program Information Management System Database Manager. In addition, other project personnel (e.g., Installation Points of Contact or their representatives, state regulator, Field Team Leader) may be involved with the determination of whether data meet project quality objectives.

The data assessment team will:

- Identify project requirements and verify field activities were performed in accordance to the SOPs detailed in Worksheets #14 and the FSP.
- Review the project data quality objectives and data validation process detailed in Worksheets #34, #35, and #36.
- Verify that all samples and analytical data collected meet the project quality objectives (PQOs).
- Evaluate validated data to assess if the data satisfy PQOs (e.g., tolerable limits on decision errors) and are adequate to make the decision regarding additional investigation for the site.
- Provide input on the suitability of the results for the purposes intended.

In the Usability Assessment, the impacts of any deviations from the planned procedures documented in this UFP-QAPP, guidance documents, or SOPs will be determined for the following items:

- Sampling Locations
- COCs
- Holding Times
- Damaged Samples

- SOPs and Methods

In addition, the possible effects of outliers or anomalous data will be evaluated from the following:

- QC Samples
- Matrix
- Meteorological Data and Site Conditions
- Comparability
- Completeness
- Background
- Critical Samples

These considerations for the Usability Assessment are discussed in detail in Section 5.2.3.2 of the UFP-QAPP Manual (USEPA, 2005). The usability assessment will include an evaluation of the data quality indicators (precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity). The impact of any data gaps or deviations from planned procedures will be evaluated. This includes rejected data based on the results of the data validation process. The usability assessment will evaluate the overall dataset for the entire site, and any trends, relationships, or correlations will be described.

After the data usability assessment has been performed, data deemed appropriate for use will be presented in the RI Report. The RI Report will include conclusions and optimization recommendations, as applicable.

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ATTACHMENT A:

DATA VALIDATION EVALUATION SHEETS

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Data Verification Evaluation Sheet

Nitrate/Nitrite by Method 353.2

Parameter	**Evaluation Criteria**	**Flagging Criteria**
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • pH≤2	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. pH>2, reject (R) all NDs and estimate (J) all detections.
Holding Time	• Extraction and analysis holding times met o Waters: 48 hours if unpreserved; 14 days if preserve with $H_2SO_4$to pH≤2	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted.

Parameter	Evaluation Criteria	Flagging Criteria
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly.	Laboratory should correct errors; if errors cannot be corrected use professional judgment.
Field Duplicates	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment Blanks (EB)/Field Blanks (FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	See qualification table for blank detections at the end of this sheet.
Source Water Blanks	• One per investigation as needed	See qualification table for blank detections at the end of this sheet.
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear	See qualification table for blank detections at the end of this sheet.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt
Initial Calibration	• Verify proper ICAL frequency and sequence • See MCAWW Method 353.2 for all evaluation criteria.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. The acceptance criterion for the calibration curve should be a correlation coefficient of 0.995 or higher.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration Verification	• Once after each IC, analysis of a second standard prior to sample analysis. • See MCAWW Method 353.2 for all evaluation criteria.	If ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. The acceptance criteria for the ICV standard must be no greater than ± 10% of its true value.
Continuing Calibration Verification	• Daily before sample analysis, every hour, and at the end of the analytical run. • See MCAWW Method 353.2 for all evaluation criteria.	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. The acceptance criteria for the CCV standard must be no greater than ± 10% of its true value.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)/Matrix Spike Duplicate (MSD)	• See Worksheet #15 for QC limits. • See Worksheet #12 for RPD limit. • One per batch of 20 samples.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Laboratory Duplicate Sample	• RPD limit is 20%. • See MCAWW Method 353.2 for all evaluation criteria.	For the specific analyte in the parent sample, qualify data as follows: RPD > 20%, qualify detections as estimated (J).
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Data Verification Evaluation Sheet

Nitrocellulose by Method 353.2

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • pH≤2	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. pH>2, reject (R) all NDs and estimate (J) all detections.
Holding Time	• Extraction and analysis holding times met o Waters: 28 days pres. to pH≤2	Holding time exceeded by <24 hours, qualify all results as estimated (J/UJ). Holding time exceeded by >24 hours, reject (R) all NDs and estimate (J) all detections.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly.	Laboratory should correct errors; if errors cannot be corrected use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Field Duplicates	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections > LOQ is 25%. • If either the parent or FD detection is > LOQ, but the other result is < LOQ or ND, calculate absolute difference. Use 2x the LOD as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	See qualification table for blank detections at the end of this sheet.
Source Water Blanks	• One per investigation as needed	See qualification table for blank detections at the end of this sheet.
Method Blanks	• One MB per analytical batch, association to samples is clear	See qualification table for blank detections at the end of this sheet.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt
Initial Calibration	• Verify proper IC frequency and sequence • See EPA Method 353.2 for all evaluation criteria. • The acceptance criterion for the calibration curve should be a correlation coefficient of 0.99 or higher.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results.
Initial Calibration Verification	• Once after each IC, analysis of a second standard prior to sample analysis. • Percent recovery shall be 90-110%	If ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. The acceptance criteria for the ICV standard must be no greater than ± 10% of its true value.

Parameter	Evaluation Criteria	Flagging Criteria
Continuing Calibration Verification	• Daily before sample analysis, every 10 samples, and at the end of the analytical run. • Percent recovery shall be 90-110%	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Qualify %recovery exceedances as estimated (J/UJ).
Laboratory Control Sample (LCS)	• Use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)	• The acceptance criteria for the MS must be no greater than ± 30% percent recovery of its true value. • The RPD for the MS/MSD pair must be no greater than ± 15% RPD.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Duplicate Sample	• The acceptance criteria for the duplicate sample must be no greater than ± 15% RPD.	Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.

Parameter	Evaluation Criteria	Flagging Criteria
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code "B" with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

ICP-AES Metals by Method 6010C

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.

Parameter	**Evaluation Criteria**	**Flagging Criteria**
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • Preserved with HNO_3 to pH<2 • See EPA ICP-AES NFGs (2014) Section I Subsections C and D for more information.	If water samples not preserved in the field (or by the laboratory within 48 hours of sample collection), use professional judgment. Consider qualifying detections as estimated (J) and non-detections as rejected (R). Temperature exceeds 6°C, but less than 10°C, use professional judgment. The EPA method does not have a temperature preservation requirement for ICP-AES metals. Temperature equal to or exceeds 10°C, qualify all results as estimated (J/UJ). Use Section I/Subsection E and Table 2 of the EPA ICP-AES NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.
Holding Time	• Analysis holding times met o Waters: 180 days pres. to pH<2 o If not preserved in the field, lab has 48 hours to preserve o Soils: 180 days	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For further guidance, use Section I and Table 2 of the EPA ICP-AES NFGs (2014) and/or professional judgment on holding time issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).

Parameter	Evaluation Criteria	Flagging Criteria
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section III and Table 5 in the EPA ICP-AES NFGs (2014).
Source Water Blanks	• One per investigation as needed	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section III and Table 5 in the EPA ICP-AES NFG (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ • Common contaminants not detected > LOQ.	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration (ICAL)	• Daily ICAL prior to sample analysis • If more than one calibration standard is used, $r^2 \geq 0.99$. • See EPA ICP-AES NFGs (2014) Section II Subsection C and D for all evaluation criteria.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Use Section II/Subsection E of the EPA ICP-AES NFG (2014) including Table 4 and/or professional judgement on other IC issues.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. All reported analytes within ± 10% of true value.	If ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as "J" and non-detections as "UJ". Consider rejecting results. Use Section II of the EPA ICP-AES NFG (2014) including Tables 3 and 4 and/or professional judgement on other ICV issues.
Low-level Calibration Check Standard	• Daily • All reported analytes within ± 20% of true value.	If Low-Level ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as "J" and non-detections as "UJ". Consider rejecting results.
Continuing Calibration Verification (CCV)	• Every 10 field samples, and at the end of the analytical run. All reported analytes within ± 10% of true value.	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as "J" and non-detections as "UJ". Use Section II/Subsection E of the EPA ICP-AES NFG (2014) including Tables 3 and 4 and/or professional judgement on other CCV issues.
Initial and Continuing Calibration Blanks (ICB/CCB)	• Before beginning an analytical run, every 10 samples, and at the end of the run • No analytes detected > LOD	See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.

Parameter	Evaluation Criteria	Flagging Criteria
Interference Check Sample	• ICS-A: Absolute value of non-spiked project analytes < LOD • ICS-AB: Recovery ± 20% of true value ICS-AB is not required if instrument can read negative responses	Qualify all results as estimated (J/UJ). Consider rejecting results if ICA requirements are significantly exceeded (e.g., ICS-AB %R < 50%). As needed, qualify data using Section IV/Subsection E and Table 6 of the EPA ICP-AES NFGs (2014).
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is ≤ 20% (Worksheet #12) Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section VII/Subsection E and Table 9 of the EPA ICP-AES NFGs (2014) for further guidance.

Parameter	Evaluation Criteria	Flagging Criteria
Laboratory Duplicate Sample	• Not required, but will be evaluated if performed If no project-specific limits are available, use the acceptability windows in the EPA ICP-AES NFGs for duplicate samples in Section VI/Subsections C and D and Table 8 or use in-house laboratory LCS limits.	For the specific analyte in the parent sample, qualify data using Section VI/Subsection E and Table 8 of the EPA ICP-AES NFGs (2014).
Serial Dilution/Dilution Test	• One per prep batch, if MS or MSD fails. • Five-fold dilution must agree within 10% of the original measurement • As needed, use the EPA ICP-AES NFGs (2014) Section VIII/Subsections C and D.	Qualify results in the parent sample as estimated (J/UJ). As needed, use Section VIII, Subsection E, Table 10 of the EPA ICP-AES NFGs (2014) for guidance.
Recalculation of Results (EPA Stage 3/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA ICP-AES NFGs (2014) – EPA National Functional Guidelines for Inorganic Methods Data Review – ICP-AES Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Blank Result	Sample Result	Action
Result ≤ negative DL, but ≥ negative LOQ	Detection or non-detection	Qualify all results as estimated (J/UJ) based on professional judgment (reason code Q).
Result < negative LOQ	Non-detection	Qualify non-detections as rejected (R) based on professional judgment (reason code Q). Use professional judgment if rejection is not warranted.
	All detections	Qualify all results as estimated (J/UJ) based on professional judgment (reason code Q). Use professional judgment for sample detections significantly higher than the LOQ (which may not be impacted by negative blank detection).

Notes:

Use 4x for common laboratory contaminants. If available, common lab contaminants will be defined in the QAPP Worksheet #15.

Only use the reason code "B" with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

ICP-MS (Metals) by Method 6020A

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • Preserved with HNO_3 to pH<2	If water samples not preserved in the field (or by the laboratory within 48 hours of sample collection), use professional judgment. Consider qualifying detections as estimated (J) and non-detections as rejected (R). Temperature exceeds 6°C, but less than 10°C, use professional judgment. The EPA method does not have a temperature preservation requirement for ICP-MS metals. Temperature equal to or exceeds 10°C, qualify all results as estimated (J/UJ). Use Section I Subsections C, D, and E and Table 2 of the EPA ICP-AES NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.
Holding Time	• Analysis holding times met o Waters: 180 days pres. to pH<2 o If not preserved in the field, lab has 48 hours to preserve o Soils: 180 days	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For further guidance, use Section I and Table 11 of the EPA ICP-MS NFGs (2014) and/or professional judgment on holding time issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).

Parameter	Evaluation Criteria	Flagging Criteria
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected.	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section IV and Table 15 in the EPA ICP-MS NFGs (2014).
Source Water Blanks	• One per investigation as needed.	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section IV and Table 15 in the EPA ICP-MS NFG (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ • Common contaminants not detected > LOQ.	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.

Parameter	Evaluation Criteria	Flagging Criteria
Tune Analysis	• Mass calibration ≤ 0.1 amu from the true value • Resolution < 0.9 amu full width at 10% peak height.	Consider rejecting all results if tuning criteria not met. Use Section II/Subsections C, D, and E of the EPA ICP-MS NFG (2014) including Table 12 and/or professional judgement on other tuning issues.
Initial Calibration (ICAL)	• Daily ICAL prior to sample analysis • If more than one calibration standard is used, $r^2 \geq 0.99$.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Use Section III Subsections C, D, and E of the EPA ICP-MS NFG (2014) including Table 14 and/or professional judgement on other ICAL issues.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • All reported analytes within ± 10% of true value.	If ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as “J” and non-detections as “UJ”. Consider rejecting results. Use Section III Subsection E of the EPA ICP-MS NFG (2014) including Table 14 and/or professional judgement on other ICV issues.
Low-level Calibration Check Standard	• Daily • All reported analytes within ± 20% of true value.	If Low-Level ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as “J” and non-detections as “UJ”. Consider rejecting results.
Continuing Calibration Verification (CCV)	• Every 10 field samples, and at the end of the analytical run. • All reported analytes within ± 10% of true value.	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as “J” and non-detections as “UJ”. Use Section III Subsection E of the EPA ICP-MS NFG (2014) including Table 14 and/or professional judgement on other CCV issues.

Parameter	**Evaluation Criteria**	**Flagging Criteria**
Initial and Continuing Calibration Blanks (ICB/CCB)	• Before beginning an analytical run, every 10 samples, and at the end of the run • No analytes detected > LOD	See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Internal Standards	• Every sample, standard and QC sample • 30-120% of intensity of the IS in the ICAL blank.	Samples suspected of matrix interference (e.g., QC sample IS recoveries within control limits) should be reanalyzed at sequential 5x dilutions until criteria are met or an alternate IS should be selected. For futher guidance, use Section X and Table 21 of the EPA ICP-MS NFGs (2014) for guidance.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits or for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is ≤ 20% (Worksheet #12) • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section VIII Subsections C, D, and E and Table 19 of the EPA ICP-MS NFGs (2014) for further guidance.
Laboratory Duplicate Sample	• Not required, but will be evaluated if performed • If no project-specific limits are available, use the acceptability windows in the EPA ICP-MS NFGs for duplicate samples in Section VII Subsections C and D and Table 18 or use in-house laboratory LCS limits.	For the specific analyte in the parent sample, qualify data as estimated (J/UJ) using Section VII Subsection E and Table 18 of the EPA ICP-MS NFGs (2014).
Serial Dilution/Dilution Test	• One per prep batch, if MS or MSD fails. • Five-fold dilution must agree within 10% of the original measurement.	Qualify results in the parent sample as estimated (J/UJ). As needed, use Section IX, Subsections C, D, and E, Table 20 of the EPA ICP-MS NFGs (2014) for guidance.
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Internal Standards o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.

Parameter	Evaluation Criteria	Flagging Criteria
Manual Integrations	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA ICP-MS NFGs (2014) – EPA National Functional Guidelines for Inorganic Methods Data Review – ICP-MS Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)
Result ≤ negative DL, but ≥ negative LOQ	Detection or non-detection	Qualify all results as estimated (J/UJ) based on professional judgment (reason code Q).
Result < negative LOQ	Non-detection	Qualify non-detections as rejected (R) based on professional judgment (reason code Q). Use professional judgment if rejection is not warranted.
	All detections	Qualify all result as estimated (J/UJ) based on professional judgment (reason code Q). Use professional judgment for sample detections significantly higher than the LOQ (which may not be impacted by negative blank detection).

Notes: Use 4x for common laboratory contaminants. If available, common lab contaminants will be defined in the QAPP Worksheet #15.

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Perchlorate by Method 6850 or 6860

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. Use professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria

Holding Time	• Extraction and analysis holding times met
	  o Waters: 28 days to analysis
	  o Soils: 28 days to analysis
		If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ).
		
		If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted.
		
		Use professional judgment on other sample integrity and preservation issues.

Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Results reported from methanol vials have MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Field Duplicates	• Minimum frequency of 1 per 20 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment Blanks (EB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	See qualification table for blank detections at the end of this sheet. As needed, qualify data using professional judgment.
Source Water Blanks	• One per investigation as needed.	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using professional judgment.

Parameter	**Evaluation Criteria**	**Flagging Criteria**
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt
Tune Check	• Prior to ICAL and after any mass calibration or maintenance is performed. • Tuning standards must span the mass range of the analytes of interest and meet acceptance criteria outlined in the method.	If tune check not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results.
Initial Calibration	• Prior to sample analysis Acceptance Criteria options: Option 1: RSD for each analyte $\leq$ 15% Option 2: Linear least squares regression for each analyte: $r^2 \geq 0.995$	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Use Section III of the EPA Semivolatiles NFGs (2014) including Tables 30 and 31 and/or professional judgment on other IC issues.
Initial Calibration Verification	• Once after each ICAL, analysis of a second standard prior to sample analysis. • All analytes within ±15% recovery of true value	If ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. If the lab reported % recovery exceedances for the CCV, qualify as follows: Qualify data "J" for detects and "UJ" for non-detects.
Continuing Calibration Verification	• Daily before sample analysis (unless immediately after ICAL and ICV), every 10 hours, and at the end of the analytical run. • All reported analytes and surrogates within ±15% recovery of true value	If the lab reported % recovery exceedances for the CCV, qualify as follows: Qualify data "J" for detects and "UJ" for non-detects.

Parameter	Evaluation Criteria	Flagging Criteria
Internal Standards	• Added to all samples and blanks at the specified concentration. The internal standard solution must contain all internal standard compounds specified in the method. • Measured ^{18}O IS area must be within + 50% for the average of the IS area counts of the ICAL and the RRT of the perchlorate ion must be 0.98-1.02. If peak is not within retention time window, presence is not confirmed.	As needed, qualify data using Section IX and Table 40 in the EPA Semivolatiles NFGs (2014).
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12. •	%R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)/Matrix Spike Duplicate (MSD)	• Use the acceptability windows in the in-house laboratory MS limits. See QAPP Worksheet #15. • RPD limit is provided in QAPP Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Isotope Ratio. $^{35}CI/^{37}CI$ (If tandem MS, this monitors both the parent ion at masses 99/101 and the daughter ion at masses 83/85)	• 2.3 - 3.8	For the specific sample, qualify data using professional judgement.
Interference Check Sample	• The percent recovery shall be 80-120%	Qualify data "J" for detects and "UJ" for non-detects.
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the positively identified target analyte mass spectrum does not meet the specified criteria, qualify the detect as "R" unusable or report the result at LOQ and qualify and non-detect ("U"). As needed, use Section IX of the EPA Trace VOA NFGs (2014) for guidance.
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Internal Standards o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g. before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code "B" with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Mercury by Methods 7470A/7471B

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody (COCs)/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • Preserved with HNO_3 to pH<2	If water samples not preserved in the field (or by the laboratory within 48 hours of sample collection), use professional judgment. Consider qualifying detections as estimated (J) and non-detections as rejected (R). Temperature exceeds 6°C, but less than 10°C, use professional judgment. The EPA method does not have a temperature preservation requirement for ICP-AES metals. Temperature equal to or exceeds 10°C, qualify all results as estimated (J/UJ). Use Section I Subsections C, D, and E and Table 22 of the EPA MERCURY NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.
Holding Time	• Analysis holding times met o Waters: 28 days pres. to pH<2 o If not preserved in the field, lab has 48 hours to preserve o Soils: 28 days	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For further guidance, use Section I and Table 22 of the EPA MERCURY NFGs (2014) and/or professional judgment on holding time issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).

Parameter	Evaluation Criteria	Flagging Criteria
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section III Subsection E and Table 25 in the EPA MERCURY NFGs (2014).
Source Water Blanks	• One per investigation as needed	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section III and Table 25 in the EPA MERCURY NFG (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ • Common contaminants not detected > LOQ.	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration (ICAL)	• Daily ICAL prior to sample analysis • $r^2 \geq 0.99$.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Use Section II Subsections C, D, and E of the EPA MERCURY NFG (2014) including Table 24 and/or professional judgement on other IC issues.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • All reported analytes within ± 10% of true value.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as "J" and non-detections as "UJ". Consider rejecting results. Use Section II of the EPA MERCURY NFG (2014) including Table 24 and/or professional judgement on other ICV issues.
Low-level Calibration Check Standard	• Daily • All reported analytes within ± 20% of true value.	If Low-Level ICV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as "J" and non-detections as "UJ". Consider rejecting results.
Continuing Calibration Verification (CCV)	• Every 10 field samples, and at the end of the analytical run. • All reported analytes within ± 10% of true value.	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %R is outside control limits, qualify all detections as "J" and non-detections as "UJ". Use Section II Subsections C, D, and E of the EPA MERCURY NFG (2014) including Table24 and/or professional judgment on other CCV issues.
Initial and Continuing Calibration Blanks (ICB/CCB)	• Before beginning an analytical run, every 10 samples, and at the end of the run • No analytes detected > LOD.	See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.

Parameter	Evaluation Criteria	Flagging Criteria
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is ≤ 20% (Worksheet #12) • Do not qualify based on MS/MSDs from another client and/or state.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section V Subsections C, D, and E and Table 27 of the EPA MERCURY NFGs (2014) for further guidance.
Laboratory Duplicate Sample	• Not required, but will be evaluated if performed • If no project-specific limits are available, use the acceptability windows in the EPA MERCURY NFGs for duplicate samples in Section IV/Subsections C and D and Table 8 or use in-house laboratory LCS limits.	For the specific analyte in the parent sample, qualify data using Section IV Subsection E and Table 26 of the EPA MERCURY NFGs (2014).

Parameter	Evaluation Criteria	Flagging Criteria
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA Mercury NFGs (2014) – EPA National Functional Guidelines for Inorganic Methods Data Review – Mercury Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)
Result ≤ negative DL, but ≥ negative LOQ	Detection or non-detection	Qualify all results as estimated (J/UJ) based on professional judgment (reason code Q).
Result < negative LOQ	Non-detection	Qualify non-detections as rejected (R) based on professional judgment (reason code Q). Use professional judgment if rejection is not warranted.
	All detections	Qualify all result as estimated (J/UJ) based on professional judgment (reason code Q). Use professional judgment for sample detections significantly higher than the LOQ (which may not be impacted by negative blank detection).

Notes:

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Pesticides by Method 8081B

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. Use Section I and Table 42 and 43 of the EPA Pesticides NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria
Holding Time	• Extraction and analysis holding times met o Waters: 7 days to extraction; 40 days to analysis. o Soils: 14 days to extraction; 40 days to analysis	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For further guidance, use Section I and Tables 42 and 43 of the EPA Pesticides NFGs (2014) and/or professional judgment on holding time issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Confirmation of Positive Results (2nd column)	• All detections must be confirmed. • Report results from the primary column. • RPD ≤ 40% between primary and secondary column.	If RPD > 40% between primary and secondary column, qualify all results as estimated (J/UJ); use professional judgment if RPD limit is grossly exceeded (e.g., consider reporting the higher of the two detections as the final result).
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).

Parameter	Evaluation Criteria	Flagging Criteria
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section IV and Table 54 in the EPA Pesticides NFGs (2014).
Source Water Blanks	• One per investigation as needed.	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Table 54 in the EPA Pesticides NFG (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 54 in the EPA Pesticides NFGs (2014).
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt
GC ECD Instrument Performance Check	• At the beginning of every ICAL sequence on each GC column and instrument • Resolution requirements are in the analytical method	Consider rejecting all results if IPC requirements in the method are not met. For further guidance, use Section II and Tables 44, 45, 46, 47, and 48 of the EPA Pesticides NFGs (2014) and/or professional judgment on other IPC issues.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration (ICAL)	• Prior to sample analysis and after ICV or CCV failure • Each analyte must meet one of three options: o RSD ≤20% for each analyte o Linear least squares regression, $r^2 \geq 0.99$ (min 5 standards) o Non-linear least squares regression, $r^2 \geq$ 0.99 (min 6 standards)	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %RSD > 20% or r^2 < 0.99 or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results. Use Section III of the EPA Pesticides NFG (2014) including Tables 49, 50, 51, and 52 and/or professional judgement on other IC issues.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • All analytes within ±20%D of true value.	If ICV not performed at specified frequency and sequence and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as "J" and non-detections as "UJ". Use Section III of the EPA Pesticides NFG (2014) including Tables 49, 50, 51, and 52 and/or professional judgement on other ICV issues.
Continuing Calibration Verification (CCV)	• Daily before sample analysis, every 12 hours, and at the end of the analytical run. • All reported analytes and surrogates within ±20%D	%D > 20%, qualify all detections as "J" and non-detections as "UJ". Use Section IV of the EPA Pesticides NFG (2014) including Table 53 and/or professional judgement on other CCV issues.
4,4'-DDT/Endrin Breakdown Check	• Prior to sample analysis and at the beginning of each 12-hr shift • Degradation for each (DDT and Endrin) ≤15%.	Flagging is not appropriate. Consider rejecting results; also review Section II and Table 48 of the EPA Pesticides NFGs (2014) for further guidance.

Parameter	Evaluation Criteria	Flagging Criteria
Surrogate Spike	• Use the QSM Appendix C QC limits, when available. Otherwise use in-house laboratory limits. See QAPP Worksheet #12.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as "J" and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as "J" and non-detections as "UJ". Surrogate %R < 10%, qualify detections as "J" and non-detections as "R". As needed, use Section VI and Table 55 of the EPA Pesticides NFGs (2014) for guidance.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limits is provided in Worksheet #12.	Qualify using evaluation criteria presented in Section VIII %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section VII and Table 57 of the EPA Pesticides NFGs (2014) for further guidance.
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the positively identified target analyte mass spectrum does not meet the specified criteria, qualify the detect as “R” unusable or report the result at LOQ and qualify and non-detect (“U”). As needed, use Section IX of the EPA Pesticides NFGs (2014) for guidance.
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.

Parameter	Evaluation Criteria	Flagging Criteria
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA Pesticides NFGs (2014) – EPA National Functional Guidelines for Organic Methods Data Review – Trace Volatile Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code "B" with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Aroclors by Method 8082A

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • See EPA Arochlor NFGs (2014) Section I Subsections C and D for more information.	Temperature exceeds 6°C, if samples are extracted within 7 days (waters) or 14 days (soils), no qualification. If temperature exceeds 6°C and holding time exceeds 7 or 14 days, then qualify all results as estimated (J/UJ). For further guidance, use Section I and Table 64 of the EPA Aroclor NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria

Holding Time	• Extraction and analysis holding times met
	  o Waters: 7 days to extraction; 40 days to analysis.
	  Soils:
	  o 14 days to extraction; 40 days to analysis.
	  o Note that under proper preservation (dark, cool), PCBs are stable up to a year.
		If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If proper preservation was maintained, do not qualify based on extraction holding time if performed within one year of sampling.
		If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted.
		For further guidance, use Section I and Table 64 of the EPA Aroclor NFGs (2014) and/or professional judgment on holding time issues.

Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Confirmation of Positive Results (2nd column)	• All detections must be confirmed. • Report results from the primary column. • RPD ≤ 40% between primary and secondary column.	If RPD > 40% between primary and secondary column, qualify all results as estimated (J/UJ); use professional judgment if RPD limit is grossly exceeded (e.g., consider reporting the higher of the two detections as the final result).
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).

Parameter	Evaluation Criteria	Flagging Criteria
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section IV and Table 68 in the EPA Aroclor NFGs (2014).
Source Water Blanks	• One per investigation as needed.	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section IV and Table 68 in the EPA Aroclor NFG (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. As needed, qualify data using Section IV and Table 68 in the EPA Aroclor NFGs (2014). See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt
Initial Calibration (ICAL)	• Prior to sample analysis and after ICV or CCV failure • Each analyte must meet one of three options: o RSD ≤20% for each analyte o Linear least squares regression, $r^2 \geq 0.99$ (min 5 standards) o Non-linear least squares regression, $r^2 \geq 0.99$ (min 6 standards)	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %RSD > 20% or $r^2 < 0.99$ or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results. Use Section II of the EPA Aroclor NFG (2014) including Table 66 and/or professional judgement on other ICAL issues.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. All analytes within ±20%D of true value.	If ICV not performed at specified frequency and sequence, and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as "J" and non-detections as "UJ". Use Section III of the EPA Aroclor NFG (2014) including Table 67 and/or professional judgement on other ICV issues.
Continuing Calibration Verification (CCV)	• Daily before sample analysis, every 12 hours, and at the end of the analytical run. • All reported analytes and surrogates within ±20%D	%D > 20%, qualify all detections as "J" and non-detections as "UJ". Use Section III of the EPA Aroclor NFG (2014) including Table 67 and/or professional judgement on other CCV issues.
Surrogate Spike	• Use the QSM Appendix C QC limits, when available. Otherwise, use in-house laboratory limits. See QAPP Worksheet #12.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as "J" and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as "J" and non-detections as "UJ". Surrogate %R < 10%, qualify detections as "J" and non-detections as "R". As needed, use Section V and Table 69 of the EPA Aroclor NFGs (2014) for guidance.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limits is provided in Worksheet #12.	Qualify using evaluation criteria presented in Section VII %R <10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section VI and Table71 of the EPA Aroclor NFGs (2014) for further guidance.
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the qualitative criteria for both columns are not met, report the result at the LOQ and qualify as a non-detect ("U"). As needed, use Section XI Sections C, D, and E of the EPA Aroclor NFGs (2014) for guidance.
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.

Parameter	Evaluation Criteria	Flagging Criteria
GPC Performance Check	• Only DoD QSM and method requirements apply. • For general guidance, use the EPA Aroclor NFGs (2014) Section VIII Sections C and D.	Use professional judgment. For guidance, use Section VIII and Table 74 of the EPA Aroclor NFGs (2014) to qualify data.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA Aroclor NFGs (2014) – EPA National Functional Guidelines for Organic Methods Data Review – Aroclors Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Herbicides by Method 8151A

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections.
Holding Time	• Extraction and analysis holding times met o Waters: 7 days to extraction; 40 days to analysis. Soils: o 14 days to extraction; 40 days to analysis.	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For other holding time issues, use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Confirmation of Positive Results (2nd column)	• All detections must be confirmed. • Report results from the primary column. • RPD ≤ 40% between primary and secondary column.	If RPD > 40% between primary and secondary column, qualify all results as estimated (J/UJ); use professional judgment if RPD limit is grossly exceeded (e.g., consider reporting the higher of the two detections as the final result).
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet.
Source Water Blanks	• One per investigation as needed.	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet.

Parameter	Evaluation Criteria	Flagging Criteria
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.
Initial Calibration (ICAL)	• Prior to sample analysis and after ICV or CCV failure • Each analyte must meet one of three options: o RSD ≤20% for each analyte o Linear least squares regression, $r^2 \geq 0.99$ (min 5 standards) o Non-linear least squares regression, $r^2 \geq 0.99$ (min 6 standards)	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %RSD > 20% or $r^2 < 0.99$ or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results. Use professional judgement on other ICAL issues.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • All analytes within ±20%D of true value.	If ICV not performed at specified frequency and sequence, and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as “J” and non-detections as “UJ”. Use professional judgement on other ICV issues.
Continuing Calibration Verification (CCV)	• Daily before sample analysis, every 12 hours, and at the end of the analytical run. • All reported analytes and surrogates within ±20%D	%D > 20%, qualify all detections as “J” and non-detections as “UJ”. Use professional judgement on other CCV issues.

Parameter	Evaluation Criteria	Flagging Criteria
Surrogate Spike	• Use the QSM Appendix C QC limits, when available. Otherwise, use in-house laboratory limits. See QAPP Worksheet #12.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as "J" and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as "J" and non-detections as "UJ". Surrogate %R < 10%, qualify detections as "J" and non-detections as "R". Use professional judgment on other surrogate issues.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limits is provided in Worksheet #12.	Qualify using evaluation criteria presented in Section VII %R <10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the qualitative criteria for both columns are not met, qualify as a non-detect ("U").
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:
DoD QSM Version 5.0 (July 2013)

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes: Only use the reason code "B" with the validation flag U (or UJ if other parameters are exceeded).
Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Volatile Organic Compounds by Method 8260B

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody (COCs)/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Sample containers have proper acid preservative (HCl, Na_2SO_4 or methanol) and are within pH requirements • Custody seals present and intact • Absence of headspace for aqueous samples	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. If aqueous VOC samples arrive with headspace less than pea-size (1/4”), no flags. If VOC samples arrive with headspace greater than pea-size (1/4”), qualify all results as estimated (J/UJ). Use Section I and Table 2 of the EPA Trace VOA NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria
Holding Time	• Extraction and analysis holding times met o Waters: 7 days unpres. 14 days pres. o Soils (Terracores/EnCores): 48 hrs unpres. 14 days pres. o Soils (jars): 14 days	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For further guidance, use Section I and Table 2 of the EPA Trace VOA NFGs (2014) and/or professional judgment on holding time issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Results reported from methanol vials have MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Trip Blanks (TB)	• One per cooler containing investigative VOC samples • No analytes detected • Common lab contaminants will use 2x the LOQ as the comparison criterion.	See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 7 in the EPA Trace VOA NFGs (2014).

Parameter	Evaluation Criteria	Flagging Criteria
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 7 in the EPA Trace VOA NFGs (2014).
Source Water Blanks	• One per investigation as needed.	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Table 7 in the EPA Trace VOA NFG (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ • Common contaminants not detected > LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 7 in the EPA Trace VOA NFGs (2014).
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.
GC/MS Instrument Performance Check	• Prior to ICAL and prior to each 12-hour period of sample analysis • Specific ion abundance criteria of BFB from method.	Consider rejecting all results if tuning criteria not met. Use Section II and Table 3 of the EPA Trace VOA NFGs (2014) and/or professional judgment on other IPC issues.

Parameter	Evaluation Criteria	Flagging Criteria

Initial Calibration (ICAL)	• Prior to sample analysis
	• Minimum RRF is 0.010[2] for each analyte.
	• Each analyte must meet one of three options:
	  o RSD ≤15% for each analyte
	  o Linear least squares regression, $r^2 \geq$ 0.99 (min 5 standards)
	  o Non-linear least squares regression, $r^2 \geq$ 0.99 (min 6 standards)
	• Additional RF criteria listed in method.
		If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results.
		If RRF < minimum RRF as specified by the method, use professional judgment to qualify results. Consider rejecting results.
		%RSD > 15% or r^2 < 0.99 or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results.
		Use Section III of the Trace VOA NFG (2014) Table 5 and/or professional judgement on other IC issues.

Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • Equal to or less than the midpoint of the calibration range. • All analytes within ±20%D of true value.	If ICV not performed at specified frequency and sequence and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as "J" and non-detections as "UJ". Use Section IV of the Trace VOA NFG (2014) Table 6 and/or professional judgement on other ICV issues.
Continuing Calibration Verification (CCV)	• Daily before sample analysis (unless immediately after ICAL and ICV), every 12 hours, and at the end of the analytical run. • All reported analytes and surrogates within ±20%D • All reported analytes and surrogates within ±50%D for end of analytical run CCV.	%D > 20%, qualify all detections as "J" and non-detections as "UJ". If no closing CCV is reported, use professional judgment. Consider rejecting all results. Use Section IV of the Trace VOA NFG (2014) Table 6 and/or professional judgement on other CCV issues.

Parameter	Evaluation Criteria	Flagging Criteria
Internal Standards	• Added to all samples and blanks; must contain all internal standard compounds specified in the method. • Area response of each internal standard compound in all samples and blanks must be within the inclusive ranges of -50% - 200% of the area response of the same internal standard compound from the associated opening CCV or the mid-point standard CS3 from the associated ICAL. • The RT of the internal standard compound in the sample or blank must not vary more than ±10.0 seconds from the RT of the same internal standard compound in the associated opening CCV or mid-point standard CS3 from the associated ICAL.	Area response < 20%, qualify detections as "J" and non-detections as "R". 20% ≤ Area response < 50%, qualify detections as "J" and non-detections as "UJ". Area response > 200%, qualify detections as "J" and do not qualify non-detections. RT shift > 10.0 seconds, reject all associated results. As needed, qualify data using Section VIII and Table 13 of the Trace VOA NFGs (2014).
Surrogate Spike (or DMC)	• Use the QSM Appendix C QC limits, when available. Otherwise, use in-house laboratory limits. See QAPP Worksheet #12.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as "J" and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as "J" and non-detections as "UJ". Surrogate %R < 10%, qualify detections as "J" and non-detections as "R". As needed, use Section VI and Table 9 and 10 of the EPA Trace VOA NFGs (2014) for guidance.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in QAPP Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section VII and Table 12 of the EPA Trace VOA NFGs (2014) for further guidance.
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the positively identified target analyte mass spectrum does not meet the specified criteria, qualify the detect as "R" unusable or report the result at LOQ and qualify and non-detect ("U"). As needed, use Section IX of the EPA Trace VOA NFGs (2014) for guidance.
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Internal Standards o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g. before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.

Parameter	Evaluation Criteria	Flagging Criteria
Tentatively Identified Compounds (TICs) (if applicable on project).	• Follow EPA NFGs Trace VOA discussion on pages 45-47. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	For the specific analyte in the parent sample, qualify data using Section XI of the EPA Trace VOA NFGs (2014). Use only J or UJ validation flags (not NJ).
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA Trace VOA NFGs (2014) – EPA National Functional Guidelines for Organic Methods Data Review – Trace Volatile Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Use 4x for common laboratory contaminants. Common lab contaminants may be defined in the QAPP Worksheet #15; otherwise, default to methylene chloride, acetone and 2-butanone (MEK).

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Semi-Volatile Organic Compounds by Method 8270D

Polynuclear Aromatic Hydrocarbons by Method 8270D SIM

Parameter	**Evaluation Criteria**	**Flagging Criteria**
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody (COCs)/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. Use Section I and Table 27 of the EPA Semi-volatiles NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria
Holding Time	• Extraction and analysis holding times met o Waters: 7 days to extraction, 40 days to analysis o Soils: 14 days to extraction, 40 days to analysis	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. For further guidance, use Section I and Tables 27 and 28 of the EPA Semi-volatiles NFGs (2014) and/or professional judgment on other sample integrity and preservation issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Results reported from methanol vials have MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Field Duplicates (FD)	• Minimum frequency of 1 per 20 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 33 in the Semi-volatiles NFGs (2014).

Parameter	Evaluation Criteria	Flagging Criteria
Source Water Blanks	• One per investigation as needed.	If laboratory is providing source water, laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 33 in the Semi-volatiles NFGs (2014).
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ • Common contaminants not detected > LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet. As needed, qualify data using Section V and Table 33 in the Semi-volatiles NFGs (2014).
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.
GC/MS Instrument Performance Check	• Prior to ICAL and prior to each 12-hour period of sample analysis • Specific ion abundance criteria of DFTPP from method.	Consider rejecting all results if tuning criteria not met. Use Section II and Table 29 of the EPA Semi-volatiles NFGs (2014) to qualify data and/or use professional judgment for other IPC issues.
Initial Calibration (ICAL)	• Prior to sample analysis • Minimum RRF is 0.010[2] for each analyte. • Each analyte must meet one of three options: o RSD ≤15% for each analyte o Linear least squares regression, $r^2 \geq 0.99$ (min 5 standards) o Non-linear least squares regression, $r^2 \geq 0.99$ (min 6 standards) • Additional RF criteria listed in method.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. If RRF < minimum RRF as specified by the method, use professional judgment to qualify results. Consider rejecting results. %RSD > 15% or $r^2 < 0.99$ or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results. Use Section III of the EPA Semi-volatiles NFGs (2014) Table 31 and/or professional judgment on other IC issues.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • Equal to or less than the midpoint of the calibration range. • All analytes within ±%D of true value listed on Table 30 of the EPA Semi-volatile NFGs.	If ICV not performed at specified frequency and sequence and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as “J” and non-detections as “UJ”. For further guidance or for other ICV issues, use Section III of the EPA Semi-volatiles NFGs (2014) including Table 31 and/or professional judgment.
Continuing Calibration Verification (CCV)	• Daily before sample analysis (unless immediately after ICAL and ICV), every 12 hours, and at the end of the analytical run. • All reported analytes and surrogates within ±%D listed in Table 30 of the EPA NFGs SVOAs. • All reported analytes and surrogates within ±%D for end of analytical run CCV as listed on Table 30 of the EPA Semi-volatile NFGs.	%D > 20%, qualify all detections as “J” and non-detections as “UJ”. If no closing CCV is reported, use professional judgment. Consider rejecting all results. For further guidance or for other CCV issues, use Section IV of the EPA Semi-volatiles NFGs (2014) including Table 32 and/or professional judgment.
Internal Standards	• Added to all samples and blanks; must contain all internal standard compounds specified in the method. • Area response of each internal standard compound in all samples and blanks must be within the inclusive ranges of 50% - 200% of the area response of the same internal standard compound from the associated opening CCV or the mid-point standard CS3 from the associated ICAL. • The RT of the internal standard compound in the sample or blank must not vary more than ±10.0 seconds from the RT of the same internal standard compound in the associated opening CCV or mid-point standard CS3 from the associated ICAL.	Area response < 20%, qualify detections as “J” and non-detections as “R”. 20% ≤ Area response < 50%, qualify detections as “J” and non-detections as “UJ”. Area response > 200%, qualify detections as “J” and do not qualify non-detections. RT shift > 10.0 seconds, reject all associated results. As needed, qualify data using Section IX and Table 40 in the EPA Semi-volatiles NFGs (2014).

Parameter	Evaluation Criteria	Flagging Criteria
Surrogate Spike (or DMC)	• Use the QSM Appendix C Limits for acceptability windows or the limits presented in Table 34 of the EPA Semi-volatile NFGs (2014) or use the in-house laboratory surrogate spike limits.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as “J” and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as “J” and non-detections as “UJ”. Surrogate %R < 10%, qualify detections as “J” and non-detections as “R”. As needed, use Section VI and Tables 35, 36, and 37 of the EPA Semi-volatiles NFGs (2014) for guidance.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS) / Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in QAPP Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section VII and Table 39 in the EPA Semi-volatiles NFGs (2014) for further guidance.
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the positively identified target analyte mass spectrum does not meet the specified criteria, qualify the detect as "R" unusable or report the result at LOQ and qualify and non-detect ("U"). For the specific analyte in the parent sample, qualify data using Section X and XI of the EPA Semi-volatiles NFG (2014). See Table 41 for discussion regarding samples with low percent solids.
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Internal Standards o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.

Parameter	Evaluation Criteria	Flagging Criteria
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration.	Not applicable. Laboratory must meet the manual integration requirements.
Tentatively Identified Compounds (TICs) (if applicable on project).	• Verify the laboratory has conducted their due diligence regarding TICs • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	For the specific analyte in the parent sample, qualify data using Section XII of the EPA Semi-volatiles NFG (2014). Use only J or UJ validation flags (not NJ).
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA Semi-volatiles NFG (2014) – EPA National Functional Guidelines for Superfund Organic Methods Data Review – Semi-volatile Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Use 4x for common laboratory contaminants. If available, common lab contaminants will be defined in the QAPP Worksheet #15.

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Hydrazine by Method 8315A

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody (COCs)/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. Use professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria
Holding Time	• Extraction and analysis holding times must meet: o Waters: 10 days to extraction; 28 days to analysis. o Soils: 10 days to extraction; 28 days to analysis	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. Use professional judgment on other sample integrity and preservation issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet.
Source Water Blanks	• One per investigation as needed.	See qualification table for blank detections at the end of this sheet.
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration (ICAL)	• Prior to sample analysis and after ICV or CCV failure • Each analyte must meet one of three options: o RSD ≤15% for each analyte o Linear least squares regression, $r^2 \geq 0.99$ (min 6 standards)	If ICAL not performed at specified frequency, sequence, or concentration use professional judgment to qualify results. Consider rejecting all results. %RSD > 15% or $r^2 < 0.99$ or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • All reported analytes within established RT windows. • All reported analytes within ± 30% of true value.	If ICV not performed at specified frequency and sequence and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 30%, qualify all detections as “J” and non-detections as “UJ”. RT windows not met, use professional judgment to qualify results. Consider rejecting all results.
Continuing Calibration Verification (CCV)	• Before sample analysis, after every 10 field samples, and at the end of the analysis sequence. • All reported analytes and surrogates within ± 30%D	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %D > 30%, qualify all detections as “J” and non-detections as “UJ”. RT windows not met, use professional judgment to qualify results. Consider rejecting all results.
Surrogate Spike	• Use the QSM Appendix C QC limits, when available. Otherwise, use in-house laboratory limits. See QAPP Worksheet #12.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as “J” and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as “J” and non-detections as “UJ”. Surrogate %R < 10%, qualify detections as “J” and non-detections as “R”. Use professional judgment on other surrogate issues.

Parameter	Evaluation Criteria	Flagging Criteria
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limits is provided in Worksheet #12.	Qualify using evaluation criteria presented in Section VIII %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J"and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use professional judgment on other MS/MSD issues.
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the positively identified target analyte mass spectrum does not meet the specified criteria, qualify the detect as "R" unusable or report the result at LOQ and qualify and non-detect ("U").

Parameter	Evaluation Criteria	Flagging Criteria
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Explosives by Method 8330B

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody (COCs)/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact	Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections. Use professional judgment on other sample integrity and preservation issues.

Parameter	Evaluation Criteria	Flagging Criteria
Holding Time	• Extraction and analysis holding times must meet: o Waters: 7 days to extraction; 40 days to analysis. o Soils: 14 days to extraction; 40 days to analysis	If holding time is exceeded, but less than 2x the holding time, qualify all results as estimated (J/UJ). If 2x the holding time is exceeded, reject non-detections (R) and qualify detections (J). Use professional judgment if rejection is not warranted. Use professional judgment on other sample integrity and preservation issues.
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Confirmation of Positive Results (2nd column)	• All detections must be confirmed. • Report results from the primary column. • RPD ≤ 40% between primary and secondary column.	If RPD > 40% between primary and secondary column, qualify all results as estimated (J/UJ); use professional judgment if RPD limit is grossly exceeded (e.g., consider reporting the higher of the two detections as the final result).
Field Duplicates (FD)	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks (EB/FB)	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	If frequency is not met, this will be noted in the Data Usability section of the final project report. See qualification table for blank detections at the end of this sheet.
Source Water Blanks	• One per investigation as needed.	See qualification table for blank detections at the end of this sheet.

Parameter	Evaluation Criteria	Flagging Criteria
Method Blanks (MB)	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt.
Initial Calibration (ICAL)	• Prior to sample analysis and after ICV or CCV failure • Each analyte must meet one of three options: o RSD ≤15% for each analyte o Linear least squares regression, $r^2 \geq 0.99$ (min 5 standards) o Non-linear least squares regression, $r^2 \geq 0.99$ (min 6 standards)	If ICAL not performed at specified frequency, sequence, or concentration use professional judgment to qualify results. Consider rejecting all results. %RSD > 15% or $r^2 < 0.99$ or fewer than minimum quantity of standards used, use professional judgment. Consider rejecting results.
Initial Calibration Verification (ICV)	• Once after each ICAL, analysis of a second source standard prior to sample analysis. • All reported analytes within established RT windows. • All reported analytes within ± 20% of true value.	If ICV not performed at specified frequency and sequence and by a second source, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as “J” and non-detections as “UJ”. RT windows not met, use professional judgment to qualify results. Consider rejecting all results.
Continuing Calibration Verification (CCV)	• Before sample analysis, after every 10 field samples, and at the end of the analysis sequence. • All reported analytes and surrogates within ± 20%D	If CCV not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. %D > 20%, qualify all detections as “J” and non-detections as “UJ”. RT windows not met, use professional judgment to qualify results. Consider rejecting all results.

Parameter	Evaluation Criteria	Flagging Criteria
Surrogate Spike	• Use the QSM Appendix C QC limits, when available. Otherwise, use in-house laboratory limits. See QAPP Worksheet #12.	If any surrogate is an outlier, qualify all associated target analytes. Surrogate %R > upper limit, qualify detections as “J” and do not qualify non-detections. 10% ≤ Surrogate %R < lower limit, qualify detection as “J” and non-detections as “UJ”. Surrogate %R < 10%, qualify detections as “J” and non-detections as “R”. Use professional judgment on other surrogate issues.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limits is provided in Worksheet #12.	Qualify using evaluation criteria presented in Section VIII %R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J”and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use professional judgment on other MS/MSD issues.
Aqueous Sample Preparation (waters only)	• Each sample and associated batch QC samples • SPE using resin-based solid phase disks or cartridges is required	Not appropriate; salting-out procedure is not allowed.
Soil Grinding Blank (soil only)	• Prior to grinding samples; after every 10 samples; and at the end of analytical batch • No analytes detected > ½ LOQ	Laboratory should investigate contamination source. See qualification table for blank detections at the end of this sheet.
Soil Subsampling Process (soil only)	• Each sample, duplicate, LCS and method blank • Entire ground sample is mixed, laid out on a flat surface, and 30 or more increments are removed from the entire depth to a sum of ~ 10 grams.	Not appropriate.
Soil Sample Triplicate (soil only)	• At the subsampling step, one per batch • Not performed on any blank sample • Three 10 gram subsamples • RSD for results > LOQ ≤20%.	RSD > 20% for results > LOQ; qualify detections in parent sample as estimated (J).

Parameter	Evaluation Criteria	Flagging Criteria
Target Analyte Identification (EPA Stage 4/Full validation)	• Target analyte results and sample specific LODs/LOQs must be calculated according to the correct equations. • If any discrepancies are found, contact the Project Chemist who should contact the laboratory to resolve the issue.	If the positively identified target analyte mass spectrum does not meet the specified criteria, qualify the detect as “R” unusable or report the result at LOQ and qualify and non-detect (“U”).
Recalculation of Results (EPA Stage 4/Full validation)	• Recalculate representative analyte results incorporating each of the following: o ICAL, ICV, CCV o Surrogate o LCS, MS/MSD o % moisture, dilutions	Not applicable. Laboratory should make corrections and/or provide example calculations and equations as needed.
Manual Integrations (EPA Stage 4/Full validation)	• Complete audit trail of manipulations (e.g., before and after) • Person performing manual integration must sign, date, and record rationale for performing manual integration	Not applicable. Laboratory must meet the manual integration requirements.
Electronic Data Deliverable (EDD)	• Upload validation flags and reason codes to EDD • 100% check on manual entries • 5% comparison check EDD to report.	Not applicable. These items must be corrected before submission.

Source Documents:

DoD QSM Version 5.0 (July 2013)

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code "B" with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

Data Verification Evaluation Sheet

Cyanide by Method SM 4500 or 9012

Parameter	Evaluation Criteria	Flagging Criteria
Data Package Completeness	• Case narrative present and complete (all outliers are discussed and clear explanations provided). If appropriate, documentation provided (e.g., client notification, before and after for manual integrations, etc.) • Summary forms for sample results, QC samples, and calibration are present and complete • Level IV packages: Raw data, chromatograms, manual integrations (before and after) are present and complete	Not applicable. These items must be present in each data package.
Chains of Custody/Sample Labels	• All samples listed on the COCs • Relinquished by field personnel (signed and dated) • Received by laboratory personnel (signed and dated) • Sample labels match the COCs. • Samples IDs and sample collection dates match laboratory report	Not applicable. Field crew and/or laboratory should make corrections. If sample custody cannot be determined, use professional judgment.
Sample Integrity and Preservation	• Sample temperature ≤6°C, but not frozen • Custody seals present and intact • pH≥10 • See EPA CYANIDE NFGs (2014) Section I Subsections C and D for more information.	Use Section I/Subsection E and Table 28 of the EPA CYANIDE NFGs (2014) and/or professional judgment on other sample integrity and preservation issues. Temperature exceeds 6°C, but less than 10°C, qualify all results as estimated (J/UJ). Temperature equal to or exceeds 10°C, reject (R) all NDs and estimate (J) all detections.
Holding Time	• Extraction and analysis holding times met o Waters: 14 days pres. to pH≥10 o Soils: 14 days	Use Section I and Table 28 of the EPA CYANIDE NFGs (2014) and/or professional judgment on holding time issues.

Parameter	Evaluation Criteria	Flagging Criteria
Sample Results	• Dilutions reported on the sample result forms and MDLs/LODs/LOQs adjusted correctly. • Results reported from methanol vials have MDLs/LODs/LOQs adjusted correctly. • Soils are reported on dry weight basis	Laboratory should correct errors; if errors cannot be corrected use professional judgment. Soil samples not reported as dry weight should be qualified as estimated (J/UJ).
Field Duplicates	• Minimum frequency of 1 per 10 investigative samples **and** 1 per site per matrix. • Waters: RPD for both parent and FD detections ≥ 5x the LOQ is 20%. (Worksheet #12) • Soils: RPD for both parent and FD detections ≥ 5x the LOQ is 40%. (Worksheet #12) • If either the parent or FD detection is < 5x the LOQ (including ND), calculate absolute difference. Use ± LOQ as the acceptance criterion.	If frequency is not met, this will be noted in the Data Usability section of the final project report. Qualify RPD or absolute difference exceedances as estimated (J/UJ).
Equipment/Field Blanks	• One per day per site or 1 per 10 investigative samples • Analyzed for all methods as the investigative samples • No analytes detected	As needed, qualify data using Section III/Subsection E and Table 31 in the EPA CYANIDE NFGs (2014).
Source Water Blanks	• One per investigation as needed	Laboratory should investigate contamination source. As needed, qualify data using Section III and Table 31 in the EPA CYANIDE NFG (2014).
Method Blanks	• One MB per analytical batch, association to samples is clear • No analytes detected > ½ LOQ • Common contaminants not detected > LOQ	Laboratory should investigate contamination source. As needed, qualify data using Section III and Table 31 in the EPA CYANIDE NFGs (2014). Note in the DVR whether the blank detection is above or below the LOQ.
Temperature Blanks	• One per cooler	Not applicable. Used to collect sample temperature during sample receipt

Parameter	Evaluation Criteria	Flagging Criteria
Initial Calibration	• Verify proper IC frequency and sequence • See EPA CYANIDE NFGs (2014) Section II Subsection C and D for all evaluation criteria.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Use Section II/Subsection E of the EPA CYANIDE NFG (2014) including Table 30 and/or professional judgement on other IC issues.
Initial Calibration Verification	• Once after each ICAL, analysis of a second standard prior to sample analysis. • See EPA CYANIDE NFGs (2014) Section II Subsection C and D for all evaluation criteria.	If ICAL not performed at specified frequency and sequence, use professional judgment to qualify results. Consider rejecting all results. Use Section II of the EPA CYANIDE NFG (2014) including Tables 29 and 30 and/or professional judgement on other ICV issues.
Continuing Calibration Verification	• Daily before sample analysis, every hour, and at the end of the analytical run. • See EPA CYANIDE NFGs (2014) Section II Subsection C and D for all evaluation criteria.	Use Section II/Subsection E of the EPA CYANIDE NFG (2014) including Tables 29 and 30 and/or professional judgement on other CCV issues.
Laboratory Control Sample (LCS)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • When an LCSD is performed, the RPD limit is provided in Worksheet #12.	%R < 10%, qualify detections as “J” and qualify non-detections as “R”. 10% ≤ %R < lower limit, qualify detections as “J” and non-detections as “UJ”. %R or RPD > upper limit, qualify detections as “J” and do not qualify non-detections. If an LCSD is performed, qualify results only if both the LCS and LCSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment.

Parameter	Evaluation Criteria	Flagging Criteria
Matrix Spike (MS)/ Matrix Spike Duplicate (MSD)	• Use the QSM Appendix C Limits for LCS acceptability windows, when available. Otherwise, use in-house laboratory LCS limits. See QAPP Worksheet #15. • RPD limit is provided in QAPP Worksheet #12. • Do not qualify based on MS/MSDs from another client and/or site.	For the specific analyte in the parent sample, qualify data as follows: %R < 10%, qualify detections as "J" and qualify non-detections as "R". 10% ≤ %R < lower limit, qualify detections as "J" and non-detections as "UJ". %R or RPD > upper limit, qualify detections as "J" and do not qualify non-detections. If an MSD is performed, qualify results only if both the MS and MSD exhibit outliers or if the RPD and one recovery is outside control limits. Use professional judgment. Use Section V/Subsection E and Table 33 of the EPA Cyanide NFGs (2014) for further guidance.
Duplicate Sample	• Use the acceptability windows in the EPA CYANIDE NFGs for duplicate samples in Section IV/Subsections C and D and Table 8 or use in-house laboratory LCS limits.	For the specific analyte in the parent sample, qualify data using Section IV/Subsection E and Table 32 of the EPA CYANIDE NFGs (2014).

Source Documents:

DoD QSM Version 5.0 (July 2013)

EPA Cyanide NFGs (2014) – EPA National Functional Guidelines for Inorganic Methods Data Review – Cyanide Data Review

Qualification Table for Blank Detections

Blank Result	Sample Result	Action
Detection ≤ LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ	No qualification
Detection > LOQ	Non-detection	No qualification
	Detection ≤ LOQ	Report at LOQ and qualify as non-detection (U)
	> LOQ, but within 2x the blank result	Report at result and qualify as non-detection (U)

Notes:

Only use the reason code “B” with the validation flag U (or UJ if other parameters are exceeded).

Note in the DVR whether the blank detection is above or below the LOQ.

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APPENDIX B

HEALTH AND SAFETY PLAN

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Final

Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater

Appendix B: Health and Safety Plan

Former Ravenna Army Ammunition Plant

Portage and Trumbull Counties, Ohio

December 21, 2016

Contract Number: W9133L-14-D-0008-0003

Task Order Number: 0003

Prepared for:

National Guard Bureau
NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

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PLAN ACCEPTANCE SIGN-OFF

Work Plan, Appendix B: Health and Safety Plan

Former Ravenna Army Ammunition Plan, Portage and Trumbull Counties, Ohio

TEC-Weston Joint Venture Health and Safety Plan Review

Health and Safety Plan Certification: Based on my review of this Health and Safety Plan, which is an Addendum to the Facility-Wide Safety and Health Plan (SAIC, 2011), the plan serves as the lower-tier document addressing the hazards and controls specific to this project and is written in compliance with industry standards, regulations, and guidelines utilizing documents including the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual, EM 385-1-1 (2014) and EM-385-1-97.

11/11/2016

David Robinson, Project Health and Safety Manager Date

TEC-Weston Joint Venture

11/11/2016

Brent Ferry, Project Manager Date

TEC-Weston Joint Venture

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LIST OF EMERGENCY CONTACTS

Point-of-Contact	Phone Number	Email
Emergency Contacts		
Camp Ravenna Range Control	614-336-6041 (office) 614-202-5783 (mobile)	N/A
Camp Ravenna Main Gate Guards (after hours only)	330-358-2017	N/A
Camp Ravenna East Gate Guards (after hours only)	614-336-6399	N/A
Local Emergency Contacts		
Poison Control Center	800-222-1222	N/A
National Response Center, Toxic Chemicals and Oil Spills	800-424-8802	N/A
VNA Robinson Memorial 6693 N. Chestnut Street Ravenna, OH 44266	330-296-2835	N/A
Windham Fire Department 9621 E. Center Street Windham, OH 44288	330-326-2222	N/A
Windham Police Department 9621 E. Center Street Windham, OH 44288	330-326-2211	N/A
Contractor Contacts		
Brent Ferry, Project Manager	512-651-7108 (office) 309-236-9235 (mobile)	brent.ferry@westonsolutions.com
David Robinson, Project Health and Safety Officer	937-572-3630 (mobile)	david.robinson@westonsolutions.com
Dave Wazny, Field Team Leader	440-262-2373 (office) 440-781-2467 (mobile)	david.wazny@cardno.com
Lynne Black, Incident Reporting Officer	434-295-4446 (office) 218-390-9909 (mobile)	lynne.black@cardno-gs.com
Camp Ravenna Contacts		
Mark Leeper, NGB Contracting Officer's Representative / Installation Program Manager	703-607-7955	mark.s.leeper.civ@mail.mil
Kevin Sedlak, ARNG Restoration Project Manage	614-336-6000 ext. 2054	kevin.m.sedlak.ctr@mail.mil
Katie Tait, OHARNG Environmental Scientist	614-336-6136	kathryn.s.tait@us.army.mil

Notes:
NGB = National Guard Bureau
N/A = Not applicable
OHARNG = Ohio Army National Guard

For All Medical Emergencies:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Notify the Incident Reporting Officer (IRO) of the injury as soon practical to do so.
- Contact Core Health at 855-227-3661.

Minor Injury:

- Have qualified first-aid site personnel administer treatment, under the direction of a Core Health specialist (855-227-3661).
- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Notify the IRO and record the injury on the appropriate Occupational Safety and Health Administration (OSHA) forms and project logs.
- Contact the Project Health and Safety Officer (PHSO) and Project Manager (PM). The PM will contact the Army National Guard (ARNG) Contracting Officer's Representative (COR).

In the event of a **medical emergency** when an actual or suspected serious injury has occurred, the following procedures shall be implemented:

Medical Emergency:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Survey the scene and evaluate whether the area is safe for entry.
- Remove the victim from immediate danger and render critical first aid.
- Decontaminate the victim after first aid is administered.
- Contact the PHSO, the IRO, and the PM. The PM will contact the ARNG COR.
- Record the injury on the appropriate OSHA forms.
- Assess site conditions and determine whether it is safe for remaining on-site personnel to return to the area.

In the event of a **fatality**, stop work immediately and do the following:

Fatality:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Contact the PHSO, the IRO, and the PM. The PM will contact the ARNG COR.
- Comply with OSHA reporting and record keeping requirements.
- Stop work following the accident until the accident investigation is completed and permission is granted to return to work.

Medical Non-Emergencies:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- In the event of a non-emergency injury where the case is a First Aid case or worse, a call should be made to Core Health at 855-CARDNO-1 (855-227-3661).
- Immediate first aid may be administered by personnel trained in Adult First Aid/Cardiopulmonary Resuscitation (CPR).
- Notify the PM and IRO of the injury as soon practical to do so.

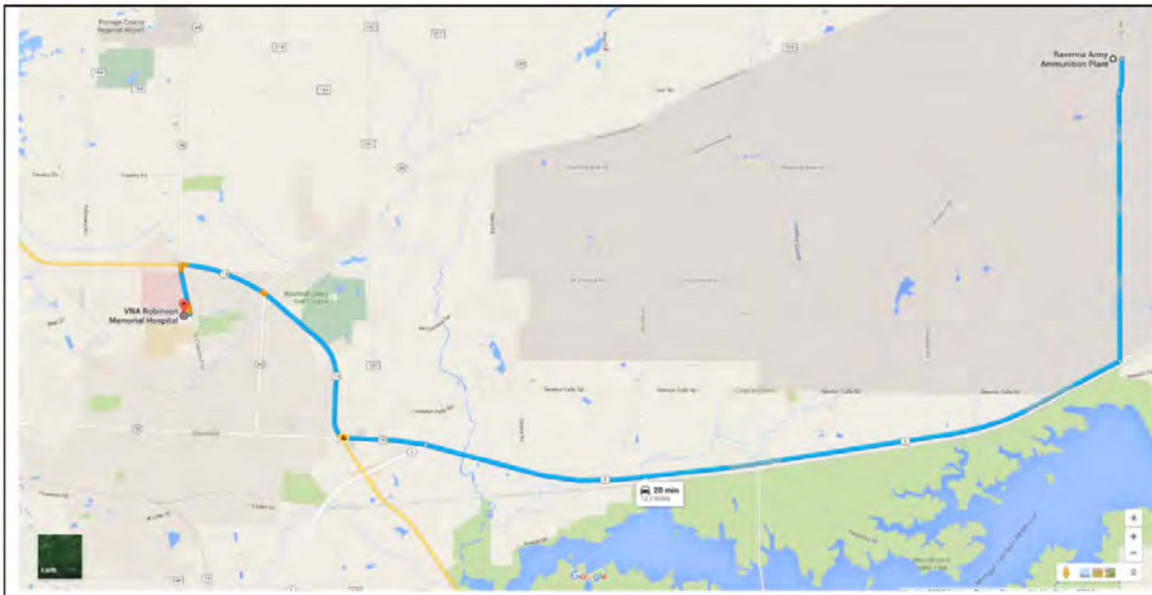
Core Health Injury Management:

If Core Health is dialed, be prepared to provide the following:

- Injured workers' name, date of birth, phone number, and social security number;
- Date/time/type of injury, work site and job title, brief description of how injury occurred; and
- Clinic name/contact information (if applicable).

If the employee does not feel first aid is required initially but subsequently changes his/her mind, Core Health may still be contacted, but the PM and IRO should be consulted first.

Most Direct Route to Local Hospital from Camp Ravenna



Driving Directions:

via OH-5 W — 20 min

19 min without traffic Show traffic — 12.7 miles

⚠ This route has restricted usage or private roads

Ravenna Army Ammunition Plant

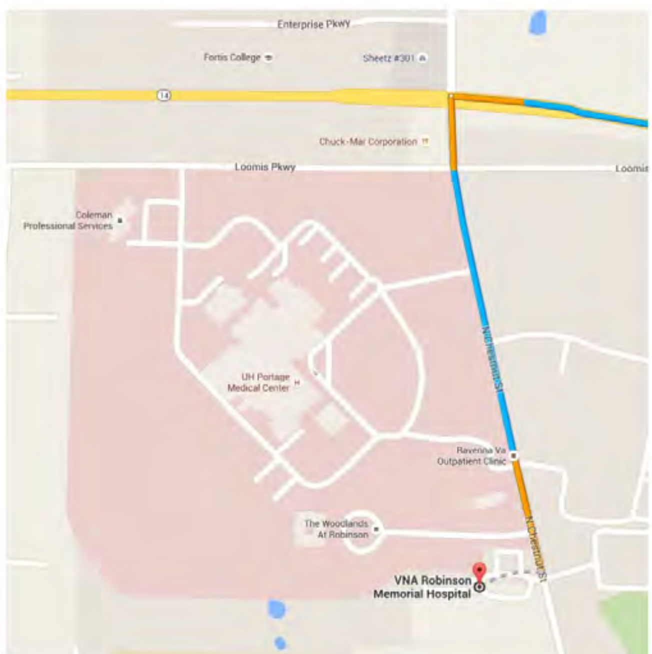
Paris Township, OH

- Head south on Wn St 3
  ⚠ Restricted usage road
  0.3 mi
- Continue onto Pa St 1
  ⚠ Partial restricted usage road
  2.4 mi
- Turn right onto OH-5 W
  6.4 mi
- Continue straight onto OH-59 W
  0.8 mi
- Turn right onto OH-14 W/OH-44 N/Cleveland - East Liverpool Rd
  2.4 mi
- Turn left onto N Chestnut St/Ravenna Painesville Rd
  Continue to follow N Chestnut St
  Destination will be on the right
  0.5 mi

VNA Robinson Memorial Hospital

6693 North Chestnut Street, Ravenna, OH 44266

VNA Robinson Memorial
6693 N. Chestnut Street.
Ravenna, OH 44266
(330) 296-2835



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LIST OF ACRONYMS/ABBREVIATIONS

°F	degree Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ARNG	Army National Guard
Camp Ravenna	Camp Ravenna Joint Military Training Center
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
COPC	Chemical of Potential Concern
COR	Contracting Officer's Representative
CPR	cardiopulmonary resuscitation
CRIOS	Carcinogenic Risk in Occupational Settings
Cr(0)	elemental chromium
Cr(III)	trivalent chromium
Cr(VI)	hexavalent chromium
CRZ	contaminant reduction zone
dBA	A-weighted decibels
DoD	Department of Defense
FS	Feasibility Study
ft	foot/feet
FTL	Field Team Leader
FWGW	Facility-Wide Groundwater
FWSHP	Facility-Wide Safety and Health Plan
H&S	health and safety
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
IRO	Incident Reporting Officer
km	kilometer
lb	pound(s)

LIST OF ACRONYMS/ABBREVIATIONS (CONTINUED)

MEC	munitions and explosives of concern
MW	Groundwater Monitoring Well
NGB	National Guard Bureau
NGB-ZC-AQ	National Guard Bureau/Operational Contracting Division
NIOSH	National Institute for Occupational Safety and Health
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
OHARNG	Ohio Army National Guard
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PE	Professional Engineer
PEL	permissible exposure limit
PG	Professional Geologist
PHSO	Project Health and Safety Officer
PID	photoionization detector
PM	Project Manager
PMP	Project Management Professional
PP	Proposed Plan
PPE	personal protective equipment
ppm	parts per million
PWS	Performance Work Statement
QA	quality assurance
QC	quality control
RI	Remedial Investigation
ROD	Record of Decision
SAIC	Science Applications International Corporation
SDS	Safety Data Sheet
SOP	Standard Operating Procedure
SSHO	Site Safety and Health Officer

LIST OF ACRONYMS/ABBREVIATIONS (CONTINUED)

SVOC	semi-volatile organic compound
TEC-Weston JV	TEC-Weston Joint Venture
TLV	threshold limit value
TO	Task Order
U.S.	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UV	ultraviolet
UXO	unexploded ordnance
VOC	volatile organic compound
WP	Work Plan

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1.0 INTRODUCTION

This Health and Safety Plan (HASP) is an addendum to the Final Facility-Wide Safety and Health Plan (FWSHP). The HASP serves as the lower-tier document addressing investigation specific Facility-wide Groundwater (FWGW) and Environmental Investigation Services at the Former Ravenna Army Ammunition Plant, now known as the Camp Ravenna Joint Military Training Center (Camp Ravenna), in Portage and Trumbull Counties, Ohio.

The FWSHP (SAIC, 2011) addresses general program issues and hazards and associated controls common to the facility. This HASP serves as the lower-tier document addressing the hazards and controls specific to the scope of work of this project. The purpose of the HASP is to be the investigation-specific site safety guidance document to govern the field sampling and field analysis for the work contracted under this Task Order (TO) for the National Guard Bureau (NGB). The FWSHP and the HASP should be utilized in conjunction by the field sampling team to ensure this effort meets the safety objectives for the TO. This project is contracted by the National Guard Bureau, Operational Contracting Division (NGB-ZC-AQ), Restoration Branch under Contract W9133L-14-D-0008, TO 0003.

1.1 Purpose and Policy

The TEC-Weston Joint Venture (TEC-Weston JV) maintains a comprehensive safety and health program that is the foundation of our training, compliance, and client service activities. The safety program is used by employees and supports the intention of each site HASP. The safety program and regulatory compliance programs are managed and enforced by the TEC-Weston JV for all industrial, construction, and hazardous waste remediation and consulting projects. The safety goals for each of TEC-Weston JV's projects are zero accidents, incidents, or recordable cases. We provide PMs with the resources and support necessary to safely execute the Performance of Work Statement (PWS), protect project personnel, and deliver a quality product to the client in a timely and cost-efficient manner. Safety is incorporated into every phase of a project.

The health and safety (H&S) protocol established in this HASP is based on the existing FWSHP (SAIC, 2011), TEC-Weston JV H&S policy statement (Attachment D; note that Cardno staff are performing all field work), specific site conditions, and chemical hazards known or anticipated to be present from available site data. This HASP is intended solely for use during FWGW and Environmental Investigation Services at Camp Ravenna. In addition to the HASP, all field activities will be performed in accordance with the Work Plan (WP). Specifications herein are subject to review and revision based on actual conditions encountered in the field during work activities.

This HASP describes project organization, personnel routine and special hazard training, field implementation, site operating procedures, and the medical monitoring program. The flexibility of this HASP allows unanticipated site-specific problems to be addressed while ensuring adequate and suitable worker protection.

Elements of this HASP include procedures for personal protection, personnel and equipment safety, medical surveillance, air quality monitoring, and general on-site work practices. Additionally, this HASP contains provisions for emergency procedures, including emergency response and First Aid capabilities. All TEC-Weston JV personnel, its subcontractors, and third parties who enter the site are required to comply with this HASP and the parent FWSHP (SAIC, 2011). Before field operations begin, all employees involved will have read and understood the FWSHP (SAIC, 2011), HASP, and all subsequent revisions and addendums. Before work begins, all affected environmental workers will sign the Site Specific Safety and Health Plan Compliance Agreement (Attachment C).

The following criteria provide the basic standards for all site activities and this HASP. The criteria include instructions, regulations, and guidelines as excerpted from the following:

- Science Applications International Corporation (SAIC), Final Facility-Wide Safety and Health Plan for Environmental Investigations, Ravenna Army Ammunition Plant. February (2011).
- Occupational Safety and Health Administration (OSHA), Title 29 Code of Federal Regulations (CFR), Parts 1910 (General OSHA Standards) and 1926 (Safety and Health Standards for Construction).
- United States Environmental Protection Agency (USEPA), Standard Operating Safety Guides (1992).

- National Institute for Occupational Safety and Health (NIOSH)/OSHA/United States Coast Guard (USCG)/USEPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985).
- United States Army Corps of Engineers (USACE), Safety and Health Requirements EM 385-1-1, Manual No. 385-1-1. September (2008).

All personnel must comply with established safety procedures as discussed in this HASP. Any staff member who does not comply with this safety policy, as established by the PHSO, Site Safety Health Officer (SSHO), and the PM, will be immediately dismissed from the site.

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2.0 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

Camp Ravenna is located in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 kilometers (km) (3 miles) northeast of the town of Ravenna. The installation consists of 21,683 acres in an 11 mile-long, 3.5 mile-wide tract bordered by a sparsely inhabited private residential area.

2.1 Scope of Work

The implementation of the Remedial Investigation (RI) will consist of several project tasks including, but not limited to the following:

- Installation access;
- Utility and unexploded ordnance (UXO) avoidance;
- Investigation-derived waste (IDW) staging and management;
- Surveying;
- Groundwater monitoring well (MW) installation;
- Groundwater sampling;
- MW and production well abandonment;
- Decontamination procedures;
- Archeological survey;
- Data management; and
- Document and record keeping.

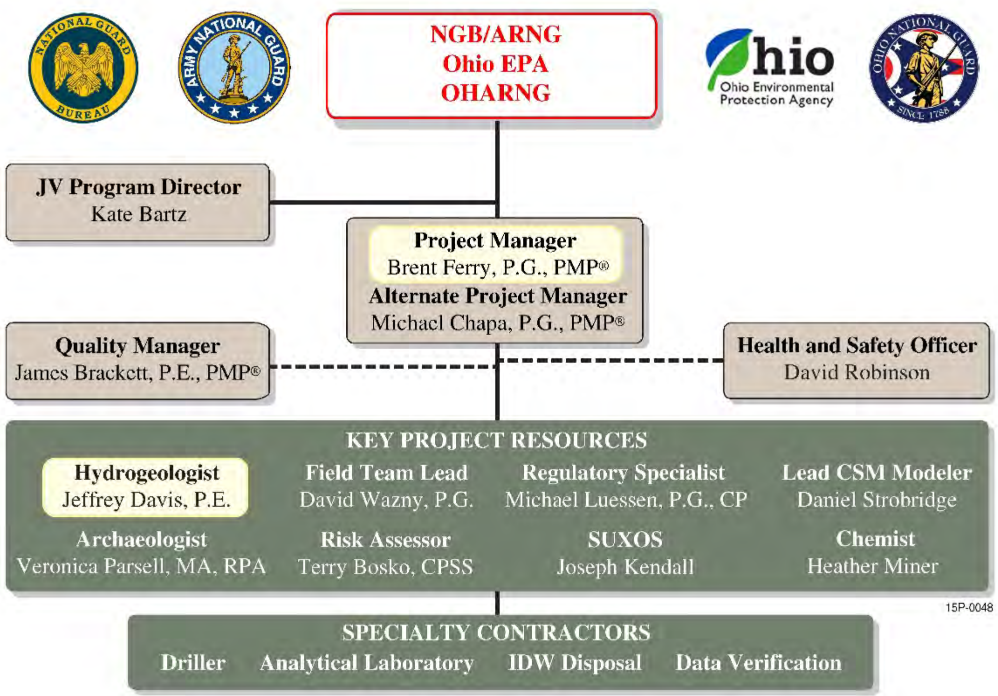
Standard Operating Procedures (SOPs) are described in the FWSHP (SAIC, 2011). Additional details regarding SOPs for activities associated with this HASP will be included in the WP to cover all aspects of field operations, environmental sampling, field measurements, and record keeping.

According to the data available from previous site investigations by others, the chemicals of potential concern (COPCs) associated with the site include volatile organic compounds (VOCs); semi-volatile organic compounds (SVOCs); metals, including hexavalent chromium (Cr[VI]); polychlorinated biphenyls (PCBs); pesticides; explosives and propellants (perchlorate, nitrocellulose, and nitroguanidine); and cyanide. COPCs are discussed in greater detail in Section 9.2.1, Chemical Hazards.

3.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

A Project Management Organization in response to the PWS requirements has been established, as shown on **Figure 3-1**. Qualifications and responsibilities of the key TEC-Weston JV personnel are detailed below.

Figure 3-1. Project Organizational Chart



JV Program Director, Ms. Kate Bartz, who has supported several NGB contracts over the last 20 years, will lead the JV Team in the TO. She will serve as the primary point of contact with the ARNG for overall NGB Programmatic issues and will be available to the ARNG Program Manager and other ARNG staff in the unlikely event of performance issues.

Project Manager, Brent Ferry, Professional Geologist (P.G.), Project Management Professional (PMP®) is the direct line of communication to the ARNG Restoration PM and will be responsible for schedule, subcontractors, invoicing, manpower, and deliverables. Mr. Ferry will be the primary point of contact for the COR for this TO. He has more than 15 years of experience managing complex projects for the Department of Defense (DoD) throughout the country, including RI/Feasibility Study (FS)/Proposed Plan (PP)/Record of Decision (ROD) actions with expertise in risk-based closure following the RI. Mr. Ferry will be responsible for all aspects of managing the TO, including assigning/removing/directing staff, selecting subcontractors, managing budget/schedule, ensuring quality and H&S, and overseeing preparation of deliverables. Mr. Ferry will also review training records and credentials to ensure TEC-Weston JV Team field personnel are qualified and proficient in field activities.

James Brackett, Professional Engineer (P.E.), PMP®, will be the Project Quality Manager responsible for development and implementation of the Quality Assurance (QA)/Quality Control (QC) Program during the TO. He will ensure all planning documents prescribe defensible procedures for implementation during phases of work and will provide overall QA/QC reviews of the primary deliverables, including the FS, PP, and ROD.

David Robinson is the Project Health and Safety Officer on this TO. Mr. Robinson has more than 25 years of experience in industrial hygiene, health and safety, and environmental science. His experience includes developing environmental health and safety programs, including hazard communications, PPE, respiratory protection, and hearing conservation, for numerous projects. He has conducted industrial hygiene and safety assessments and audits at more than 100 facilities.

Heather Miner is the Project Chemist. Ms. Miner has 13 years of experience working on federal environmental restoration projects and has served as Project Chemist for NGB Installations and Mission Support Directorate Operations, Division, Restoration Branch, United States (U.S.) Army, U.S. Navy and U.S. Air Force indefinite delivery, indefinite quantity contracts since 2002. Ms. Miner will manage the subcontract laboratory and interface with the laboratory director and laboratory project manager to ensure analytical chemistry deliverables meet QA and data quality objectives.

Dave Wazny, P.G., is the Field Team Leader **(FTL).** With more than 25 years of experience leading environmental investigations, Mr. Wazny is responsible for overseeing field efforts, managing local subcontractors, and supporting compliance with local regulatory requirements. The FTL communicates requirements between the PM and the field team.

4.0 TRAINING

OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training requirements, as described in 29 CFR 1910.120 (for general industry), apply to those persons conducting field work on-site. The regulation states that all personnel involved with characterizing or remediating an uncontrolled hazardous waste site are required to have 40 hours of initial off-site training and 3 days of supervised field training. All field personnel will submit their training certifications to Vista prior to any field work.

All field personnel must attend a safety orientation meeting before commencing field work. The meeting will be scheduled and conducted by the FTL or SSHO. The meeting will include presentation and review of the HASP and completion of the required signed acknowledgement forms by the SSHO and field crew.

4.1 Pre-Assignment Training

Prior to arrival at the job site, certification must be provided that shows field personnel meet the requirements of pre-assignment training. Consistent with OSHA 29 CFR 1910.120 paragraph (e)(3), each employee should be able to provide a certificate for 40 hours of HAZWOPER training and/or certificates for annual refresher training. Before admission to the site, personnel will be required to document their fulfillment of these requirements and demonstrate their understanding of this plan by signing the Agreement and Acknowledgement Statement form included in Attachment C of this HASP.

4.2 Supervisor Training

Consistent with OSHA 29 CFR 1910.120 paragraph (e)(4), individuals designated as site supervisors require an additional 8 hours of training. Supervisory personnel will be required to show proof of training prior to assignment to the position.

4.3 UXO Technician Training

Should field work conducted during the FWGW RI be necessary within areas of Camp Ravenna that have not already been cleared for munitions and explosives of concern (MEC)/UXO, and, therefore, anomaly avoidance be required, all work shall proceed in accordance with Section 10.16

of the FWSHP. The TEC-WESTON JV will provide a UXO team consisting of a minimum of two personnel, one of whom must be a UXO Technician II. This individual will be the UXO team leader. The UXO team must be on-site during all sampling activities at these areas of the site. The technicians must have proof of current training from a DoD-recognized Explosive Ordnance Disposal training program. As team leader, the UXO Tech II should also have the 8-hour site HAZWOPER Site Supervisors Training and both personnel should have Adult First Aid/CPR and current bloodborne pathogens training.

Once the UXO team determines that a proposed drill hole location is free of anomalies, drilling activities can proceed in accordance with the following protocols (refer to the FWSHP for full details):

a) The drilling contractor's actual drill hole must be located within a 2-foot radius of the pilot hole installed by the UXO team.
b) Any drilling beyond the clearance depth of the pilot hole will be conducted in 12-inch increments to allow the UXO team to screen for anomalies. In order to avoid magnetic interference from the augers, the drill rig must withdraw its augers from the hole for the geophysical survey. If an anomaly is detected, the drill hole will be backfilled in accordance with site-specific procedures and sampling personnel must select a new drill hole location.
c) When working in impact areas, the UXO team may discontinue incremental screening once the drilling has extended to a depth of 30 feet below ground surface, the depth of penetration of the MEC has been exceeded, or the planned depth of drilling has been reached, whichever is less.
d) For all other areas, incremental screening will be determined based on an assessment of the site's characteristics and history.

4.4 Cardiopulmonary Resuscitation and First Aid Training

There will be at least two Adult First Aid/CPR trained and certified personnel assigned and on-site at all times while work is being performed. In addition, first aid providers should be trained in handling bloodborne pathogens to maintain compliance with 29 CFR 1910.1030.

4.5 Safety Equipment

Basic emergency and first-aid equipment will be available on-site. All field personnel will be informed of the locations of the safety equipment and the proper use of the equipment. Weekly inspections of the safety equipment will be performed by the SSHO while personnel are working on-site.

4.6 Training and Medical Clearance Documents

Copies of current OSHA training and medical clearance documents for all TEC-Weston JV personnel will be maintained in the on-site project file and available upon request. Copies of these documents will be provided via fax, hand-delivery, or electronically.

4.6.1 Site-Specific Training

All personnel entering the site shall receive site-specific Hazard Communication training and shall be familiar with the HASP. Site-specific training shall include at least the description of chemical and physical hazards associated with the project; site control, monitoring, and SOPs that are applicable to the project; location of emergency response equipment; accident/incident procedures; and the location of the nearest hospital. Training on known site contaminants required by OSHA substance-specific standards (benzene, inorganic arsenic, cadmium, chromium (VI), vinyl chloride, and lead) will be required for site personnel with exposure potential. Training requirements for field personnel will be reviewed by the SSHO and the PM to ensure compliance with the HASP.

An initial (pre-entry) safety meeting will be held prior to the start of on-site work. The SSHO will be responsible for conducting this meeting. This safety meeting will be documented, and any questions about the HASP will be answered. In addition, the pre-entry safety meeting will review site safety rules and prohibitions; the location of emergency equipment, such as eye wash containers and fire extinguishers; escape routes; accident reporting; directions to the nearest medical facilities; how to summon medical assistance; and personal protective equipment (PPE) requirements for the specific tasks. This safety training should enable site personnel to perform their work in a safe manner.

For the duration of the field work, tailgate safety meetings will be held daily. These meetings are conducted to review pertinent aspects of site operations and to establish safe working procedures for those operations. Safety meeting minutes and attendees will be documented. If determined necessary, additional safety meetings will be held to address deficiencies noted or procedural improvements that could be made based on the previous day's activities.

4.6.2 Visitor Training

All visitors to the site will be required to check in with the SSHO and have in their possession the appropriate PPE (Section 5.4). If they do not have the appropriate PPE with them, they will be asked to leave the exclusion zone and obtain the necessary PPE. Depending on the purpose of their visit, the SSHO will provide them with an orientation briefing, which will include site-specific hazards, ways to protect themselves from these hazards, locations of first aid and emergency equipment, and emergency response procedures.

5.0 PERSONAL PROTECTIVE EQUIPMENT

The level of protection required to ensure the H&S of field personnel will be determined by the PHSO and SSHO, based on specific site activities, available instrumentation readings or existing baseline data, and professional experience and judgment. To protect personnel from potential site H&S hazards, minimum PPE and respiratory requirements have been established. These requirements do not preclude the need to conduct monitoring, nor do they preclude the need to amend PPE requirements as conditions warrant. Any amendment to the minimum PPE requirements must first be approved by the PHSO. Field personnel, at their own discretion, may increase but not decrease the degree of respiratory protection and PPE used. When a conflict exists with the PPE requirements, the more restrictive shall apply.

PPE requirements apply to all employees and subcontractors of TEC-Weston JV who are required by contract or regulation to wear PPE in the course of their work. The levels of PPE required for specific work tasks shall be communicated to all personnel prior to beginning work. As part of site-specific training, the SSHO will describe what types of PPE are necessary for each of the work tasks to be performed during this investigation, and how to properly don, doff, adjust, wear, maintain, store, inspect, and dispose of the PPE. Field personnel are responsible for using and maintaining all PPE required for each work task. Only properly fitting PPE shall be worn by field personnel. Field personnel shall be physically able and determined medically qualified to use the PPE required for their job tasks.

The review of historical data from previous groundwater investigations and monitoring programs at Camp Ravenna indicates that Level D PPE or Level D-modified is appropriate for all anticipated site contaminants. If air monitoring indicates respiratory protection is required (as defined in Section 7.0 of this HASP), work will be stopped and personnel removed from the area until H&S procedures are revised to suit the situation. Only workers who are qualified to wear respiratory protection and who are involved in an ongoing medical surveillance program will be allowed in any area that requires Level C or greater protection. Workers who come in direct contact with sample materials will be closely monitored by the SSHO, who will determine the need for additional PPE (e.g., Saranex® suit and safety goggles if splash hazard is present).

5.1 Modified Level D Personal Protective Equipment

Minimum PPE requirements depend on the specific type of activity being performed. These PPE requirements are identified as Level A, Level B, Level C, and Level D. A slight deviation from Level D will be used for site activities; therefore, the term "modified" shall be used. Modified Level D PPE will consist of the following:

- Work uniform consisting of, at a minimum, long pants and long sleeve shirt, or coveralls shall be worn by field personnel;
- Steel-toed or hard-toed boots in compliance with American Society for Testing and Materials standard F2413-05 (formerly American National Standards Institute Z41-1999);
- Work gloves (nitrile gloves when sampling);
- Safety glasses;
- Safety goggles (only when splash hazard to eyes exists);
- Hearing protection (for noise levels above 85 decibels [dBA]);
- Hard-hat (only when overhead hazards exist);
- Class II high-visibility safety vests (when exposed to traffic); and
- Saranex (waterproof) suits for decontamination procedures and drumming liquids.

5.2 Unknown Environments

The requirement for field personnel to enter unknown environments is not anticipated as part of the PWS for this TO, and field personnel are prohibited from entering any environment where Level A, B, or C PPE is required. If an unknown environment is encountered, field personnel shall not enter the area until the chemical or physical hazards in the area can be identified and measures taken to reduce or eliminate those hazards. If additional PPE above modified Level D is required, the SSHO will consult the PHSO to determine what kinds of PPE are necessary and appropriate to continue work.

5.3 Considerations for Selecting Levels of Protection

Factors that are considered in selecting the appropriate level of PPE include heat and cold stress; air monitoring results; chemical, physical, and biological hazards associated with the task; routes of exposure; and weather conditions. The SSHO will determine the level of PPE required for the specific work task following an evaluation of these factors. The SSHO will be responsible for ensuring all field personnel adhere to the PPE requirements. Based on existing information and data for the activities to be performed at Camp Ravenna, modified Level D PPE will be the initial requirement for all scoped tasks. Exposure to elevated airborne concentrations of contaminants above the respective permissible exposure limits (PELs) is not anticipated during this field investigation; thus, the use of respiratory protection is not anticipated. However, if site conditions, field activities, or air monitoring results indicate the need for respiratory protection during field activities, the SSHO will evaluate the activities to be performed by site personnel, and if necessary, engineering controls implemented, hazards eliminated, and/or modifications to the PPE requirements may be implemented.

5.4 PPE for Visiting Personnel

Site visitors will be required to have the appropriate modified Level D PPE prior to site entry. No personnel will be allowed to enter the site if they do not have the appropriate modified Level D PPE.

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6.0 MEDICAL SURVEILLANCE

All field personnel must meet the medical monitoring requirements of 29 CFR 1910.120. The regulations require that employers implement a medical monitoring program consistent with paragraph (f) of the standard, which states that a medical examination will be completed for each employee prior to employment, annually thereafter (minimum), as a follow-up to injuries or over-exposures, and upon termination of their employment with the company. Employees who must receive medical examinations include those who wear a respirator for 30 or more days a year and those who are, or may be, exposed to hazardous substances at or above PELs, regardless of respirator use, for 30 or more days a year.

Any personnel injured or suspected of being injured as a result of an uncontrolled release of a hazardous substance or energy, or other emergency situation, must be given a medical evaluation as soon as possible thereafter.

6.1 Medical Records Availability

TEC-Weston JV employee medical records are available upon the employee's request from the performing medical facility. The IRO will confirm medical certification to work and wear respiratory protection and keep a copy of the certification (containing certifying physician's signature) in the personnel files. Physical examination forms shall be released only with the individual employee's approval.

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7.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

7.1 Monitoring Requirements

Routine air monitoring of the work areas using a photoionization detector (PID) and detector tubes (e.g., Dräger or Gastec tubes) will be required during field work. Two types of air monitoring will be performed: perimeter air monitoring and breathing zone air monitoring. Perimeter air monitoring will be conducted with a PID by the sampler and recorded on the corresponding field form. Breathing zone monitoring will be conducted with a PID at 5- to 10-minute intervals (or greater frequencies as needed) in the driller's breathing zone. Additionally, detector tubes will be used to monitor the workers breathing zone if the breathing zone PID reading exceeds 5 parts per million (ppm).

Because of the age of the anticipated contaminants to be encountered during the field work, it is not likely that hazardous organic vapors, including benzene, will be encountered in significant concentrations. Therefore, an action level of 5 ppm sustained for over 1 minute in the breathing zone has been established for this project. The air monitoring action levels established for this project are summarized in **Table 7-1**.

Table 7-1. Air Monitoring Action Levels

Instrument	Instrument Response/Action Limits	Action
PID meter with 10.6eV lamp	< background reading	Continue operations.
	>5 ppm sustained for 1 minute in the breathing zone	Collect detector tube sample as soon as possible.
Detector tubes (specific for benzene and vinyl chloride)	Negative result	Continue operations.
	Benzene >0.5 ppm vinyl chloride >0.5 ppm	Stop work until readings fall below background, or notify the SSHO and PHSO. Reassess WP.

Notes:

< = Less Than
> = Greater Than
eV = electron volt
PHSO = Project Health and Safety Officer
PID = Photoionization Detector
ppm = parts per million
SSHO = Site Health and Safety Officer
WP = Work Plan

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8.0 HEAT/COLD STRESS MONITORING

Heat and cold stress is considered a physical hazard and is discussed in Section 9.2.2, Physical Hazards.

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9.0 STANDARD OPERATING PROCEDURES

SOPs are described in the FWSHP (SAIC, 2011). In addition to performing field activities in accordance with the SOP, field team members should conduct an Activity Hazard Analysis (AHA) prior to beginning any task.

9.1 Hazard Assessment and Risk Analysis

This section discusses the results of the hazard assessment conducted for the specific field investigation and monitoring activities that comprise the scope of the current TEC-Weston JV project at Camp Ravenna. It is a modification of the AHA presented in the FWSHP, Section 3.0 (SAIC, 2011). These activities were assessed to identify their chemical, physical, and biological hazards. These hazards, along with ways to minimize them, are discussed below.

As the work proceeds and objective data are documented in the field, the protective measures for the individual activities may be modified by the SSHO with concurrence from the PHSO, depending on the results of the risk evaluation performed from the new field data. If necessary, an addendum to the HASP will be prepared to address these changes.

9.2 Hazard Analysis

Based on the project-specific scope of work, the following field work will be performed as part of TO 0003:

- Conduct environmental investigation activities at Camp Ravenna sites, including an archaeological survey and UXO avoidance. Activities for the RI at these locations include a shovel test survey, installation of MWs, and collection of IDW characterization samples. Well drilling activities, drill rig decontamination, and IDW disposal will be conducted by subcontractors.
- Collect groundwater samples from MWs for off-site laboratory. Activities for the groundwater monitoring task include collection of groundwater samples from MWs and collection, handling, and characterization of IDW.

AHAs for each of the activities listed above are provided in the tables included as **Attachment A**. The hazards inventory presented in the FWSHP (SAIC, 2011), Table 3-1 provides a checklist of general hazards expected during environmental investigations. Table 3-2 of the FWSHP (SAIC,

2011) presents AHAs for all planned environmental investigation activities at Camp Ravenna. The AHAs have been reviewed and modified as necessary to reflect expected site or procedural changes. If additional tasks or significant hazards are identified during the work, this document will be modified by addendum or field change order to include the additional information.

The results of the job hazard assessments for the chemical, physical, and biological hazards associated with the field investigation activities are discussed in the following subsections. General safety hazards applicable to any site are discussed at the end of the section.

9.2.1 Chemical Hazards

As previously stated, the COPCs associated with the site include VOCs; SVOCs, including polycyclic aromatic hydrocarbons (PAHs); metals, including Cr(VI); PCBs; pesticides; explosives and propellants (perchlorate, nitrocellulose and nitroguanidine); and cyanide. These chemical hazards mirror the analytical sample list presented in the WP and are specific to the PWS under this TO. It is not anticipated that COPCs in groundwater are present in toxic, explosive, or reactive concentrations. **Table 9-1** lists the chemicals, associated hazards, threshold limit values (TLVs), and/or PELs, and where available, routes of exposure and signs and symptoms of exposure (American Conference of Governmental Industrial Hygienists, 2014; California Division of Occupational Safety and Health, 2012; NIOSH, 2007; OSHA, 2006). If the chemical hazard refers to a class of chemicals or several chemicals (e.g., VOCs), then the chemical with the lowest TLV/PEL is included in **Table 9-1**. Chemical hazards subject to the OSHA Hazard Communication regulation (29 CFR l9l0.l200) may also be encountered during the field investigation. The potential chemical hazards associated with the site are briefly discussed below. Copies of Safety Data Sheets (SDSs) for the chemicals that will be brought into the field (e.g., sample preservatives) are provided in **Attachment B**.

Table 9-1. Chemical Hazard Assessment

Chemical Hazard	TLV/PEL	Route of Exposure	Signs and Symptoms
VOCs	TLV = varies depending on the VOC present TWA = 1 ppm STEL = 5 ppm Benzene [1]	Eye, skin, inhalation, ingestion	Irritated eyes, skin, and mucous membranes; dermatitis; headache, fainting, blurred vision, dizziness, slurred speech, confusion, and convulsions; kidney, liver and hematopoietic system damage. Some may be carcinogens.
SVOCs	TLV = varies depending on the SVOC present PEL-TWA=0.2 mg/m^3 Benzo(a)pyrene [1]	Skin, ingestion, eye	Irritated eyes, skin, upper respiratory, mucous membranes; dermatitis, headache, bronchitis, hyperpigmentation of skin; possible liver, kidney damage; some may be carcinogens.
Metals	TLV = varies depending on the metal present TLV- TWA = 0.01 mg/m^3 PEL- TWA = 0.01 mg/m^3 Arsenic [1]	Skin, ingestion, eye	Cancer (lung, lymphatic, skin), Liver effects (cirrhosis, hepatitis), acute toxicity, including respiratory, neurological, and gastrointestinal effects, nervous system effects (peripheral neuritis), skin, eye, mucous membrane, and respiratory irritation; skin sensitization; contact dermatitis; keratosis.
Cr(VI)	TLV-TWA (water soluble) =0.05 mg/m^3 TLV-TWA (insoluble) =0.01 mg/m^3 PEL-TWA = 5.0 $\mu g/m^3$	Skin, ingestion, eye, inhalation	Cancer (lung, nasopharynx, oropharynx, nasal passages), eye irritation, and skin sensitization.
PCBs	TLV = varies depending on the PCB present PEL-TWA=0.5 mg/m^3 Aroclor-1254 [1]	Eye, skin, inhalation, ingestion, absorption	Irritated eyes, chloracne, liver damage; reproductive effects; possible carcinogen.
Pesticides	TLV = varies depending on the pesticide present PEL-TWA=0.1 mg/m^3 Endrin[1]	Eye, skin, ingestion, inhalation, absorption	Irritation of the skin; agitation, flushing, dry mouth, tremor, epileptiform convulsion; stupor, head, dizziness; abdominal discomfort, nausea, vomiting; insomnia; aggressiveness, confusion; drowsiness, lassitude (weakness, exhaustion); anorexia; central nervous system, liver.

Table 9-1. Chemical Hazard Assessment (Continued)

Chemical Hazard	TLV/PEL	Route of Exposure	Signs and Symptoms
Explosives/ Propellants	TLV/PELs are not established for all constituents. TLV = varies depending on the constituent present TWA-PEL = 1 mg/m^3 m-Dinitrobenzene [1]	Skin, eyes, inhalation, ingestion, absorption	Anoxia, cyanosis; visual disturbance, central scotomas; bad taste, burning mouth, dry throat, thirst, yellowing hair, anemia, liver damage; irritated eyes (redness) and skin; throbbing head, head irritability, lassitude (weakness, exhaustion), tremor, nausea, dizziness, vomiting, insomnia, convulsions; abdominal pain; hypotension; flush; palpitations; methemoglobinemia; delirium; angina; affected organs include: eyes, skin, blood, liver, cardiovascular system, central nervous system.
Cyanide	TWA = 11mg/m^3 Hydrogen cyanide[1]	Eyes, skin; inhalation, ingestion,	Weakness, confusion, headache, nausea, difficulty breathing, loss of consciousness, seizures, cardiac arrest.

Notes:
[1] Indicator chemicals shown were selected because they maintain low TLV/PEL values, representing a conservative approach to Chemical Hazard Assessment.
µg/m^3 = micrograms per cubic meter
Cr(VI) = hexavalent chromium
mg/m^3 = milligrams per cubic meter
PCBs = polychlorinated biphenyls
PEL = permissible exposure limit
ppm = parts per million
STEL = short-term exposure limit
SVOCs = semi-volatile organic compounds
TLV = threshold limit value
TWA = time weighted average
VOC = volatile organic compound

9.2.1.1 Volatile Organic Compounds

VOCs refer to a class of organic chemicals that have a high vapor pressure at ordinary room temperature. Their high vapor pressure causes a large number of molecules to evaporate or sublimate into the surrounding atmosphere. VOCs include both chlorinated VOCs and fuel components. VOCs are both man-made chemicals and naturally occurring in the environment. Not all VOCs are carcinogenic; however, benzene (a classified known carcinogen) has the lowest exposure limits so it is listed in **Table 9-1** as an indicator chemical for VOCs. Typically, VOCs are not acutely toxic, but have compounding long-term effects that may present a threat to human health and environment.

The primary exposure potential is anticipated to be from inhalation or direct contact with contaminated soil or groundwater. Therefore, a PID will be used to ensure that personnel are not exposed to airborne levels of VOCs. The hazards are minimized by limiting dust-generating activities and by protecting against skin contact with contaminated soil and water. Thus, personnel will wear nitrile gloves, work uniforms or coveralls, and safety glasses at all times during the field work. Based on the site conditions (paved or developed areas), exposure from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.2 Semi-Volatile Organic Compounds

SVOCs are a group of compounds that includes some pesticides, ingredients in cleaning agents and personal care products, and additives to materials such as vinyl flooring, furniture, clothing, cookware, food packaging, and electronics. Exposure typically comes from direct product use and from the indoor air environment where people spend time. Because of their slow rate of release from sources and because of their propensity to partition into sorbed states, SVOCs can persist for years indoors. Many SVOCs are known as endocrine disrupting chemicals, which are suspected to contribute to the occurrence of neurodevelopmental and behavioral problems, reproductive abnormalities, metabolic disorders, and cancer.

The primary exposure potential is anticipated to be from inhalation or direct contact with contaminated soil or groundwater. There is little likelihood of elevated airborne SVOC concentrations unless significant airborne dust levels are observed. It is possible that skin contact with potentially contaminated media will present a slight health threat. Therefore, personnel will be protected from skin contact with potentially contaminated soil and/or groundwater by using nitrile gloves, work clothes or coveralls, and safety glasses, and by remaining upwind of site activities as much as possible. Based on the site conditions (paved or developed areas), exposure risk from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.3 Metals

Metals refer to a group of elements, compounds, and alloys that, in general, are malleable, ductile, and fusible. Because metals is used as a group term, arsenic was selected as an indicator chemical, and is discussed below. Arsenic is a semi-metallic element found in both inorganic and organic forms. In nature, arsenic is commonly found in minerals with sulfur and other metals. In industry, arsenic is used to strengthen copper and lead alloys, as a semiconductor in electronics, and in the production of pesticides, insecticides, and herbicides. The primary target of inorganic arsenic exposure depends on the exposure route. For ingestion and dermal exposure, the gastrointestinal tract and skin are the primary targets. For inhalation, mucus membranes and the lungs are the primary targets. The USEPA has classified inorganic arsenic as a known human carcinogen. Chronic exposure to arsenic may result in an increased risk of skin and lung cancer, as well as kidney damage, anemia, low blood pressure and shock, and central nervous system symptoms (headache, weakness, delirium). Acute exposure to arsenic may result in gastrointestinal, repertory, and neurological effects.

The primary exposure potential is anticipated to be from inhalation or direct contact with contaminated soil or groundwater. The hazards are minimized by limiting dust-generating activities and by protecting against skin contact with contaminated soil and water. Thus, personnel will wear nitrile gloves, work uniforms or coveralls, and safety glasses at all times during the field work. Based on the site conditions (paved or developed areas), exposure risk from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.4 Hexavalent Chromium

Chromium is a transition metal that occurs in three main forms: elemental chromium (Cr[0]), trivalent chromium (Cr[III]) and Cr(VI). Cr(VI) refers to a specific class of compounds that contain chromium ions in the +6 oxidization state. Cr(VI) is considered more toxic than Cr(0) and Cr(III) because the increased oxidization state results in higher cellular uptake of the molecule (CRIOS, 2014). Cr(VI) compounds have a variety of uses in industry, including textile dyes, wood preservation, and anti-corrosion agents. Cr(VI) dust is also a byproduct of hot work such as welding. Cr(VI) is acutely toxic to the gastrointestinal tract and chronically toxic to skin and mucous membranes (CRIOS, 2014). Inhaled Cr(VI) dust is a known carcinogen associated with lung cancer.

The primary exposure potential is anticipated to be from inhalation or direct contact with contaminated soil or groundwater. The hazards are minimized by limiting dust-generating activities and by protecting against skin contact with contaminated soil and water. Thus, personnel will wear nitrile gloves, work uniforms or coveralls, and safety glasses at all times during the field work. Based on the site conditions (paved or developed areas), exposure risk from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.5 Polychlorinated Biphenyls

PCBs include a broad family of man-made organic chemicals known as chlorinated hydrocarbons. PCBs were domestically manufactured from 1929 until their manufacture was banned in 1979 and were used in hundreds of industrial and commercial applications, including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and in many other industrial applications. Products that may contain PCBs include transformers and capacitors; other electrical equipment, including voltage regulators, switches, reclosers, bushings, and electromagnets; oil used in motors and hydraulic systems; old electrical devices; fluorescent light ballasts; cable insulation; thermal insulation material, including fiberglass, felt, foam, and cork; adhesives and tapes; oil-based paint; caulking; plastics; carbonless copy paper; and floor finish.

PCBs do not readily break down and may remain for long periods of time cycling between air, water, and soil. PCBs can enter the body through eating or drinking contaminated food, through inhalation, or by skin contact. PCBs are easily absorbed by the body and are stored in fatty tissue. PCBs are not eliminated well, so they can accumulate in the body. PCBs have been demonstrated to cause cancer, as well as a variety of other adverse health effects on the immune system, reproductive system, nervous system, and endocrine system.

Based on the project, the primary exposure potential is anticipated to be from inhalation or direct contact with contaminated soil or groundwater. The hazards are minimized by limiting dust-generating activities and by protecting against skin contact with contaminated soil and water. Thus, personnel will wear nitrile gloves, work uniforms or coveralls, and safety glasses at all times during the field work. Based on the site conditions (paved or developed areas), exposure risk from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.6 Pesticides

Pesticides include a very large and diverse group of substances or mixture of substances (including herbicides and insecticides) intended to control pests such as insects, weeds, rats and mice, bacteria, and mold. Because pesticides are toxic, they are also potentially hazardous to humans and the environment. Pesticides have been linked with a wide range of human health hazards, ranging from short-term effects, such as headaches and nausea, to chronic impacts like cancer, reproductive harm, and endocrine disruption. Pesticides contact the body in four main ways: oral exposure (swallowing), inhalation (breathing), ocular (through the eyes), and dermal (through the skin).

The primary exposure potential is anticipated to be from inhalation or direct contact with contaminated soil or groundwater. The hazards are minimized by limiting dust-generating activities and by protecting against skin contact with contaminated soil and water. Thus, personnel will wear nitrile gloves, work uniforms or coveralls, and safety glasses at all times during the field work. Based on the site conditions (paved or developed areas), exposure risk from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.7 Explosives and Propellants

Explosive materials are substances or mixtures of substances which, when suitably initiated, decompose with the rapid formation of large volumes of hot gases, causing extreme high pressures. An explosive material may be a solid, liquid, or gelatinous substance. Explosives are commonly categorized as primary and secondary explosives, propellants, and pyrotechnics. Primary explosives are the most sensitive and will trigger an explosive reaction; whereas secondary explosives produce a high-velocity shock wave and large volumes of gas. They are manufactured both for military and commercial applications. Military explosives are used in a wide range of equipment, including shells, bombs, and missiles. Propellants are used to accelerate a bullet or shell along the bore of a gun or to provide thrust to propel a rocket or missile. Pyrotechnic compositions have a wide range of applications, including signaling and illuminating flares, fireworks, incendiary devices, smoke flares, explosive igniters, and as propellants (UK DOE, 1995).

As a result of the history of Camp Ravenna, some UXO has surfaced and been found by construction personnel; therefore, it is possible that additional MEC may be encountered during field investigation activities. Specific details regarding MEC avoidance protocols and UXO avoidance are discussed in Section 10.16 of the FWSHP.

9.2.1.8 Cyanide

Cyanides are fast-acting lethal poisons that can exist in various forms. Cyanide can be a colorless gas, such as hydrogen cyanide or cyanogen chloride, or a crystal form, such as sodium cyanide or potassium cyanide. Cyanide enters water, soil, or air as a result of both natural processes and industrial activities. When present in air, it is usually in the form of gaseous hydrogen cyanide. Exposure to cyanide may be caused by breathing air, drinking water, eating food, or touching soil that contains cyanide.

Based on the project, it is possible that an inhalation health threat may exist with respect to cyanide-containing soil and/or groundwater during the field investigation and monitoring activities. The hazards are minimized by limiting dust-generating activities and by protecting against skin contact with contaminated soil and water. Thus, personnel will wear nitrile gloves, work uniforms or coveralls, and safety glasses at all times during the field work. Based on the time of the year this project will occur, exposure risk from dust generation is considered to be low. If dust is generated during field activities, a stop work order will be given until sufficient engineering controls (e.g., fans or water) can be implemented to mitigate the hazard.

9.2.1.9 Chemicals Subject to OSHA Hazard Communication

Chemicals brought into the field, such as chemically-preserved sample containers, calibration gases, decontamination solutions, or any other hazardous chemical, must be properly labeled and must have an SDS provided with the chemical. Site employees must be provided the necessary training in accordance with OSHA 29 CFR 1910.1200 requirements. The proper PPE shall be worn by all personnel while handling or using these materials.

9.2.2 Physical Hazards

Potential physical hazards associated with the field investigation and monitoring activities to be performed at Camp Ravenna include noise; slips, trips, and falls; heat and cold stress; ultraviolet

(UV) radiation (non-ionizing) from sunlight; severe weather (tornados, lightning); lifting; materials handling; vehicular traffic; fire; or explosion hazards, MEC, and electrical hazards. The potential physical hazards associated with these tasks are discussed below and summarized in **Table 9-2**. Exposure to ionizing radiation, entry into confined spaces, or exposure to fall hazards greater than 6 feet (ft) is not anticipated.

Table 9-2. Physical Hazards and Effects

Physical Hazard	Effect
Noise	Hearing loss/disruption of communication
Slips, Trips, Falls (Rough Terrain)	Slips and falls/vehicle accident risk increase/instruments malfunction/falling objects
Heat Stress	Heat rash/cramps/exhaustion/heatstroke
Cold Stress	Hypothermia
UV Sunlight (non-ionizing radiation)	Sunburn/eye glare
Severe Weather (e.g., tornados, lightning)	Follow site tornado shelter/site evacuation plans Follow 30/30 rule for lightning (as discussed in Section 9.2.2.6 of this document)/seek shelter
Lifting	Back strain/abdomen/arm/leg muscle/joint injury
Vehicular Traffic	Struck by vehicle/collision
Fire or Explosion Hazard	Burns
Munitions and Explosives of Concern	Burns
Electrical Hazards	Smashing body parts/pinching/cuts/electrocution

Notes:
UV = ultraviolet

9.2.2.1 Noise

Equipment used for drilling and excavation activities has the potential to generate noise levels approaching 85 A-weighted decibels (dBA). Thus, hearing protection must be worn by personnel when they are exposed to noise levels of 85 dBA or greater. A general guideline to follow is if a conversation cannot be held with a person 3 ft from you without raising your voice, the noise levels are too high and hearing protection should be worn.

9.2.2.2 Slips, Trips, and Falls

Slips, trips, and falls are of concern while working at Camp Ravenna. Personnel must be aware of their surroundings while moving about the site. Pathways and work areas must be kept free of debris and supplies to prevent unsafe walking and working conditions. Changes in walking surfaces including ruts, holes, broken pavement, or berms, are known to exist at the site, and the location of these should be identified to all field personnel. If possible, potential slip, trip, and fall areas should be marked with bright flagging or a similar type of marker.

When water is used during any of the work tasks, care must be taken to avoid creating muddy or slippery conditions. If slippery conditions are unavoidable, these areas should be barricaded with warning signs or cones, or the locations communicated to all field personnel.

To prevent foot injury and contamination and to assist in preventing injuries due to slipping, appropriate footwear with waterproof uppers, hard toes, and non-skid soles should be worn at all times.

9.2.2.3 Heat Stress

General requirements for heat/cold stress monitoring are presented in the FWSHP (SAIC, 2011), Section 9.0.

Field personnel may be required to perform their work tasks in ambient temperatures of 70 degrees Fahrenheit (°F) or above or while wearing coveralls or impervious clothing. The average maximum temperatures experienced in Ravenna, Ohio, range up to 80°F from May to September (The Weather Channel, 2015). The frequency of breaks will increase, physiological monitoring will be considered, and all personnel must be instructed on the symptoms of the primary heat-related disorders and how to minimize their chances of becoming affected by them. These disorders, their symptoms, and first-aid measures are outlined below:

- Heat Rash: Decreased ability to tolerate heat, raised red vesicles (bumps or rash) on affected areas, and clothes that chafe. Maintain good personal hygiene and use drying powders or lotions.
- Heat Cramps: Muscle spasms and pain in the extremities and abdomen. Rest in cool area and drink plenty of fluids. If pain persists, seek medical attention.
- Heat Exhaustion: Shallow breathing; pale, cool, moist, clammy skin; profuse sweating; dizziness; lassitude; and fainting. Rest in a cool area and drink plenty of fluids. Get medical attention prior to returning to work.
- Heat Stroke: Red, hot, dry skin; no perspiration; nausea; dizziness; confusion; strong rapid pulse; or coma. Cool victim immediately with cool or cold water. Seek immediate medical attention.

At a minimum, any personnel wearing coveralls or impermeable clothing at temperatures greater than 70°F should take a break every 1 to 2 hours and drink plenty of fluids. The intake of an average of one quart of fluids per hour is recommended. A cool or shaded rest area should be provided.

9.2.2.4 Cold Stress

General requirements for heat/cold stress monitoring are presented in the FWSHP (SAIC, 2011), Section 9.0.

The minimum average temperatures experienced in Ravenna, Ohio, range down to 31°F from November to March (The Weather Channel, 2015). Field work will be conducted during spring and summer months, so there is little danger of any cold stress effects on field team members. Because the combination of wind and rain, even during periods of temperatures in the 60°F range, can cause symptoms of hypothermia, the team will be instructed to carry rain gear or an additional layer of clothing to maintain body temperature.

9.2.2.5 UV Sunlight

Exposure to UV sunlight may be mitigated by field workers by wearing appropriate PPE such as, long sleeved shits and pants, tinted safety glasses, or sunscreen. All PPE used to mitigate the hazards associated with UV sunlight exposure must comply with the PPE requirements outlined in Section 5.0.

9.2.2.6 Severe Weather

Peak tornado season in Ohio is generally April through July, but tornados can and have occurred at any time, during any season. Tornadoes and/or other severe weather conditions may occur during the field work at the installation. Personnel must prepare for tornados and severe weather by familiarizing themselves with shelter locations and warning systems and establishing accountability procedures (e.g., the buddy system). The following precautions should be taken:

- Be aware of the weather to foresee and watch for the buildup of possible thunderstorms;
- Be prepared to demobilize and take cover before thunderstorms are too close;
- Determine shelters on-site for tornadoes or other severe weather events;

- Cease operations when threatening conditions exist; and
- Use extra care when working outside in inclement weather. Poor footing and difficulty driving vehicles can result from wet or icy surfaces.

If personnel are caught outdoors when a tornado is threatening, they should seek shelter in a sturdy building. If a shelter is not in walking distance, workers should try to drive in a vehicle to the nearest shelter. If flying debris is encountered while in a vehicle, there are two options: (1) stay in the vehicle with a seat belt on, keeping your head below the windows and covering it with your hands, an extra jacket, or blanket; or (2) if there is an area which is noticeably lower than the roadway, lie in that area and cover your head with your hands (OSHA, 2014).

If personnel are caught outdoors when lightning is threatening, personnel should seek shelter and follow the 30/30 rule: After the first sign of lightning, count the time until you hear thunder. If the time is less than 30 seconds, seek proper shelter. Wait 30 minutes or more after hearing the last thunder before leaving shelter.

9.2.2.7 Lifting

The use of some sampling equipment involves lifting components that could weigh in excess of 50 pounds (lb). To ensure personnel safety, the following lifting guidelines will be employed at the site:

- If possible, use two individuals to lift heavy objects, such as sample coolers that are filled with samples;
- Establish steady footing when lifting the load;
- Feet shall be spread no wider than the width of the person's shoulders when lifting; and
- Use only one person to give commands when conducting team-lifting activities.

9.2.2.8 Vehicular Traffic

All vehicular traffic routes that could impact worker safety must be identified and the locations communicated to field personnel. Workers must don high visibility safety vests when working near roadways. Whenever necessary, barriers or other methods must be established to prevent injury from moving vehicles. OSHA requirements for working in or around vehicular traffic will be communicated to and followed by all personnel.

9.2.2.9 Fire and Explosion Hazards

Although unlikely due to the outdoor work environment, potentially explosive conditions may be encountered where petroleum hydrocarbons or other flammable gases or vapors have accumulated. Care will be exercised at all times during field activities where flammables are known or suspected to be present. A PID will be used to evaluate the work area for combustible gases whenever flammable chemicals or conditions are encountered. If elevated levels of combustible gases are detected during the field investigation or monitoring activities (above background readings), personnel will temporarily stop work and position themselves upwind from the location of the work area until it is safe to resume their activities (less than background readings).

An ABC fire extinguisher with a minimum charge of 10 lb will be located within 10 ft of the work area. No smoking or open flames are allowed in areas where flammable conditions are known or suspected to be present. When using a gasoline-powered generator, the generator should be placed in an area that has minimal dried vegetation or other potential combustible materials.

9.2.2.10 Munitions and Explosives of Concern

MEC can be UXO, Discarded Military Munitions, or Munitions Constituents. Due to the history and former operations of the facility as the Ravenna Army Ammunition Plant, there is a potential to encounter MEC at the facility. MEC has been previously identified at the facility. Work that involves, or may involve, exposure to MEC will comply with the general requirements outlined in the FWSHP (SAIC, 2011), Section 10.16, and with Section 33 of the USACE *Safety and Health Requirement Manual* (USACE, 2008).

All encountered MEC items or items suspected to be ammunition and any other munitions or explosive device encountered on post must be immediately considered as UXO. Do not touch or move the suspected UXO. Report the incident immediately to Camp Ravenna Range Control or contact the Main Gate Guards. For quick response, contact information is provided in the front of this HASP. Camp Ravenna personnel will take immediate action to secure the area and ensure proper disposal of the suspected UXO.

General actions if UXO is found include:

1. Secure the area
   a. Do not move closer
   b. Do not touch, move, or disturb UXO
   c. Do not transmit radio frequencies, including the use of cell phone
2. Evaluate the degree of danger to personnel and material or facilities
   a. Do not attempt to remove anything near UXO
   b. Clearly mark the UXO area
3. Initiate necessary protective and evacuation measures
4. Notify Camp Ravenna Range Control or Gate Guards immediately by telephone with the description of item. ***Do not*** touch the suspected UXO!
5. Show Camp Ravenna personnel the exact location of the item
6. Render such assistance as may be required in support of clearance operations
7. Note the following information:
   a. Time of encounter (date and time)
   b. Location (coordinates/street/grid name)
   c. Individuals present (names and organization)
   d. Ordnance condition (i.e., buried, partially buried, exposed)
   e. Type of ordnance (rocket, grenade, projectile)
   f. Estimate size of ordnance (length, width, height)
   g. Distinctive features of ordnance (shape, color, markings)
   h. Nearby structures (landmarks, names, types, distance from ordnance)

9.2.2.11 Electrical Hazards

Electrical safety will be of concern for those aboveground activities using equipment or instrumentation that is powered by electricity. The location of overhead electrical lines is also a concern while using large or heavy equipment. Electrical cords or plugs will be equipped with a ground-fault circuit interrupter.

For subsurface work in areas where subsurface utilities are known or suspected to be present, underground utilities/cables must be identified and demarcated, if applicable, by persons knowledgeable about the existence of such utilities, prior to the commencement of drilling or other subsurface exploratory work. General SOPs are described in the FWSHP (SAIC, 2011), Sections 10.7 and 10.8, and provide specific guidance for locating utilities prior to drilling/digging activities.

In addition, the following guidelines will be followed by all personnel while they are on-site:

- All extension cords used for portable tools or other equipment must be designated for hard or extra hard usage and be three-wire pronged.
- All 120-volt, single-phase 15- and 20-ampere receptacle outlets located in areas of moisture or where water contact may occur must be equipped with a ground-fault circuit interrupter.
- Temporary lighting lamps for general illumination must be protected from accidental breakage, and metal case sockets must be grounded.

9.2.3 Biological Hazards

Field staff should be provided with the information and training necessary to avoid accidental injury or illness, which can result from exposure to biological hazards. This includes ensuring the site is carefully assessed when personnel are on location so that the hazards associated with biological entities are recognized and eliminated or controlled. General requirements for biological hazards are contained in the FWSHP (SAIC, 2011). Potential biological hazards associated with the Camp Ravenna sites include poisonous plants, venomous animals, insects; diseases associated with exposure to animals and their waste; and microbial hazards. The hazards associated with these biological entities are discussed below.

9.2.3.1 Poisonous Plants

Although poisonous plants are not expected to be encountered, personnel should be aware of the presence of irritant plants that may be located in areas adjacent to the sites. The most dangerous toxic effects from plants are due to ingestion of nuts, fruits, or leaves. Consequently, personnel are prohibited from eating any fruits, nuts, or other plant material that may grow on-site or adjacent to the site. Common contact poisonous plants of Ohio are listed in **Table 9-3** (Schaffner, 1904). Reactions to contacting poisonous plants vary depending on the person and degree of exposure. If exposed to a contact poisonous plant, personnel may contact poison control at 1-800-222-1222 and seek medical attention, as necessary. Contact with poisonous plants will be minimized or mitigated with proper PPE (e.g., wearing gloves, pants, steel-toed boots, and long sleeves).

Table 9-3. Contact Poisonous Plants of Ohio

Name [1]	**Description** [1]	**Image** [2]
Poison ivy	It is the most widespread and well known contact poison among plants in Ohio. It can be very troublesome to sensitive persons. It is identified by three glossy, oval leaflets, two lateral and one in the center. Leaf color changes with the season; poison ivy leaves are green in the summer but change to shades of yellow, orange, and red in the fall and spring. The hairless poison ivy leaves range from three-quarters of an inch to four inches long. Poison ivy grows on woody stems, often climbing on nearby vegetation.	
Poison sumac	Poison sumac in the spring or summer features green leaves accompanied by green flowers and white fruit. In the fall, the plant changes to vibrant hues including yellow, scarlet, and purple. Poison sumac sap envelopes all of the plant, so simply brushing up against the leaves can result in a reaction.	
Poison oak	Contact with the oil on poison oak leaves results in burning, itching skin followed by a rash. Like poison ivy, poison oak features three-parted, shiny leaves that are green, red, orange, yellow, or reddish black, depending on the season.	
Nettle	This plant has more nuisance value than true poisonous qualities. The stinging sensation is unpleasant but not long lasting	
Snow-on-the-mountain	This and other Euphorbias are irritating to varying degrees to many persons.	

Sources:
[1] Schaffner, J.H. 1904. Poisonous and Other Injurious Plants of Ohio. United States Department of Agriculture (USDA). Ohio Journal of Science. January.

Table 9-3. Contact Poisonous Plants of Ohio (Continued)

[2] In order of appearance in table:
Huffman. 2013. Fact and Fiction about Poison ivy. Consumer Affairs. Retrieved from: http://www.consumeraffairs.com/news/fact-and-fiction-about-poison-ivy-042213.html
USDA. Natural Resources Conservation Service. Retrieved from:
Poison Sumac. http://plants.usda.gov/core/profile?symbol=TOVE
Poison Oak. http://plants.usda.gov/core/profile?symbol=TOPU2
Secretly Healthy. 2014. Retrieved from: http://www.secretlyhealthy.com/nettle-stinging-health/
Morris, S., 2013. Daffodil, the Flower of March. Retrieved from: http://www.stephenmorrisauthor.com/daffodil-the-flower-of-march/
Robs Plants. 2008. *Euphorbia marginata* 'Summer Icicle': Snow on the Mountain. Retrieved from: http://www.robsplants.com/stock/photo.php?id=157

9.2.3.2 Insects

Insects may be encountered at any outdoor work area. Insects that may be encountered at the site and could pose a health and safety concern to field personnel include bees, wasps, scorpions, spiders, ticks, and mosquitoes. Contact with insects will be minimized or mitigated with proper PPE (e.g., wearing gloves, pants, steel-toed boots, and long sleeves).

All spiders have poison; however, only a few have poison strong enough to harm humans. Only two groups of Ohio spiders, the black widows and the recluse spiders (**Table 9-4**) are considered dangerous to humans (ODNR, 2012). Reactions to spider bites vary depending on the person, type of bite, location of bite, and the amount of venom released. If bitten by any of the insects shown in **Table 9-4**, personnel may contact poison control at 1-800-222-1222 and seek medical attention as necessary.

Table 9-4. Harmful Spider Species Found in Ohio

Brown Recluse Spider	Black Widow Spider	Mediterranean Recluse Spider
		

Source:
Ohio Department of Natural Resources (ODNR), Division of Wildlife. 2012. Common Spiders of Ohio Field Guide. Retrieved from: http://wildlife.ohiodnr.gov/portals/wildlife/pdfs/publications/id%20guides/pub5140.pdf

Personnel who know that they are allergic to bee, wasp, or scorpion venom should carry their sting kits to the field site and inform coworkers of their allergic reaction and the location of their kit. For personnel who are not allergic to bee, or wasp, or scorpion venom, treatment of these bites can be handled by basic first-aid treatment. If stung by a bee or wasp, remove the stinger immediately using tweezers or by scraping with a flat edge. Apply a cold compress to the area for 10 to 30 minutes. An antihistamine such as Benadryl, taken by mouth or applied in a topical cream, can give some added relief, and help prevent the reaction from spreading.

When possible, avoid tick-infested areas. Be alert for ticks in high grasses or brushy areas or areas where wildlife is known to be present or to frequent. Wear clothing that interferes with ticks attaching to the skin, such as long sleeve shirts that are tight at the wrists and tucked in at the waist. Wear long pants that are either gathered around the ankle or tucked into the boots or socks. Wear light-colored clothing so ticks can be seen more easily. Insect repellants containing DEET can be applied to clothes and exposed skin to help minimize tick bites; however, application to exposed skin should be minimized. Every 4 hours and at the end of each workday, field personnel should inspect their clothes, hair, and exposed skin areas and their co-workers thoroughly for ticks.

When possible, avoid mosquito-infested areas, including stagnant pools of water. Mosquitoes are carriers for Dengue Fever that can cause severe illness and often death. When personnel have to work in areas that are potentially mosquito infested, they should wear long-sleeved shirts and long pants, avoid wearing scented products, tuck pants into socks or boots, and spray outer clothes with DEET or permethrin-containing insect repellant. Minimize using either DEET or permethrin on skin.

9.2.3.3 Rodents

According to the Centers for Disease Control and Prevention (2012), four species of rodents that carry the Hantavirus have been identified in the U.S. and its territories. They include the deer mouse, the cotton rat, the rice rat, and the white-footed mouse. The virus is present in their feces and urine, and remains active after the wastes are dry. Care should be taken to avoid contact with feces and urine by wearing proper PPE for your hands, and when walking through dusty areas where feces are present, avoid raising dust. Contaminated clothing and footwear should be removed and washed as soon as possible, taking care not to wash the contaminated materials with other clothing.

The primary exposure pathway for the Hantavirus is through respiration of the contaminated dust. The virus can also be contracted by touching contaminated dust, feces, or urine and touching the eyes, nose, or mouth. Additionally, the virus can be contracted through mouse or rat bites.

Symptoms of Hantavirus infection, or Hantavirus pulmonary syndrome, appear approximately 1 to 5 weeks after contact and include fever, severe muscle aches, and fatigue. Untreated, symptoms will progress to difficulty breathing, headaches, dizziness, chills, nausea, vomiting, diarrhea, and stomach pain.

The optimum exposure prevention is avoidance. If rat or mouse droppings are present, do not enter the area and report the condition to the SSHO. If an area must be accessed, use a dust mask, boot covers, and surgical gloves. Upon leaving a contaminated area, dispose of all protective wear in a plastic bag. The PPE should *not* be reused. Wash hands, face, and any other exposed skin with soap and water, rinsing and drying well.

9.2.3.4 Dead Animal Carcasses

Dead animal carcasses may be encountered during the field investigation. Health risks to humans from exposure to dead animal carcasses are low if proper precautions are taken. The following precautions should be taken if dead cattle or other animal carcasses are encountered during the field investigation:

- Do not move or disturb the animal carcass. Contact local police or fire and rescue to report the finding and have it removed.
- During field work, practice proper hand washing to prevent infection from residual pathogens that may be transmitted from carcasses that were removed by others.
- After working in an area where a carcass has been removed, wash work clothes separately from street clothes.
- Shower and wash hair thoroughly after working in an area from which a carcass had been removed.

9.2.3.5 Snakes

Ohio has three species of poisonous snakes: the timber rattlesnake (*Crotalus horridus*), Eastern massasauga (*Sistrurus catenatus*), and northern copperhead (*Agkistrodon contortrix*). The timber rattlesnake and the copperhead are found in the southern half of Ohio, presumably not near Camp Ravenna. The massasauga ranges into northeastern Ohio, which includes the area of Camp Ravenna (ODNR, 2008). **Table 9-5** shows the unique coloring of each poisonous snake in Ohio and their respective habitat locations. Contact with snakes will be minimized or mitigated with proper PPE (e.g., wearing gloves, pants, steel-toed boots, and long sleeves).

Table 9-5. Poisonous Snakes of Ohio

Northern Copperhead	Massasauga	Timber Rattlesnake
		

Source: Ohio Department of Natural Resources (ODNR), Division of Wildlife. 2008. Reptiles of Ohio, Field Guide. Publication 354 (608). July.

The timber rattlesnakes are long (36 to 60 inches), yellowish brown to dark brown or gray with dark blotches down their back that become cross bands toward the tail (ODNR, 2008). The head is usually unmarked, and the tail (in adults) is black. Timber rattlesnakes prefer to live in forested areas with rock outcroppings suitable for hibernation. Timber rattlesnakes may be active in the day or night time, depending on the temperatures.

Eastern massasauga are small (18 to 24 inches), gray to brownish gray snakes with stout bodies and small rattles. They have been historically recorded in 30 Ohio counties. Eastern massasauga live in prairie or grassland habitats, often near marshes and rock outcrops (ODNR, 2008).

Copperhead snakes are long (approximately 24 to 36 inches), stout-bodied, copper to tan or chestnut colored with reddish-brown hourglass cross banding down the back. Young copperhead snakes have a yellow-tipped tail, and are born late summer to early fall. Their natural habitat consists of wooded areas with rocky outcrops for hibernation. But copperheads are also known to live in abandoned buildings and sawdust, wood, or debris piles. They are generally active during the night and most commonly found in Gage and Richardson Counties (Johnson, 2003).

If bitten by any snake in Ohio, the bite should be washed thoroughly with warm soapy water, bandaged loosely, and Core Health should be consulted for further treatment recommendations. Do not cool with an ice pack, apply a tourniquet or cut into the bitten area (Johnson, 2003). If recommended, the team member should be transported to the nearest medical facility for follow-up testing and treatment. Any indication of infection or severe swelling should be followed by an immediate visit to an emergency medical facility. If additional information is necessary, hospital staff may contact Poison Control Center at 1-800-222-1222.

Snake bites can be avoided by thoroughly inspecting any place hands are to be placed and never placing hands under objects that have not been completely exposed by rolling the object over. It is highly unlikely that field teams will encounter snakes in Ohio; however, if snake habitat is discovered close to the work area, the following precautions should be followed while on the site:

- Wear leather boots that extend above the ankle to protect from snake bites;
- Always watch where you step, sit, and place your hands;
- If bitten on the hand, remove any rings or other jewelry before swelling begins; and
- Do not cut the wound and do not apply a tourniquet, minimize movement of the affected area.

9.2.3.6 Mammals

Do not pet or befriend wild animals as they may carry several communicable diseases, including rabies. Do not offer food to any wild animal, and keep any lunches, snacks, or beverages in sealed coolers. Place any food waste or wrappers in plastic bags, tie closed, and place in a trash receptacle or vehicle for eventual disposal.

An abundance of rats and mice are found in some places in Ohio. Rats carry diseases that can be transmitted by a bite, fecal material, or from parasites/lice/fleas that have been on the rat. Rat bites can also be severe and infection is likely with every bite. If bitten by a rat, immediately remove all jewelry to minimize swelling risks, clean the wound with warm soapy water, control the bleeding (if any) using appropriate steps, and apply a clean, dry bandage with antibiotic ointment. For severe bleeding, do not apply a tourniquet; instead go immediately to the hospital.

9.2.3.7 Microbial Hazards

Microbial hazards can occur when the materials workers are handling are biologically contaminated. Sources of exposure include poor sanitation and bloodborne pathogens. Proper sanitation and first-aid equipment will be provided to the field personnel, and their locations and procedures to avoid microbial hazards will be provided in the initial safety training. A minimum of two field personnel will be current in first aid and CPR training.

Waterborne and foodborne diseases can be contracted if adequate precautions are not taken to keep food and drinking water properly stored and isolated.

Tetanus is another biological hazard encountered on hazardous waste sites. If the skin is broken by any piece of equipment which is covered with soil, or if a field team member is bitten by a reptile, amphibian, or mammal, and the skin surface is broken, a tetanus shot may be necessary. Core Health should be consulted for first aid treatment and follow-up vaccination.

9.3 General Safety Requirements

Modified Level D protective equipment, which includes work clothes or coveralls, steel-toed boots, and safety glasses or goggles, shall be worn at all times when working at the site. Additional

PPE (i.e., outer gloves, neoprene boots, respirators) shall be available for emergency use or for use on tasks where this level of PPE has been selected for personnel safety.

Eating, drinking, smoking, and horseplay shall be strictly prohibited in the immediate work area. Routine and scheduled inspections shall be conducted, along with system monitoring, to ascertain that the work site is free of chemical and physical hazards, and that SOPs are being performed in accordance with this HASP and those outlined in the FWSHP (SAIC, 2011). Inspections shall be made of all emergency response equipment and to assure that fire extinguishers are available for use. In case of a fire or other emergency, Camp Ravenna Range Control should be contacted to coordinate emergency response.

Petroleum hydrocarbons and their lighter-weight constituents are flammable. Smoking is not permitted on-site except in designated areas. Because of the anticipated contaminants that will be encountered during the field work and the age of the contaminants, it is not likely benzene will be encountered in significant quantities.

10.0 SITE CONTROL MEASURES

General site control measures are described in the FWSHP (SAIC, 2011), Chapter 11. Measures specific to this PWS are discussed below.

10.1 Site Control Measures

The purpose of site control is to minimize the H&S risks to the field personnel and the general public by means of establishing work zones and control procedures. Because of the nature and concentrations of the contaminants present at the site, airborne exposures (above the PEL) to contaminants are not anticipated. Therefore, modified versions of the three work zones as described by OSHA and USEPA hazardous waste regulations will be implemented by the field personnel.

Because disposable PPE will be worn by field personnel while they are performing the field investigation and sampling activities, decontamination stations will not be required. Necessary first aid equipment will be located within the support vehicle, and emergency decontamination materials will be available. The Support Zone is considered to be uncontaminated; thus, personnel shall remove any PPE that has come into contact with hazardous waste or materials prior to entering this zone.

10.2 Work Zones

There are three primary work zones used for site control. A description of each of the zones is provided below as a reference for field workers.

10.2.1 Exclusion Zone

The Exclusion Zone, by definition, is an area that may be contaminated at levels posing a threat to site workers. If an area is known or suspected to be contaminated at elevated levels, only persons fulfilling H&S training requirements (including 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.1200) would be allowed to work in these zones.

A 25-ft perimeter will be established around the Exclusion Zone to prevent unauthorized personnel from entering. As necessary, the perimeter of the Exclusion Zone will be demarcated using cones, barrier tape, or visual monitoring by the SSHO.

10.2.2 Contaminant Reduction Zone

The contaminant reduction zone (CRZ) is a buffer zone between the Exclusion Zone and the Support Zone. Decontamination and doffing of PPE must occur in the CRZ before entering the Support Zone. By definition, the CRZ is presumed contaminated, although by design, it should be less contaminated than the Exclusion Zone.

The CRZs have controlled exit points to their respective Support Zones. Leading to these exit points will be decontamination equipment and supplies organized to support moving from a more contaminated area (near the site activities) to a less contaminated area (the support vehicle).

It is not anticipated that work areas in this field investigation will be contaminated at levels posing a threat to workers as described above; therefore, a CRZ will not be demarcated beyond the exclusion zone described previously. If levels of contamination are determined in the field to pose a threat to workers and the environment, the HASP will be revised to include provisions for a CRZ.

10.2.3 Support Zone

By definition, the Support Zone is presumed to be free from site hazards. Activities in the Support Zone may include pre-entry briefings, field work coordination, PPE and contaminant-free equipment and supplies storage, PPE donning, documentation production, and sample handling.

The Support Zone will be the only zone where eating and drinking are allowed. The support vehicle will be located at least 10 ft from the investigation activities.

It is not anticipated that work areas in this field investigation are contaminated at levels posing a threat to workers as described above. Therefore, the support zone will be all areas outside of the exclusion zone.

10.3 Safe Work Practices

Safe work practices for site activities include the following:

1. Only vehicles and equipment necessary to complete work tasks (such as the drill rig and support trucks) will be permitted within the exclusion zone. All non-essential vehicles and equipment will remain within the support zone.
2. Containers (such as drums) will be moved only with the proper equipment and will be secured to prevent loss of control during transport.

3. All personnel will avoid contact with potentially contaminated substances. Walking through puddles or mud and kneeling on the ground will be avoided whenever possible.
4. Food and beverages, use of tobacco products, and application of cosmetics will not be permitted in the exclusion zone.
5. All personnel will be required to wash their hands and faces before eating, drinking, smoking, or applying cosmetics.
6. Site personnel will observe each other for signs of toxic exposure and heat stress. Indications of adverse effects include but are not limited to changes in complexion and skin discoloration, changes in coordination, changes in demeanor, excessive salivation, and changes in speech patterns.

Site personnel will inform each other of non-visual effects of illness, such as headache; dizziness; nausea; blurred vision; cramps; and irritation of eyes, skin, or respiratory tract.

10.3.1 Daily Safety Meetings

Prior to daily work commencing, a Tailgate Safety Meeting (Attachment C) will take place to review site-specific issues, such as the following:

1. Individual responsibilities and the chain of command (highest ranking able employee directs and commands any emergency activities until he/she is relieved of authority by a higher-ranking person);
2. Prevention and recognition of emergencies (any employee may stop work if an emergency is recognized); and
3. Evacuation routes, safe distances, and places of refuge (proceed to the nearest access point, typically upwind and uphill).

10.3.2 Personnel Precautions

1. Eating, drinking, chewing gum or tobacco, smoking, and any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the exclusion zone and in any other area known to be contaminated.
2. The hands and face of each employee must be thoroughly washed upon leaving the work area.
3. Contact with contaminated or suspected contaminated surfaces should be avoided. When possible, do not walk through puddles, leachate, or discolored surfaces; kneel on the ground; or lean, sit, or place equipment on drums, containers, or the ground.
4. Medicine and alcoholic beverages can cause or increase the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel at hazardous waste

operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverage consumption will not be allowed during working hours. Illegal drug intake will not be allowed at any time. Personnel under the influence of alcoholic beverages, illegal drugs, or drugs that impair field skills will be removed from the site.

5. All personnel must be familiar with standard operating safety procedures and any additional instructions and information contained in this HASP. All visitors and subcontractors shall read this HASP prior to entering the site.
6. Personnel will be familiar with the chemicals used on-site and the associated hazards as described in each respective SDS. The SDSs for appropriate chemicals used by personnel on-site will be available and located in the company vehicle (Attachment B). Personnel on-site will be familiar with the hazard communication program prior to performing any activity on-site.

See Section 5.0 for PPE requirements, including respirators.

10.3.3 Operations

1. All personnel going to the site must be adequately trained and thoroughly briefed on anticipated hazards, equipment, safety practices, emergency procedures, and communications.
2. Any required PPE must be worn by all personnel going into areas designated for wearing protective equipment.
3. Personnel on-site must use the buddy system as specified in OSHA 29 CFR 1910.120. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.
4. During continuous operations, on-site workers act as safety backup to each other; off-site personnel provide emergency assistance.
5. Personnel should practice unfamiliar operations prior to the actual procedure. This practice will occur in an area outside of the zone of exclusion.
6. Personnel and equipment in the contaminated area should be minimized, consistent with effective site operations.
7. Work areas for various operational activities must be established.
8. Procedures for leaving a contaminated area must be planned and implemented prior to going to the site. Work areas and decontamination procedures must be established based on expected site conditions.

9. Frequent and regular inspections of site operations will be conducted to verify compliance with this HASP. If changes in operations occur, the HASP must be modified to reflect these changes.
10. All electrical equipment (i.e., power tools, extension cords, instruments, radios) shall conform to OSHA 29 CFR 1926.400, Subpart K.
11. Fire prevention and protection (i.e., appropriate signs for flammable liquids, smoking areas, storage areas of combustible or flammable materials) shall be in accordance with OSHA 29 CFR 1926.150, Subpart F.
12. Site safety meetings will be held daily to discuss anticipated site conditions and daily activities. This meeting will be summarized in the field logbook.

10.3.4 Vehicle Issues

In heavy traffic areas, use extra caution when moving around the site. Observe contractor personnel on the site to ensure their safety as well. Precautions that can be taken include traffic barricades, cones, signs, a flag person who keeps a constant watch on traffic, and blocking the work area with vehicles. Planning processes for the traffic control needed when activities must be conducted in the roadway or in the right-of-way where traffic flow will be altered will be designed and implemented according to the Manual on Uniform Traffic Control Devices, current edition (Federal Highway Administration, 2009).

The following traffic areas may be present at the investigation area and need to be considered:

- Highway and road shoulders;
- City streets;
- Parking lots; and
- Construction sites.

10.3.5 Weather Hazards

This information is presented in Section 9.2.2.6.

10.3.6 Drill Rig Safety

General drill rig SOPs are discussed in the FWSHP (SAIC, 2011), Section 10.15.

It must be verified that subcontractor drilling personnel meet the OSHA definition of qualified persons to operate the drill rig. It is necessary to practice proper safety measures when drilling with a hollow-stem auger drill rig or direct push sampling rig. Each morning, prior to commencing field work, the subcontracting drillers will conduct a drill rig inspection using the Daily Safety Inspection Form (Attachment C). Additionally, the Weekly Drill Rig Checklist inspection (Attachment C) will be conducted weekly and certified by the subcontractor, and the report will be reviewed by TEC-Weston JV. General drill rig safety includes:

- Be aware of all other on-site personnel and their movement;
- Ensure the driller wears proper PPE, as described in Section 5.0, when operating the drill rig;
- Do not place any body parts within range of the rotary bit;
- Do not disturb the operator of the drill rig while it is in operation; and
- Make yourself visible to the drill operator before approaching him/her.

10.3.7 Area Marking

Cones or construction barricades and/or yellow caution tape will bound all areas to enhance demarcation of all field activities.

10.4 Health and Safety Equipment Checklist

Table 10-1 provides a checklist of the H&S equipment. Anticipated H&S equipment includes PPE (modified Level D), instrumentation, first aid equipment, and decontamination equipment.

Table 10-1. Health and Safety Equipment Checklist

PPE – Level D (Modified)		First Aid Equipment	
Steel-Toed Boots		First Aid Kit	
High Visibility Vest		Hand Wipes	
Safety Glasses /Safety Goggles		Eyewash Bottles	
Nitrile Gloves		Soap and Water	
Hard Hat		**Decontamination Equipment**	
Rain Gear		Alconox	
Saranex Suit		Buckets/ Wash Tubs	
Hearing Protection		Trash Bags/ Trash Cans	
Leather Working Gloves		Duct Tape	
Equipment and Materials		Deionized Water	
Instrumentation		Paper Towels	
Detector Tube		Traffic Cones	
PID		Scrub Brushes	
Calibration Gas		Pressurized Sprayer	
Calibration Log		Plastic Sheeting	
Documentation		Disposable Tarps	
Safety Data Sheets		Yellow Caution Tape	
Container Labels		Isopropyl alcohol	
Employee Training Records		**Miscellaneous**	
Health and Safety Plan		Radios or Cell Phones	
Required OSHA and Workman's Compensation Posters		ABC Fire Extinguisher	
		Drinking Water	

Notes:
OSHA = Occupational Safety and Health Administration
PID = Photoionization Detector
PPE = Personal Protective Equipment

10.5 Accident Prevention

Accident prevention is the best way to eliminate the possibility of injury to employees and equipment damage. Accidents are usually complex and arise out of several events or causes. Most accidents are also preventable by eliminating one or more causes. The AHA is an accident prevention strategy designed to identify the specific causes or occupational hazards associated with a task. The AHA assimilates the relationship between the worker, the tools, the task, and the work environment. The purpose of an AHA is to identify hazards before they occur, by breaking down each activity into smaller steps.

Attachment A provides the AHA from the FWSHP (SAIC, 2011) for the following:

- Mobilization and demobilization;
- Vegetation clearing (if required for other field activities);
- Civil survey;
- Soil boring and sampling, MW installation using a drill rig, and groundwater sampling (including UXO avoidance);
- MW abandonment;
- IDW handling; and
- Equipment decontamination.

10.5.1 Heavy Equipment Operation

Heavy equipment operation activities will be performed by subcontractors. At a minimum, sampling personnel will wear modified Level D PPE and defer to the subcontractor’s H&S requirements (e.g., the subcontractor’s HASP or AHA) when working near the heavy equipment. The SSHO shall ensure that equipment operators observe regular scheduled breaks from work activities, and a brief discussion of ergonomic hazards should be added to the list of topics included in Tailgate H&S meetings (Attachment C). Use of hearing protection shall be required within 12 ft of heavy equipment operation. When working in areas where regular conversation is impacted as a result of noise, select the appropriate hearing protection to allow for the recognition of audible emergency signals. Observe wind speed and direction each work day and modify operations as needed to prevent contamination of workers by airborne particulates.

10.5.2 Sampling Practices

This information is provided in Section 4.0 of the Field Sampling Plan (A.1 of Appendix A Sampling and Analysis Plan).

10.6 Site Security

The facility is secured by a facility perimeter fence that has two main access gates that are manned by security guards. Access to the facility must be coordinated and approved by the OHARNG. All TEC-Weston JV personnel will comply with site security protocols.

11.0 PERSONAL HYGIENE AND DECONTAMINATION

Proper decontamination procedures will be employed during the field investigation as outlined in the FWSHP (SAIC, 2011), Section 12.0. Monitoring activities, as discussed in Section 7.0 of this document, to minimize exposure of personnel to contaminated materials and to minimize the possibility of cross-contamination from contaminated equipment will also be employed. Disposal of decontamination wastes will be through certified disposal transporters/operators according to the waste characteristics.

11.1 Personnel Decontamination

Revisions to the decontamination requirements will be established prior to site work on a case-by-case basis. The SSHO, with concurrence from the PHSO, will be responsible for revising the decontamination requirements.

Direct contact with pure contaminants is not anticipated. Instead, a more likely scenario is physical contact with materials such as decontamination water used for cleaning sampling equipment. Disposable PPE will be worn by field personnel while they are performing the field investigation and monitoring activities. Because gross contamination is not anticipated, all disposable PPE shall be placed into a labeled container for subsequent off-site disposal with other decontamination wastes. In non-gross contamination work areas, to ensure the protection of field personnel, simple decontamination of personnel will be performed outside of the Exclusion Zone.

11.2 Sampling Equipment Decontamination

This information is included in Section 4.0 of the Field Sampling Plan (A.1 of Appendix A Sampling and Analysis Plan).

11.2.1 Contamination Prevention

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention practices should minimize personnel exposure and help ensure valid sample results by precluding cross-contamination.

Personnel should observe the following procedures for contamination avoidance:

- Do not walk through areas of obvious or known contamination;
- Do not handle or touch contaminated materials directly;
- Make sure all PPE has no cuts or tears prior to donning;
- Fasten all closures on suits, covering with tape if necessary;
- Particular care should be taken to protect any skin injuries;
- Stay upwind of airborne contaminants;
- Dust controls shall be implemented, as necessary; and
- Do not carry items such as cigarettes, gum, food, or water into the exclusion zone area or CRZ.

11.3 Waste Handling/Packaging

All discarded materials, waste materials, or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on-site. All potentially contaminated materials (e.g., outer boots and gloves, Saranex suits, towels) shall be placed in labeled containers with secure lids for subsequent off-site disposal.

All contaminated waste materials will be properly stored in appropriate containers until final disposal at an approved disposal facility. Storage of waste materials will not exceed a period of 90 days, and access to the storage location will be limited to authorized personnel only. All uncontaminated materials shall be collected and contained for appropriate disposal as normal domestic waste.

12.0 EQUIPMENT DECONTAMINATION

This information is presented in Section 4.0 of the Field Sampling Plan (Appendix A.1 of Appendix A Sampling and Analysis Plan).

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13.0 EMERGENCY PROCEDURES AND EQUIPMENT

13.1 Communication

Several different means of communication may be utilized by field personnel in order to communicate emergency and non-emergency information. In accordance with the FWSHP (SAIC, 2011), Section 13.2, a telephone and a two-way radio will be present in the field and available for use at all times. These devices may include, but are not limited to:

- Radios—Two-way radio units may be utilized by field teams for communication between field operations and support services. All radio frequencies need to be cleared through Range Control prior to use.
- Telephones—Field personnel will have cellular telephones for communication with each other and emergency support services/facilities.
- Hand Signals—Hand signals may be used on-site to communicate safety, emergency response, and evacuation procedures. The hand signals should be determined on the first day at the Tailgate Meeting, if the noise level warrants.

All emergencies on-site will be coordinated first through the Range Control who will coordinate the response.

13.2 Contingency Plan

13.2.1 Injury/Medical Emergency

At least two field personnel will be trained in administering adult first-aid/CPR treatment techniques. A first-aid kit will be located in the support vehicle. Injured personnel are to be immediately administered first aid as appropriate and transported to the nearest medical clinic/hospital (**Figure 13-1**). Copies of the figures and directions will be kept in the support vehicle, and their location communicated to all field personnel at the daily Tailgate Meeting. Emergency contact names and numbers for Camp Ravenna are provided in **Table 13-1**.

Uninjured personnel shall not enter an area to attempt a rescue if there is any doubt concerning the hazards present at the site. The decision whether to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant. If decontamination does not interfere with essential treatment, it should be performed.

For All Medical Emergencies:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Notify the Incident Reporting Officer (IRO) of the injury as soon practical to do so.
- Contact Core Health at 855-227-3661.

Minor Injury:

- Have qualified first-aid site personnel administer treatment, under the direction of a Core Health specialist (855-227-3661).
- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Notify the IRO and record the injury on the appropriate Occupational Safety and Health Administration (OSHA) forms and project logs.
- Contact the Project Health and Safety Officer (PHSO) and Project Manager (PM). The PM will contact the Army National Guard (ARNG) Contracting Officer's Representative (COR).

In the event of a **medical emergency** when an actual or suspected serious injury has occurred, the following procedures shall be implemented:

Medical Emergency:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Survey the scene and evaluate whether the area is safe for entry.
- Remove the victim from immediate danger and render critical first aid.
- Decontaminate the victim after first aid is administered.
- Contact the PHSO, the IRO, and the PM. The PM will contact the ARNG COR.
- Record the injury on the appropriate OSHA forms.
- Assess site conditions and determine whether it is safe for remaining on-site personnel to return to the area.

In the event of a **fatality**, stop work immediately and do the following:

Fatality:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783) who will coordinate the response.
- Contact the PHSO, the IRO, and the PM. The PM will contact the ARNG COR.
- Comply with OSHA reporting and record keeping requirements.
- Stop work following the accident until the accident investigation is completed and permission is granted to return to work.

Medical Non-Emergencies:

- Notify Range Control (desk: 614-336-6041 or cell: 614-202-5783), who will coordinate the response.
- In the event of a non-emergency injury where the case is a First Aid case or worse, a call should be made to Core Health at 855-CARDNO-1 (855-227-3661).
- Immediate first aid may be administered by personnel trained in Adult First Aid/Cardiopulmonary Resuscitation (CPR).
- Notify the PM and IRO of the injury as soon practical to do so.

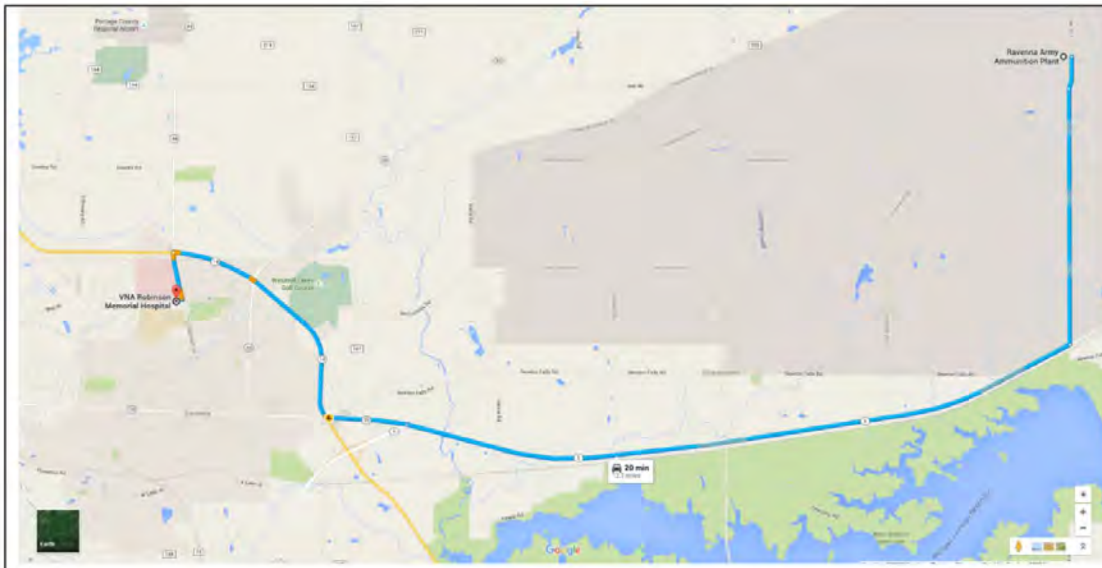
Core Health Injury Management:

If Core Health is dialed, be prepared to provide the following:

- Injured workers' name, date of birth, phone number, and social security number;
- Date/time/type of injury, work site and job title, brief description of how injury occurred; and
- Clinic name/contact information (if applicable).

If the employee does not feel first aid is required initially but subsequently changes his/her mind, Core Health may still be contacted, but the PM and IRO should be consulted first.

Figure 13-1. Most Direct Route to the Local Hospital



Driving Directions:

via OH-5 W — 20 min

19 min without traffic · Show traffic — 12.7 miles

This route has restricted usage or private roads.

Ravenna Army Ammunition Plant

Paris Township, OH

- Head south on Wn St 3
  Restricted usage road
  0.3 mi
- Continue onto Pa St 1
  Partial restricted usage road
  2.4 mi
- Turn right onto OH-5 W
  6.4 mi
- Continue straight onto OH-59 W
  0.8 mi
- Turn right onto OH-14 W/OH-44 N/Cleveland - East Liverpool Rd
  2.4 mi
- Turn left onto N Chestnut St/Ravenna Painesville Rd
  Continue to follow N Chestnut St
  Destination will be on the right
  0.5 mi

VNA Robinson Memorial Hospital

6693 North Chestnut Street, Ravenna, OH 44266

VNA Robinson Memorial

6693 N. Chestnut Street.
Ravenna, OH 44266
(330) 296-2835

Table 13-1. Emergency Contacts

Point-of-Contact	Phone Number	Email
Emergency Contacts		
Camp Ravenna Range Control	614-336-6041 (office) 614-202-5783 (mobile)	N/A
Camp Ravenna Main Gate Guards (after hours only)	330-358-2017	N/A
Camp Ravenna East Gate Guards (after hours only)	614-336-6399	N/A
Local Emergency Contacts		
Poison Control Center	800-222-1222	N/A
National Response Center, Toxic Chemicals and Oil Spills	800-424-8802	N/A
VNA Robinson Memorial 6693 N. Chestnut Street Ravenna, OH 44266	330-296-2835	N/A
Windham Fire Department 9621 E. Center Street Windham, OH 44288	330-326-2222	N/A
Windham Police Department 9621 E. Center Street Windham, OH 44288	330-326-2211	N/A
Contractor Contacts		
Brent Ferry, Project Manager	512-651-7108 (office) 309-236-9235 (mobile)	brent.ferry@westonsolutions.com
David Robinson, Project Health and Safety Officer	937-572-3630 (mobile)	david.robinson@westonsolutions.com
Dave Wazny, Field Team Leader	440-262-2373 (office) 440-781-2467 (mobile)	david.wazny@cardno.com
Lynne Black, Incident Reporting Officer	434-295-4446 (office) 218-390-9909 (mobile)	lynne.black@cardno-gs.com
Camp Ravenna Contacts		
Mark Leeper, NGB Contracting Officer's Representative / Installation Program Manager	703-607-7955	mark.s.leeper.civ@mail.mil
Kevin Sedlak, ARNG Restoration Project Manage	614-336-6000 ext. 2054	kevin.m.sedlak.ctr@mail.mil
Katie Tait, OHARNG Environmental Scientist	614-336-6136	kathryn.s.tait@us.army.mil

Notes:
NGB = National Guard Bureau
N/A = Not applicable
OHARNG = Ohio Army National Guard

13.2.2 Emergency Equipment and First Aid

The Support Zone, which will be the support vehicle, will be equipped with an American National Standards Institute-approved first aid kit for 10 people, and an ABC-type dry chemical fire extinguisher. Each first aid kit will be checked by the SSHO for completeness at least once a week while site work is occurring. Any subcontractor working on-site will be required to have a first aid kit readily available at all times during working hours.

Transportation will be available at all times during work hours to take any ill or injured person to the doctor or hospital, if required. Prospective operators of such transportation will be thoroughly familiar on the location of and route to the appropriate facilities in the local area.

13.2.3 Emergency Response Procedures

All incidents will be dealt with in a manner to minimize health risks to site workers and the surrounding facilities, consistent with procedures established in the FWHSP, Section 13.0. The initial response to any emergency will be to protect human H&S. Secondary response to the emergency will be identification, containment, treatment, and disposal of contaminated materials. In the event of an incident, the following procedures shall be completed at a minimum:

- First aid and other appropriate initial action will be administered by properly trained personnel closest to the incident. This assistance will be conducted in a manner to assure that those rendering assistance are not placed in a situation of unacceptable risk.
- All incidents in the field will be reported to the PM and documented by the SSHO, who is responsible for coordinating the emergency response in an efficient, rapid, and safe manner. Attachment C provides an Incident Report Form. The Incident Report Form will be submitted to the PM, PHSO, and IRO.
- The PM will immediately notify and inform the ARNG COR of the incident (USACE, 2008). The PM will fill out and submit the required Accident Report (Attachment C) to the ARNG COR within 2 days.
- In the event of an accident or emergency, all field personnel are responsible for conducting themselves in a mature, calm manner to avoid spreading danger to themselves, surrounding workers, or the community in general.

Potential incidents fall under four general classifications: (1) chemical material release, (2) fire or explosion, (3) personnel injury or illness, and (4) severe weather conditions such as tornado and lightning storms. Emergency planning procedures for responding to each of these potential incidents are provided in Section 13.0. These procedures will be communicated to all field personnel as part of the initial site-specific training. During activation of the emergency procedures, the SSHO or designated representative will control access to the site.

13.2.4 Personnel Evacuation

In the event of an emergency that necessitates the evacuation of the work area, such as a chemical release or fire or explosion, field personnel will implement the following procedures:

- Because this work will be performed using the buddy system, field personnel will be alerted by shouting, hand signals, or radio.
- Personnel in the Exclusion Zone may or may not perform field decontamination prior to leaving the Exclusion Zone, depending on the nature of the incident requiring the evacuation.
- Once personnel have evacuated to the designated meeting point, the SSHO will perform a head count and contact the necessary emergency response agencies.

13.2.4.1 Tornado Evacuation

Tornado season will occur during site operations. Site workers must complete the TEC-Weston JV-required pre-job safety briefing, which includes emergency plans for tornados and severe weather. All subcontract workers must adhere to bulletins issued for preparation of equipment and evacuation of personnel in advance of the arrival of a pending tornado.

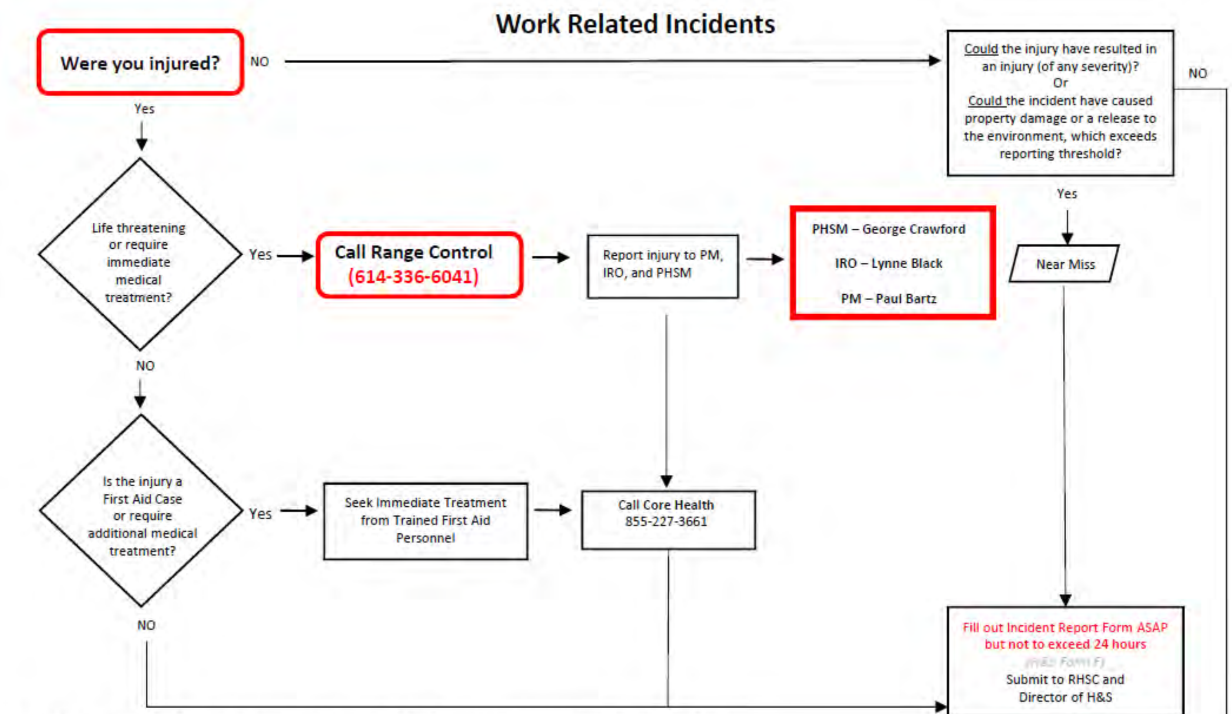
13.2.5 Emergency Contact/Notification System

All field personnel will have access to emergency contact information. If an emergency occurs that requires outside agency assistance or notification, field personnel are instructed to contact the appropriate emergency agencies on the list and to speak directly with a representative of the agency. Never leave an emergency notification on an answering machine, but rather call the 24-hour emergency answering service number if no one answers the primary number.

13.3 Incident Reporting

All work-related injuries, illness, or incidents, including “Near Miss” incidents of personnel, vehicles, and/or environmental incidents/exposures must be reported. **Figure 13-2** presents a flowchart to identify work related incidents. Attachment C provides an Incident Investigation Report form.

Figure 13-2. Incident Reporting Flowchart



If the Core Health Injury Management line is dialed, prepare to provide the following:

- Injured worker(s)' name, DOB, phone number, and SSN
- Date/time/type of injury, work site and job title, brief description of how injury occurred.
- Clinic name/contact information (if applicable)

Core Health should be contacted regardless of whether the Employee feels First Aid is required or not required. Remember that only Medical Professionals may diagnose

* Complete and submit the Accident Report form ***(ENG Form 3394)*** to the USACE Project Manager within 2 days (See Appendix B of the SSHP Addendum).

The following incidents are considered reportable. Emergency response for all reportable incidents will be coordinated though the Range Control:

- **Fatalities—**Reportable to IRO and PHSO immediately upon discovery.
- **High Potential Event—**An incident or near miss with a high potential for fatality, major injury, or serious environmental incident.
- **Major Injury**—An injury that, if left untreated, would endanger life.
- **Medical Treatment Injury/Illness—**Results in care from a doctor or other registered health care professional (but not solely for observation, counseling, diagnostic procedures, and/or first aid).
- **Lost Time Injury/Illness**—Results in one or more days away from work (other than the day of injury/illness).
- **Restricted Work Injury/Illness**—Keeps a worker from either working normal hours or performing one or more of the routine functions of his or her job (other than on the day of injury/illness).
- **First Aid Case Injury/Illness—**Requires first aid care (e.g., cleaning of wounds, wound coverings [bandages], hot or cold therapy, support devises such as finger guards, wraps).
- **"Near Miss"** (also known as a near event)**—**An incident that could easily have resulted in property damage or an injury requiring medical treatment, restricted work, lost time, or property damage.
- **Serious Environmental Incident—**Release to the environment (to soil, water, or air) outside containment, which exceeds any government or client numerical reporting threshold.

13.3.1 Reporting Requirements

All TEC-Weston JV personnel are required to report occupational incidents as defined above.

Upon any incident, immediately notify the PM, PHSO, and IRO (or as soon as practical if the emergency is life threatening).

Fill out the Incident Investigation Report (Attachment C) and submit it to the IRO within 24 hours.

All injuries classified as a First Aid Case or above should be reported to the Core Health Injury Management line.

13.3.2 Accident Investigations

To prevent recurrence, every actual accident, equipment damage, high potential event, or "near miss" incident must be investigated to identify the primary and contributing causes. If the contributing conditions are not eliminated, they will continue to contribute to the potential for future incident/injury. The investigation should focus on causes, not fixing blame. Because most accidents involve unsafe conditions and/or unsafe acts, it is the responsibility of the investigators to uncover causes, both the hazardous conditions and human failures, as well as any system or procedural errors that may have contributed. The SSHO, working with the PM, PHSO, Project Staff, and IRO as necessary, will conduct the investigation of any injury or illness during the project work.

14.0 LOGS, REPORTS AND RECORD KEEPING

14.1 Subcontractor Inspections

The SSHO will perform safety inspections of on-site subcontractors or vendors prior to the beginning of their contract work and periodically during their performance. Issues or deficiencies will be noted in the field logbook and reported to the subcontractor supervisor. If conditions warrant, the SSHO can stop work until the safety violation is addressed and corrected.

14.2 Procedure for Tracking Deficiencies/Corrective Actions

All safety deficiencies identified by any field team member will be reported to the SSHO immediately, with follow-on notification provided to the PM. The SSHO will note all deficiencies in his/her field logbook and will record the corrective actions performed or required to correct the deficiencies. If the SSHO did not implement the corrective action, when the corrective action is complete, the SSHO will be notified by the person responsible for implementing the corrective action and the SSHO will perform a follow-up inspection. All steps to correct the deficiency will be noted by the SSHO and recorded in the field logbook.

14.3 Documentation

All field investigation and monitoring activities, observations, and pertinent field information will be documented by the Site Superintendent on standard forms or in the field logbook. Safety-related information that will be documented during the field investigation is discussed below.

Prior to the start of each workday, the SSHO will review applicable H&S information with all field personnel and subcontractors. These tailgate meetings will review the work to be performed, the hazards associated with the work, protective measures, and appropriate emergency response procedures. Topics discussed and attendees at the tailgate meeting will be documented daily on the appropriate field form.

Results of the SSHO's daily safety inspection of the work area will be documented in the field logbook, along with any deficiencies observed and corrective actions taken. The results of these inspections will be communicated to all field personnel.

Real-time air monitoring/sampling results, site conditions, weather, field activities being performed, and any other unusual or pertinent information will be documented on a daily basis in the field logbook by the SSHO.

In the event that accidents or injuries occur during the field investigation or monitoring activities, the SSHO will fill out a copy of the Incident Investigation Report (Attachment C). The IRO, PHSO, and PM will be notified, with subsequent notification of the ARNG COR, immediately or as soon as possible, after the accident or injury.

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ATTACHMENT A

ACTIVITY HAZARD ANALYSIS

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Table A-1. Activity Hazard Analysis

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation
Activities Job: Site Mobilization and Demobilization

Risk Assessment Code (RAC):

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:
Level D PPE

JOB STEPS			
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	Level D PPE Insect repellant, as necessary. Pant legs tucked into boots or otherwise closed to minimize tick entry or contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18) Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments and/or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and/or animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks, if needed (see Section 9.0) Chilled water if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily. Temperatures greater than 80°F, temperatures less than 30°F, and the use of impermeable clothing require additional controls (see Section 9.0) Site- and season-specific instruction in weather hazards and hazard controls	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdraw all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A

Table A-1. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Site Mobilization and Demobilization

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Exposure to chemicals	Wash face and hands and any other exposed areas prior to taking anything by mouth. HAZWOPER training and medical clearance	EM 385-1-1 06.A and B, and Section 28
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Vehicle Operation	Vehicle accidents	Vehicle operation (valid driver's license, seat belt use, routine vehicle inspections, no cell phone use while driving, compliance with applicable laws and regulations, and defensive driving). Visual inspection includes the vehicle and any associated items such as trailers or external cargo carriers. The operator verifies that the following items are present and functional: seatbelt(s), lights, turn signals, operating brakes, speedometer, fuel gage, horn, windshield, windshield wiper, defrosting/defogging system, rear view mirror, cab, non-slip surfaces on steps, and tires (approximately proper inflation) While driving on RVAAP, facility personnel shall take necessary precautions to avoid hitting deer. Observe and maintain posted speed limits for both day and night driving conditions.	EM 385-1-1 18
Moving Equipment	Musculoskeletal injuries (lifting heavy items)	Maximum 50 lb per individual, safety shoes, mechanical assistance >50 lb An evaluation of potential pinch points and/or weight strain should be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lb, or has to be moved by maneuvering through awkward positioning Plan activities so body is not twisted/contorted	EM 385-1-1 14.A
	General safety hazards (slips, trips, and falls)	Clean and organized work areas, keeping walkways and working areas clear, including snow, ice, and standing water	EM 385-1-1 2.B

Table A-1. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Site Mobilization and Demobilization

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles General hand tools, if necessary	Daily safety inspections of operations. Initial and at least weekly inspections of equipment All tools must be inspected daily and taken out of service if damaged Daily vehicle inspection	HAZWOPER 40-hr training and current refresher training Medical clearance Properly trained personnel to operate equipment Valid driver's licenses Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

Table A-2. Activity Hazard Analysis

Risk Assessment Code (RAC):

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation
Activities Job: Site Walk and/or Civil Survey

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:
Level D PPE

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	Level D PPE Insect repellant, as necessary Pant legs tucked into boots or otherwise closed to minimize tick entry and contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18) Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments and/or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and/or animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks if needed (see Section 9.0) Chilled water if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily. Temperatures greater than 80°F, temperatures less than 30°F, and the use of impermeable clothing require additional controls (see Section9.0) Site- and season-specific instruction in weather hazards and hazard controls	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdraw all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A

Table A-2. Activity Hazard Analysis

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation
Activities Job: Site Walk and/or Civil Survey

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Exposure to chemicals	Wash face and hands and any other exposed areas prior to taking anything by mouth. HAZWOPER training and medical clearance	EM 385-1-1 06.A and B and Section 28
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Vehicle Operation	Vehicle accidents	Vehicle operation (valid driver's license, seat belt use, routine vehicle inspections, no cell phone use while driving, compliance with applicable laws and regulations, and defensive driving). The visual inspection includes the vehicle and any associated items such as trailers or external cargo carriers. The operator verifies that the following items are present and functional: seatbelt(s), lights, turn signals, operating brakes, speedometer, fuel gage, horn, windshield, windshield wiper, defrosting/defogging system, rear view mirror, cab, non-slip surfaces on steps, and tires (approximately proper inflation) While driving on RVAAP, facility personnel shall take necessary precautions to avoid hitting wildlife. Observe and maintain posted speed limits for both day and night driving conditions.	EM 385-1-1 06

Equipment to be Used	Inspection Requirements	Training Requirements
Vehicles	Daily safety inspections of operations. Initial and at least weekly inspections of equipment Daily vehicle inspection	HAZWOPER 40-hr training and current refresher training Medical clearance Properly trained personnel to operate equipment Valid driver's licenses Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

Table A-3. Activity Hazard Analysis

Risk Assessment Code (RAC):

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation Activities
Job: Soil Boring and Sampling, Monitoring Well Installation Using a Drill Rig, and Groundwater Sampling

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:
Level D PPE including hardhat plus nitrile or equivalent gloves for contact with contaminated material

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	Level D PPE Insect repellant, as necessary Pant legs tucked into boots or otherwise closed to minimize tick entry and contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18) Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks if need (see Section 9.0) Chilled water if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily. Temperatures greater than 80°F, temperatures less than 30°F, and impermeable clothing require additional controls Site- and season-specific instruction in weather hazards and hazard controls	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdraw all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A

Table A-3. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Soil Boring and Sampling, Monitoring Well Installation Using a Drill Rig, and Groundwater Sampling

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Lifting heavy items	Evaluation of potential pinch points and/or weight strain. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lb, or has to be moved by maneuvering through awkward positioning	EM 385-1-1 14.A
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Drilling	General safety hazards (rotating machinery, suspended loads, moving equipment, slips, and falls)	Level D PPE (see Section 6.0) plus hard hat No employees under lifted loads At least two functional kill switches Functional back-up alarm Drill rig manual on-site Only experienced operators Exclusion zone at least equal to mast height Hazardous waste safety training Monitoring - daily site safety inspections. Weekly drill rig inspections	EM 385-1-1 18.H
	Noise	Hearing protection within 7.6 m (25 ft) of rig unless rig-specific monitoring indicates noise exposure of less than 90 dB Monitoring - daily safety inspections	EM 385-1-1 05.C
	Fire (vehicle fuels or subsurface contaminants)	Fuels stored in safety containers labeled/listed by nationally recognized testing laboratory Bonding and grounding during fuel transfers Fuel storage areas marked with “No Smoking” or “Open Flame” signs No ignition sources within 50 ft of fuel storage areas Fire extinguishers in all fuel use areas and inspected monthly Monitoring - combustible gas indicator if buried organic material or other source of flammable gas is suspected	EM 385-1-1 09.A
	Contact with buried or overhead electrical or other hazards	Identification and clearance of overhead and underground utilities Monitoring - visual of all work areas	EM 385-1-1 05.I

Table A-3. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Soil Boring and Sampling, Monitoring Well Installation Using a Drill Rig, and Groundwater Sampling

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
Drilling	Operating hand tools or power tools	Clean and organized work areas, keeping walkways and working areas clear. 110-V portable tools will be connected through GFCI	EM 385-1-1 13.A
Soil and Groundwater Sampling	Exposure to chemicals	PPE (Level D) plus nitrile or equivalent gloves for contact with contaminated material. Washing face and hands prior to taking anything by mouth. Staying upwind of any dust-generating activities. Minimal contact Hazard communication training MSDS for chemical tools on-site Chemical containers labeled to indicate contents and hazard Medical clearance for hazardous waste work Decontamination of potentially contaminated equipment prior to servicing Monitoring - photoionization detector or other monitoring as appropriate	EM 385-1-1 06.A and B
	Cuts or other injuries from opening sampling tubes	Use dedicated tube cutter or hooked safety blades when using polymer sample tubes. Wear heavy cut-resistant gloves when opening polymer sample tubes. Keep fingers from between split spoon halves	EM 385-1-1 13.A
Shipping and Packing Samples	Hazardous material shipping/transportation regulatory violation or spill (soil and groundwater samples)	Ensure DOT/IATA compliance if shipping chemicals or other hazardous materials or samples Hazardous materials shippers must be trained and certified	EM 385-1-1 6.B.03.f

Equipment to be Used	Inspection Requirements	Training Requirements
Drill rig Support truck Sampling equipment if necessary	Daily safety inspections of operations. Initial and at least weekly inspections of excavation equipment Daily vehicle inspection All tools must be inspected daily and taken out of service if damaged	HAZWOPER 40-hr training and current refresher training Medical clearance Properly trained personnel to operate drill rig Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

Table A-4. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation

Activities Job: Monitoring Well and Borehole Abandonment

Risk Assessment Code (RAC):

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:
Level D PPE including hardhat plus nitrile or equivalent gloves for contact with contaminated material

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	Level D PPE Insect repellant, as necessary Pant legs tucked into boots or otherwise closed to minimize tick entry and contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18) Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks if needed (see Section 9.0) Chilled water if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily Temperatures greater than 80°F, temperatures less than 30°F, and impermeable clothing require additional controls Site- and season-specific instruction in weather hazards and hazard controls	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdraw all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A

Table A-4. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation

Activities Job: Monitoring Well and Borehole Abandonment

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Lifting heavy items	Evaluate the lift and potential pinch points and/or weight strain. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lb, or has to be moved by maneuvering through awkward positioning	EM 385-1-1 14.A
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Drilling to Abandon Wells	General safety hazards (rotating machinery, suspended loads, moving equipment, slips, and falls)	Level D PPE (see Section 6.0) plus hard hat No employees under lifted loads At least two functional kill switches or switches that require continuous force to activate Functional back-up alarm Drill rig manual on-site Only experienced operators Exclusion zone at least equal to mast height	EM 385-1-1 18.H
	Noise	Hearing protection within 7.6 m (25 ft) of rig unless rig-specific monitoring indicates noise exposure of less than 90 dB Monitoring - daily safety inspections	EM 385-1-1 05.C
	Fire (vehicle fuels or subsurface contaminants)	Fuels stored in safety containers labeled/listed by nationally recognized testing laboratory Bonding and grounding during fuel transfers Fuel storage areas marked with “No Smoking” or “Open Flame” signs No ignition sources within 50 ft of fuel storage areas Fire extinguishers in all fuel use areas and inspected monthly Monitoring - combustible gas indicator if buried organic material or other source of flammable gas is suspected	EM 385-1-1 09.A
	Electric shock	Identification and clearance of overhead and underground utilities Monitoring - visual of all work areas 110-V electrical tools connected through GFCI	EM 385-1-1 05.I
	Struck by equipment, cables, drill rods	Level D+ PPE with hard hat. Maintain general work area awareness, separate work area from drill rig and moving parts where possible. Drilling subcontractor will operate per their own health and safety programs, plans, and procedures and will provide trained and qualified personnel. Driller will inspect the rig at the start of each shift. Drill rig will be equipped with at least two kill switches or will be operated by dead man switches. No workers under suspended heavy loads	EM 385-1-1 18.H
	Operating hand tools or power tools	Clean and organized work areas, keeping walkways and working areas clear. 110-V portable tools will be connected through GFCI	EM 385-1-1 13.A

Table A-4 Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Monitoring Well and Borehole Abandonment

Equipment to be Used	Inspection Requirements	Training Requirements
Drill rig Support truck Hand tools, if necessary	Daily safety inspections of operations. Initial and at least weekly inspections of excavation equipment Daily vehicle inspection All tools must be inspected daily and taken out of service if damaged	HAZWOPER 40-hr training and current refresher training Medical clearance Properly trained personnel to operate drill rig Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

Table A-5. Activity Hazard Analysis

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation
Activities Job: IDW Handling

Risk Assessment Code (RAC):

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:
Level D PPE and nitrile or equivalent gloves for contact with contaminated material

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	PPE (boots, work clothes – long pants and shirts with sleeves) Insect repellant, as necessary Pant legs tucked into boots or otherwise closed to minimize tick entry or contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18 Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments and/or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and/or animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks if needed (see Section 9.0) Chilled water if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily Temperatures greater than 80°F, temperatures less than 30°F, and use of impermeable clothing require additional controls Site- and season-specific instruction in weather hazards and hazard controls	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdrawal of all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A

Table A-5. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation

Activities Job: IDW Handling

3JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Lifting heavy items	Evaluate lifts in advance. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lb, or has to be moved by maneuvering through awkward positioning	EM 385-1-1 14.A
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Operating equipment	General hazards (lifting equipment, manual lifting, and slips)	Level D PPE including heavy duty gloves for materials handling (see Section 6.0) Unnecessary personnel will stay well clear of operating equipment Functional back-up alarm on fork trucks, bobcats, trucks, etc. Documented forklift training for forklift operators Only experienced operators will be allowed to operate equipment No personnel allowed under lifted loads Lifts of over 50 lb will be made with two or more personnel or with lifting equipment Hazardous waste safety training Compliance with EM 385-1-1, Sections 14 and 16	EM 385-1-1 14.A and 18.G.29
	Load stability	All loads will be secured to the forklift with locking strap or equivalent. Whenever possible, loads will be transported without stacking	EM 385-1-1 14.A and 18.G.29
	Visibility	Ensure maximum visibility is available when transporting drums. If vision is obscured, drive in reverse if possible	EM 385-1-1 14.A
	Pinch points	Be aware of all pinch points when handling drums or containers. Heavy duty gloves	EM 385-1-1 14.A
	Musculoskeletal injuries (opening/closing drums)	Plan activities so body is not twisted/contorted. Evaluate potential pinch points. Use proper tools for the task. Lifts of more than 50 lb require mechanical assistance or buddy lift	EM 385-1-1 13.A
	Fire (vehicle fuels and flammable contaminants)	Fuels stored in safety containers labeled/listed by a nationally recognized testing laboratory Bonding and grounding during fuel transfers Fuel storage areas marked with "No Smoking" or "Open Flame" signs Fire extinguishers in all fuel use areas and inspected monthly No ignition sources within 50 ft of areas where flammable materials are stored	EM 385-1-1 09.A
	Noise	Hearing protection within 7.6 m (25 ft) of any noisy drum moving equipment unless equipment-specific monitoring indicates exposures less than 90 dB	EM 385-1-1 05.C
	Electric shock	Identification and clearance of overhead utilities. Maintain at least 10 ft from all electrical wiring, more for high-voltage systems. Electrical tools must be connected through GFCI	EM 385-1-1 05.I
	Exposure to chemicals	PPE (Level D) plus nitrile or equivalent gloves for contact with contaminated material. Washing face and hands prior to taking anything by mouth Minimal contact	EM 385-1-1 06.A and B

Table A-5. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: IDW Handling

Equipment to be Used	Inspection Requirements	Training Requirements
Fork trucks, bobcats, and trucks, if necessary	Daily safety inspections of operations. Initial and at least weekly inspections of equipment	HAZWOPER 40-hr training and current refresher training Medical clearance
Hand tools	All tools must be inspected daily and taken out of service if damaged	Properly trained personnel to operate equipment Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

Table A-6. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Equipment Decontamination (Hot or Pressurized Water Washing, Soap and Water Washing, HCl, and Methanol or Isopropanol Rinse)

Risk Assessment Code (RAC):

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:
Level D PPE and nitrile or equivalent gloves for contact with contaminated material

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	PPE (boots, work clothes – long pants and shirts with sleeves) Insect repellant, as necessary Pant legs tucked into boots or otherwise closed to minimize tick entry or contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18) Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments and/or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and/or animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks if needed (see Section 9.0) Chilled drinks if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily. Temperatures greater than 80°F, temperatures less than 30°F, and the use of impermeable clothing require additional controls	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdraw all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A
	Electric shock	GFCIs for electrical equipment/tools used in decontamination. Inspect electrical equipment for damaged or missing insulation and remove unsafe equipment from use	EM 385-1-1 11.E

Table A-6. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Equipment Decontamination (Hot or Pressurized Water Washing, Soap and Water Washing, HCl, and Methanol or Isopropanol Rinse)

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Lifting heavy items	Evaluate potential pinch points and/or weight strain prior to lifting. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lb, or has to be moved by maneuvering through awkward positioning	EM 385-1-1 14.A
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Equipment Decontamination	Hot water, slips, falls, and equipment handling	Level D PPE (see Section 6.0) plus nitrile or PVC gloves Face shield and Saranax or rain suit (when operating steam washer)	EM 385-1-1 13.A
	Noise (spray washer)	Hearing protection when washer is operating unless equipment-specific monitoring indicates that exposure is less than 90 dB	EM 385-1-1 05.C
	Fire (decontamination solvents and gasoline)	Flammable material stored in original containers or in safety containers labeled/listed by a nationally recognized testing laboratory. Fuel storage areas marked with “No Smoking” or “Open Flame” signs Fire extinguisher kept near decontamination area and inspected monthly No ignition sources within 50 ft of areas where flammable materials are stored or used for decontamination	EM 385-1-1 09.A
	Exposure to chemicals	PPE (Level D) plus nitrile or equivalent gloves for contact with contaminated material. Washing face and hands prior to taking anything by mouth. Minimal contact. When using volatile chemicals, work should be performed under conditions of adequate ventilation. Hazard communication training for chemical tools MSDS on-site All chemical containers labeled to indicate contents and hazard Suitable facilities/equipment for flushing eyes of harmful chemicals	EM 385-1-1 06.A and B

Equipment to be Used	Inspection Requirements	Training Requirements
Hand tools	Daily safety inspections of operations. Initial and at least weekly inspections of equipment Daily test of GFCIs All tools must be inspected daily and taken out of service if damaged	HAZWOPER 40-hr training and current refresher training Medical clearance Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

Table A-7. Activity Hazard Analysis

Risk Assessment Code (RAC):

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation
Activities Job: Vegetation Clearing with Chainsaws, Machetes, and Sling Blades

E = Extremely High Risk
H = High Risk
M = Moderate Risk
L = Low Risk

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic					
	Critical					
	Marginal					
	Negligible					

Recommended Protective Clothing & Equipment:

Level D PPE with hardhat and nitrile or equivalent gloves for contact with contaminated material. Leg protection required when operating chainsaw.

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Biological hazards (bees, mosquitoes, ticks, Lyme disease, histoplasmosis, poisonous plants, wasps, and snakes)	PPE (boots, work clothes – long pants and shirts with sleeves) Insect repellant, as necessary Pant legs tucked into boots or otherwise closed to minimize tick entry or contact with harmful plants Inspect for ticks during the day and at the end of each work day (see Section 10.18) Avoidance of accumulations of bird or bat droppings (see Section 10.17) Protective ointments and/or specialized cleaners if working in areas with poisonous plants Site-specific instruction in recognition and avoidance of harmful plants and/or animals	EM 385-1-1 06.D
	Temperature extremes	Administrative controls (see Section 9.0) Cooled (shaded) or warmed break area depending on the season Routine breaks in established break area and unscheduled breaks if needed (see Section 9.0) Chilled water if temperature exceeds 70°F Monitoring – ambient temperature measurements at least twice daily. Site- and season-specific instruction in weather hazards and hazard controls. Temperatures greater than 80°F, temperatures less than 30°F, and the use of impermeable clothing require additional controls (see Section 9.0)	EM 385-1-1 06.I
	Contact with MEC	On-site training in ordnance recognition for all field personnel. Any investigation work within a MRS will follow MEC avoidance protocol. MEC surveys will be conducted in MRSs by a UXO technician for intrusive work and a UXO technician will accompany investigation teams. Avoid areas or withdraw all personnel from area, as directed by UXO technician, if ordnance or suspected ordnance is discovered. Monitoring - visual surveys for ordnance. Instrument surveys by UXO technicians in MRS. Follow requirements of governing Explosive Safety Submittal, if required, for the project.	EM 385-1-1 33.A

Table A-7. Activity Hazard Analysis

Date Prepared: January 2016

Project: Camp Ravenna Facility-Wide Environmental Investigation Activities

Job: Vegetation Clearing with Chainsaws, Machetes, and Sling Blades

JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	EM 385-1-1 (PARA REF)
General	Lifting heavy items	Evaluate potential pinch points and/or weight strain. Clear area of all unnecessary equipment and slip/trip hazards. Additional help will be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lb, or has to be moved by maneuvering through awkward positioning	EM 385-1-1 14.A
	Severe weather	Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lightning within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding	EM 385-1-1 06.I
Operating Machinery	General safety hazards (rotating machinery, contact with sharp edges, slips, and falls)	Level D PPE (see Section 6.0) plus hard hat Only experienced operators Personnel operating brush-clearing tools must maintain separation of at least 4.5 m (15 ft) Tools must be inspected daily and taken out of service if damaged Exclusion zone if there is a potential for entry of unauthorized personnel	EM 385-1-1 13.A and F
	Chainsaw kickback and related hazards	Level D protection including safety glasses or goggles, safety shoes, heavy duty work gloves, chainsaw chaps Saws must have automatic chain brake or kickback device Idle speed adjusted so chain does not move when idling Saws must not be used to cut above shoulder height Saws must be held with both hands when operating Additional requirements at EM 385-1-1, Section 31	EM 385-1-1 13.F
	Noise (chainsaw)	Hearing protection within 7.6 m (25 ft) of operating chainsaw unless equipment-specific monitoring indicates noise exposure of less than 90 dB	EM 385-1-1 05.C
	Fire (fuels)	Fuels stored in safety containers labeled/listed by a nationally recognized testing laboratory Bonding and grounding during fuel transfers Fuel storage areas marked with "No Smoking" or "Open Flame" signs No ignition sources within 50 ft of fuel storage areas Fire extinguishers in all fuel use areas and inspected monthly Gasoline-powered equipment turned off and allowed to cool for at least 5 min prior to fueling	EM 385-1-1 09.A
	Exposure to chemicals	PPE (Level D) plus nitrile or equivalent gloves for contact with contaminated material. Washing face and hands prior to taking anything by mouth. Minimal contact Chemical containers labeled to indicate contents and hazard	EM 385-1-1 06.A and B
	Electric shock	Electrical tools (110 V) must be connected through heavy duty power cord to GFCI	EM 385-1-1 05.I

Table A-7. Activity Hazard Analysis

Date Prepared: January 2016
Project: Camp Ravenna Facility-Wide Environmental Investigation
Activities Job: Vegetation Clearing with Chainsaws, Machetes, and Sling Blades

Equipment to be Used	Inspection Requirements	Training Requirements
Chainsaws, Machetes, and Sling Blades	Daily safety inspections of operations All tools must be inspected daily and taken out of service if damaged	HAZWOPER 40-hr training and current refresher training Medical clearance Properly trained personnel to operate tools Site-specific training including site hazard communication training CPR and first aid training for at least two on-site personnel and at least one person per field team

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ATTACHMENT B

SAFETY DATA SHEETS

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Material Safety Data Sheet

Hydrochloric Acid

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Hydrochloric Acid

Synonyms/Generic Names: Aqueous Hydrogen chloride, Muriatic acid.

Product Use: Industrial, Manufacturing or Laboratory use

Manufacturer: Columbus Chemical Industries, Inc.
N4335 Temkin Rd. Columbus, WI. 53925

For More Information Call: 920-623-2140
(Monday – Friday 8:00-4:30)

IN CASE OF EMERGENCY CALL: CHEMTREC
(24 Hours/Day, 7 Days/Week) 800-424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Weight %	Component	CAS #	EINECS# / ELINCS#	Classification*
36 - 38%	Hydrochloric Acid	7647-01-0	231-595-7	C; R35, **

*Symbol and R phrase according to EC Annex1
** Subject to the reporting requirements of SARA Title III Section 313

3. HAZARDS IDENTIFICATION

Clear, colorless solution with caustic odor.

R35 – Causes severe burns.

S1/2, S26, S30, S45

Routes of Entry: Skin, eyes, inhalation and ingestion.

Ingredients found on carcinogen lists:

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST	ACGIH
Hydrochloric Acid	Not Listed	Not Listed	Not Listed	Not Listed

4. FIRST AID INFORMATION

Inhalation: Inhalation of mists can cause corrosive action on mucous membranes. Symptoms include burning, choking, coughing, wheezing, laryngitis, shortness of breath, headache or nausea. Move casualty to fresh air and keep at rest. Get medical attention if symptoms persist.

Eyes: Contact rapidly causes severe damage. Symptoms include eye burns, watering eyes. Permanent damage to cornea may result. In case of eye contact, rinse with plenty of water and seek medical attention immediately.

Skin: Severe and rapid corrosion from contact. Extent of damage depends on duration of contact. Symptoms include burning, itching, redness, inflammation and/or swelling of exposed tissues. harmful if absorbed through skin. Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and wash using soap. Get medical attention immediately.

Ingestion: Do Not Induce Vomiting! Severe and rapid corrosive burns of the mouth, gullet and gastrointestinal tract will result if swallowed. Symptoms include burning, choking, nausea, vomiting and severe pain. Wash out mouth with water and give a glass of water or milk. Get medical attention immediately.

5. FIRE-FIGHTING MEASURES

FLAMMABLE PROPERTIES:

Flash Point:	Not Flammable
Flash Point method:	Not Applicable
Autoignition Temperature:	Not Applicable
Upper Flame Limit (volume % in air):	Not Applicable
Lower Flame Limit (volume % in air):	Not Applicable

Extinguishing Media: Product is not flammable. Use appropriate media for adjacent fire. Cool containers with water, keep away from common metals.

Special fire-fighting procedures: Wear self-contained, approved breathing apparatus and full protective clothing, including eye protection and boots. Material can react violently with water (spattering and misting) and react with metals to produce flammable hydrogen gas.

Hazardous combustion products: Emits toxic fumes under fire conditions. (See also Stability and Reactivity section).

Unusual fire and explosion hazards: Material can react with metals to produce flammable hydrogen gas.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: See section 8 for recommendations on the use of personal protective equipment.

Environmental precautions: Cleanup personnel need personal protection from inhalation and skin/eye contact. Evacuate and ventilate the area. Prevent spillage from entering drains. Cautiously add water to spill, taking care to avoid splashing and spattering. Neutralize diluted spill with soda ash or lime. Absorb neutralized spill with vermiculite or other inert absorbent material, then place in a suitable container for disposal. Clean surfaces thoroughly with water to remove residual contamination. Any release to the environment may be subject to federal/national or local reporting requirements. Dispose of all waste or cleanup materials in accordance with local regulations. Containers, even when empty, will retain residue and vapors.

7. HANDLING AND STORAGE

Normal handling: See section 8 for recommendations on the use of personal protective equipment. Use with adequate ventilation. Wash thoroughly after using. Keep container closed when not in use.

Storage: Store in cool, dry well ventilated area. Keep away from incompatible materials (see section 10 for incompatibilities). Drains for storage or use areas for this material should have retention basins for pH adjustment and dilution of spills.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational exposure controls: (consult local authorities for acceptable exposure limits)

Chemical name	Regulatory List	Value and type
Hydrochloric Acid	UK OES STEL	7 mg/m^3 (10 minutes)
	USA OSHA PEL	7 mg/m^3 Ceiling
	USA ACGIH	7 mg/m^3 TLV Ceiling
	USA NIOSH	7 mg/m^3 Ceiling
	Canada TLV	7 mg/m^3
	OSHA IDLH	50 ppm
	VLE France (STEL)	7.5 mg/m^3 (15 minutes)

TWA: Time Weighted Average over 8 hours of work.
TLV: Threshold Limit Value over 8 hours of work.
REL: Recommended Exposure Limit
STEL: Short Term Exposure Limit during x minutes.
IDLH: Immediately Dangerous to Life or Health

Ventilation: Provide local exhaust, preferably mechanical.

Respiratory protection: If necessary use an approved respirator with acid vapor cartridges.

Eye protection: Wear chemical safety glasses with a face shield for splash protection.

Skin and body protection: Wear neoprene or rubber gloves, apron and other protective clothing appropriate to the risk of exposure.

Other Recommendations: Provide eyewash stations, quick-drench showers and washing facilities accessible to areas of use and handling. Have supplies and equipment for neutralization and running water available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear, colorless to slight yellow liquid
Physical state:	Liquid
Odor:	Acidic
Odor Threshold:	0.25 to 10 ppm
Specific Gravity:	1.1800
pH:	1
Melting Point/Freezing Point:	-46°C (-51°F)
Boiling Point/Range:	51°C (123°F)
Flammability:	Not Flammable (See section 5)
Flash point:	Not Flammable (See section 5)
Evaporation Rate (Butyl Acetate =1):	Not Available
Explosive Limits:	Not Explosive (See section 5)
Vapor Pressure (at 20ºC):	15 mmHg
Vapor Density (air =1):	1.267
Solubility:	Completely soluble in water
Partition coefficient/n-octanol/water:	Not Available
% Volatile:	Not Available
Autoignition Temperature:	See section 5

10. STABILITY AND REACTIVITY

Stability: Stable

Conditions to avoid: Uncontrolled addition of water.

Incompatibility: Moisture, bases, organic material, metals, carbides, cyanides, chlorates, nitrates, picrates, permanganate, peroxides, zinc iodide, azides, perchlorates, phosphorus.

Hazardous decomposition products: Carbon oxides.

Hazardous polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Effects: See section 4 for symptoms of exposure and effects. Likely routes of exposure are skin, eyes and inhalation.
Target organs: Kidney, liver, mucous membranes, respiratory system, skin, eyes and cardiovascular system.

Acute Toxicity Data:

Hydrochloric acid	Lowest Published Lethal Doses (LDL/LCL) LDL [Man] Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M LD50 [oral, rat]; 700 mg/kg LC50 [rat]; 3124 (1 hour)

Chronic Effects: May affect liver, bleeding of nose and gums, nasal and oral mucosal ulceration, conjunctivitis, yellowing of teeth and erosion of tooth enamel, dermatitis.

Teratogenicity: Not Available
Mutagenicity: Not Available
Embryotoxicity: Not Available
Synergistic Products/Effects: Not Available

12. ECOLOGICAL INFORMATION

Ecotoxicity (aquatic and terrestrial): LD50 @ pH of 3 – 3.6
LC80 (72 hours): 56 mg/L (Daphnia Magna)

Persistence and Degradability: Not Available

Bioaccumulative Potential: Not Available

Mobility in Soil: Not Available

Other Adverse Effects: Not Available

13. DISPOSAL CONSIDERATIONS

RCRA:
Hazardous waste? Yes RCRA ID number: DOO2

Waste Residues: Carefully dilute with water, neutralize per spill procedures in section 6. Neutralized material may be flushed to sewer (REGULATIONS PERMITTING!) or disposed of through a licensed contractor. Users should review their operations in terms of the applicable federal/nation or local regulations and consult with appropriate regulatory agencies before discharging or disposing of waste material.

Product containers: Containers, if thoroughly cleaned, preferably by rinsing three times and handling the rinse water as waste residues, may be disposed of or recycled as non-hazardous waste. Users should review their operations in terms of the applicable federal/national or local regulations and consult with appropriate regulatory agencies before discharging or disposing of waste material.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product may significantly change the characteristics of the material and alter the waste classification and proper disposal methods.

14. TRANSPORTATION INFORMATION

DOT: UN1789, Hydrochloric Acid, 8, pg II

TDG: UN1789, Hydrochloric Acid, 8, pg II

PIN: Not Available

IDMG: UN1789, Hydrochloric Acid, 8, pg II
Marine Pollutant: No

IATA/ICAO: UN1789, Hydrochloric Acid, 8, pg II

RID/ADR: Class 8, Item 5(b), corrosive, Kemler plate: 80/1789

15. REGULATORY INFORMATION

TSCA Inventory Status: All ingredients are listed on the TSCA inventory.

Federal and State Regulations:
Connecticut hazardous material survey: Hydrochloric acid
Illinois toxic substances disclosure to employee act: Hydrochloric acid
Illinois chemical safety act: Hydrochloric acid
New York release reporting list: Hydrochloric acid
Rhode Island RTK hazardous substances: Hydrochloric acid
Pennsylvania RTK: Hydrochloric acid
Minnesota: Hydrochloric acid
Massachusetts RTK: Hydrochloric acid
Massachusetts spill list: Hydrochloric acid
New Jersey: Hydrochloric acid
New Jersey spill list: Hydrochloric acid
Louisiana RTK reporting list: Hydrochloric acid
Louisiana spill reporting: Hydrochloric acid
California Director's List of Hazardous Substances: Hydrochloric acid

SARA 302/304/311/312 extremely hazardous substances: Hydrochloric Acid
SARA 313 toxic chemical notification and release reporting: Hydrochloric Acid
CERCLA: Hazardous Substances: Hydrochloric Acid, 5000lbs.

California Proposition 65:	No
WHMIS Canada:	Class E - corrosive liquid. Class D-2A – Material causing other toxic effects (very toxic)
DSCL (EEC):	R35 – Causes severe burns.

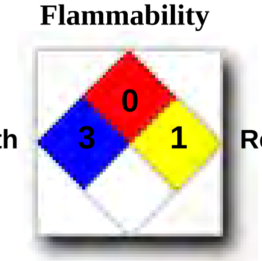
HMIS (U.S.A.)

Health Hazard	3
Fire Hazard	0
Reactivity	2

National Fire Protection Association (U.S.A.)

Flammability

Health



Reactivity

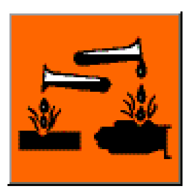
Specific hazard

Protective Equipment:

ADR (Europe):

TDG (Canada):

DSCL (Europe):



1. OTHER INFORMATION

Current Issue Date: November 30, 2005
Previous Issue Date: N/A
Prepared by: Sherry Brock (920) 623-2140

Disclaimer: Columbus Chemical Industries, Inc. ("Columbus") believes that the information herein is factual but is not intended to be all inclusive. The information relates only to the specific material designated and does not relate to its use in combination with other materials or its use as to any particular process. Because safety standards and regulations are subject to change and because Columbus has no continuing control over the material, those handling, storing or using the material should satisfy themselves that they have current information regarding the particular way the material is handled, stored or used and that the same is done in accordance with federal, state and local law. COLUMBUS MAKES NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING (WITHOUT LIMITATION) WARRANTIES WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN OR WITH RESPECT TO FITNESS FOR ANY PARTICULAR USE.

COLUMBUS CHEMICAL INDUSTRIES INC.

Safety Data Sheet

Sodium Hydroxide 25% Solution

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Sodium Hydroxide 25% Solution

Synonyms/Generic Names: Caustic Soda Solution

Product Number: 9488

Product Use: Industrial, Manufacturing or Laboratory use

Manufacturer: Columbus Chemical Industries, Inc.
N4335 Temkin Rd.
Columbus, WI. 53925

For More Information Call: 920-623-2140 (Monday-Friday 8:00-4:30)

In Case of Emergency Call: CHEMTREC - 800-424-9300 or 703-527-3887 (24 Hours/Day, 7 Days/Week)

2. HAZARDS IDENTIFICATION

OSHA Hazards: Corrosive, Target organ effect

Target Organs: Kidney, Liver, Eyes, Skin, Mucous membranes, Respiratory system, Cardiovascular system

Signal Words: Danger

Pictograms:

GHS Classification:

Skin corrosion	Category 1
Serious eye damage	Category 1
Acute aquatic toxicity	Category 3

GHS Label Elements, including precautionary statements:

Hazard Statements:

H314	Causes severe skin burns and eye damage.
H401	Harmful to aquatic life.

Precautionary Statements:

P280	Wear protective gloves/protective clothing/eye protection/face protection.
P305+P351+P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do so. Continue rinsing.
P310	Immediately call a POISON CENTER or doctor/physician.

Potential Health Effects

Eyes	Causes severe eye burns.
Inhalation	May be harmful if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Skin	May be harmful if absorbed through skin. Causes skin burns.
Ingestion	May be harmful if swallowed.

NFPA Ratings

Health	3
Flammability	0
Reactivity	1
Specific hazard	Not Available

HMIS Ratings

Health	3
Fire	0
Reactivity	1
Personal	H

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	Weight %	CAS #	EINECS# / ELINCS#	Formula	Molecular Weight
Sodium Hydroxide	25	1310-73-2	215-185-5	NaOH	40.00 g/mol
Water	Balance	7732-18-5	231-791-2	H_2O	18.00 g/mol

4. FIRST-AID MEASURES

Eyes	In case of eye contact, rinse with plenty of water and seek medical attention immediately.
Inhalation	Move casualty to fresh air and keep at rest. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention immediately.
Skin	Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and wash using soap. Get medical attention immediately.
Ingestion	**Do Not Induce Vomiting!** Never give anything by mouth to an unconscious person. If conscious, wash out mouth with water. Get medical attention.

5. FIRE-FIGHTING MEASURES

Suitable (and unsuitable) extinguishing media	Product is not flammable. Use appropriate media for adjacent fire. Cool containers with water.
Special protective equipment and precautions for firefighters	Wear self-contained, approved breathing apparatus and full protective clothing, including eye protection and boots.
Specific hazards arising from the chemical	Emits toxic fumes (sodium oxides) under fire conditions. (See also Stability and Reactivity section).

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	See section 8 for recommendations on the use of personal protective equipment.

Environmental precautions	Prevent spillage from entering drains. Any release to the environment may be subject to federal/national or local reporting requirements.
Methods and materials for containment and cleaning up	Neutralize spill. Absorb spill with noncombustible absorbent material, then place in a suitable container for disposal. Clean surfaces thoroughly with water to remove residual contamination. Dispose of all waste and cleanup materials in accordance with regulations.

7. HANDLING AND STORAGE

Precautions for safe handling
See section 8 for recommendations on the use of personal protective equipment. Use with adequate ventilation. Wash thoroughly after using. Keep container closed when not in use. Avoid formation of aerosols.

Conditions for safe storage, including any incompatibilities
Store in cool, dry well ventilated area. Keep away from incompatible materials (see section 10 for incompatibilities).

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational exposure controls:

Component	Exposure Limits	Basis	Entity
Sodium Hydroxide	2 mg/m^3	CEIL	ACGIH
	2 mg/m^3	PEL	OSHA
	2 mg/m^3	CEIL	NIOSH

TWA: Time Weighted Average over 8 hours of work.
TLV: Threshold Limit Value over 8 hours of work.
REL: Recommended Exposure Limit
PEL: Permissible Exposure Limit
STEL: Short Term Exposure Limit during x minutes.
IDLH: Immediately Dangerous to Life or Health
WEEL: Workplace Environmental Exposure Levels
CEIL: Ceiling

Personal Protection

Eyes	Wear chemical safety glasses or goggles, and face shield.
Inhalation	Provide local exhaust, preferably mechanical. If exposure levels are excessive, use an approved respirator.
Skin	Wear nitrile or rubber gloves, and full body covering. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
Other	Not Available

Other Recommendations
Provide eyewash stations, quick-drench showers and washing facilities accessible to areas of use and handling.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance (physical state, color, etc.)	Colorless liquid.
Odor	Odorless.
Odor threshold	Not Available

pH	~14
Melting point/freezing point	-12-10°C (10-50°F)
Initial boiling point and boiling range	105-140°C (221-284°F)
Flash point	Not Flammable
Evaporation rate	Not Available
Flammability (solid, gas)	Not Flammable
Upper/lower flammability or explosive limit	Not Explosive
Vapor pressure	<24 hPa (<18 mmHg) at -20°C (68°F)
Vapor density	1.33 (air=1)
Density	1.54 g/cm^3
Solubility (ies)	Soluble in water.
Partition coefficient: n-octanol/water	Not Available
Auto-ignition temperature	Not Applicable
Decomposition temperature	Not Available

10. STABILITY AND REACTIVITY

Chemical Stability	Stable
Possibility of Hazardous Reactions	Will not occur.
Conditions to Avoid	Not Available
Incompatible Materials	Acids, organic materials, chlorinated solvents, aluminum, phosphorus, zinc, tin.
Hazardous Decomposition Products	Sodium oxides.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Skin	Not Available
Eyes	Not Available
Respiratory	Not Available
Ingestion	Not Available

Carcinogenicity

IARC	No components of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.
ACGIH	No components of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
NTP	No components of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
OSHA	No components of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Signs & Symptoms of Exposure

Skin	Extent of damage depends on duration of contact. Burning, itching, redness, inflammation or swelling of exposed tissues.
Eyes	Eye burns, watering eyes.
Respiratory	Burning, choking, coughing, wheezing, laryngitis, shortness of breath, headache, nausea.
Ingestion	Burning, choking, nausea, vomiting, severe pain.

Chronic Toxicity	Not Available
Teratogenicity	Not Available
Mutagenicity	Not Available
Embryotoxicity	Not Available
Specific Target Organ Toxicity	Not Available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Aquatic Vertebrate	Not Available
Aquatic Invertebrate	Not Available
Terrestrial	Not Available

Persistence and Degradability	Not Available
Bioaccumulative Potential	Not Available
Mobility in Soil	Not Available
PBT and vPvB Assessment	Not Available
Other Adverse Effects	Not Available

13. DISPOSAL CONSIDERATIONS

Waste Residues	Users should review their operations in terms of the applicable federal/national or local regulations and consult with appropriate regulatory agencies if necessary before disposing of waste product container.
Product Containers	Users should review their operations in terms of the applicable federal/national or local regulations and consult with appropriate regulatory agencies if necessary before disposing of waste product container.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product may significantly change the characteristics of the material and alter the waste classification and proper disposal methods.

14. TRANSPORTATION INFORMATION

US DOT	UN1824, Sodium hydroxide solution, 8, pg II
TDG	UN1824, SODIUM HYDROXIDE SOLUTION, 8, pg II
IMDG	UN1824, SODIUM HYDROXIDE SOLUTION, 8, pg II
Marine Pollutant	No
IATA/ICAO	UN1824, Sodium hydroxide solution, 8, pg II

15. REGULATORY INFORMATION

TSCA Inventory Status	All ingredients are listed on the TSCA inventory.
DSCL (EEC)	All ingredients are listed on the DSCL inventory.
California Proposition 65	Not Listed
SARA 302	Not Listed
SARA 304	Not Listed
SARA 311	Sodium Hydroxide
SARA 312	Sodium Hydroxide
SARA 313	Not Listed
WHMIS Canada	Class E: Corrosive material.

16. OTHER INFORMATION

Revision	Date
Revision 1	12/03/2012
Revision 2	07/09/2013

SAFETY DATA SHEET

Creation Date 12-Nov-2010 **Revision Date** 19-May-2016 **Revision Number** 2

1. Identification

Product Name	**Sulfuric Acid (Certified ACS Plus)**
Cat No. :	**A300-212; A300-225LB; A300-500; A300-612GAL; A300-700LB; A300C212; A300P500; A300S212; A300S212EA; A300S500; A300SI212**
Synonyms	Hydrogen sulfate; Vitriol brown oil; Oil of vitriol
Recommended Use	Laboratory chemicals.
Uses advised against	No Information available

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 1 A
Serious Eye Damage/Eye Irritation	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
Causes severe skin burns and eye damage

Precautionary Statements
Prevention
Do not handle until all safety precautions have been read and understood

Use personal protective equipment as required
Do not breathe dust/fume/gas/mist/vapors/spray
Wash face, hands and any exposed skin thoroughly after handling
Use only outdoors or in a well-ventilated area

Response

Immediately call a POISON CENTER or doctor/physician

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Skin

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

Ingestion

IF SWALLOWED: Rinse mouth. DO NOT induce vomiting

Storage

Store locked up
Store in a well-ventilated place. Keep container tightly closed

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

None identified
WARNING! This product contains a chemical known in the State of California to cause cancer.

Unknown Acute Toxicity

.? percent of the mixture consists of ingredient(s) of unknown acute toxicity

3. Composition / information on ingredients

Component	CAS-No	Weight %
Sulfuric acid	7664-93-9	90 - 98
Water	7732-18-5	2 - 10

4. First-aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Remove and wash contaminated clothing before re-use. Call a physician immediately.

Inhalation If not breathing, give artificial respiration. Remove from exposure, lie down. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Call a physician immediately.

Ingestion Do not induce vomiting. Clean mouth with water. Never give anything by mouth to an unconscious person. Call a physician immediately.

Most important symptoms/effects Causes burns by all exposure routes. Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media CO_2, dry chemical, dry sand, alcohol-resistant foam.

Unsuitable Extinguishing Media DO NOT USE WATER

Flash Point Not applicable
Method - No information available

Autoignition Temperature No information available
Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. The product causes burns of eyes, skin and mucous membranes.

Hazardous Combustion Products
Sulfur oxides Hydrogen
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
3	0	2	W

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.
Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from water. Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sulfuric acid	TWA: 0.2 mg/m³	(Vacated) TWA: 1 mg/m³ TWA: 1 mg/m³	IDLH: 15 mg/m³ TWA: 1 mg/m³

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Sulfuric acid	TWA: 1 mg/m³ STEL: 3 mg/m³	TWA: 1 mg/m³	TWA: 0.2 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Clear, Colorless to brown
Odor	Odorless
Odor Threshold	No information available
pH	0.3 (1N)
Melting Point/Range	10 °C / 50 °F
Boiling Point/Range	290 - 338 °C / 554 - 640.4 °F
Flash Point	Not applicable
Evaporation Rate	Slower than ether
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	< 0.001 mmHg @ 20 °C
Vapor Density	3.38 (Air = 1.0)
Specific Gravity	1.84
Solubility	Soluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	340°C
Viscosity	No information available
Molecular Formula	H_2SO_4
Molecular Weight	98.08

10. Stability and reactivity

Reactive Hazard	Yes
Stability	Reacts violently with water. Hygroscopic.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to moist air or water.
Incompatible Materials	Water, Organic materials, Strong acids, Strong bases, Metals, Alcohols, Cyanides, Sulfides
Hazardous Decomposition Products	Sulfur oxides, Hydrogen
Hazardous Polymerization	Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Oral LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Dermal LD50	Based on ATE data, the classification criteria are not met. ATE > 2000 mg/kg.
Vapor LC50	Based on ATE data, the classification criteria are not met. ATE > 20 mg/l.

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Sulfuric acid	2140 mg/kg (Rat)	Not listed	LC50 = 510 mg/m³ (Rat) 2 h
Water	-	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation Causes severe burns by all exposure routes

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen. Exposure to strong inorganic mists containing sulfuric acid may cause cancer by inhalation.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Sulfuric acid	7664-93-9	Group 1	Known	A2	X	A2
Water	7732-18-5	Not listed	Not listed	Not listed	Not listed	Not listed

IARC: (International Agency for Research on Cancer)
IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

NTP: (National Toxicity Program)
NTP: (National Toxicity Program)
Known - Known Carcinogen
Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen

ACGIH: (American Conference of Governmental Industrial Hygienists)
A1 - Known Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Animal Carcinogen
ACGIH: (American Conference of Governmental Industrial Hygienists)

Mexico - Occupational Exposure Limits - Carcinogens
Mexico - Occupational Exposure Limits - Carcinogens
A1 - Confirmed Human Carcinogen
A2 - Suspected Human Carcinogen
A3 - Confirmed Animal Carcinogen
A4 - Not Classifiable as a Human Carcinogen
A5 - Not Suspected as a Human Carcinogen

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known
STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
This product contains the following substance(s) which are hazardous for the environment. .

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Sulfuric acid	-	LC50: > 500 mg/L, 96h static (Brachydanio rerio)	-	EC50: 29 mg/L/24h

Persistence and Degradability No information available
Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT
- **UN-No** UN1830
- **Proper Shipping Name** Sulfuric acid
- **Hazard Class** 8
- **Packing Group** II

TDG
- **UN-No** UN1830
- **Proper Shipping Name** SULFURIC ACID
- **Hazard Class** 8
- **Packing Group** II

IATA
- **UN-No** UN1830
- **Proper Shipping Name** SULFURIC ACID
- **Hazard Class** 8
- **Packing Group** II

IMDG/IMO
- **UN-No** UN1830
- **Proper Shipping Name** SULFURIC ACID
- **Hazard Class** 8
- **Packing Group** II

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Sulfuric acid	X	X	-	231-639-5	-		X	X	X	X	X
Water	X	X	-	231-791-2	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Sulfuric acid	7664-93-9	90 - 98	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	Yes

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Sulfuric acid	X	1000 lb	-	-

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Sulfuric acid	1000 lb	1000 lb

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Sulfuric acid	7664-93-9	Carcinogen	-	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Sulfuric acid	X	X	X	X	X
Water	-	-	X	-	-

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	N
DOT Severe Marine Pollutant	N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

Canada
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class	D1A Very toxic materials E Corrosive material D2A Very toxic materials

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	12-Nov-2010
Revision Date	19-May-2016
Print Date	19-May-2016
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Material Safety Data Sheet

Nitric Acid

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Nitric Acid

Synonyms/Generic Names: Aqua Fortis, Azotic acid, Hydrogen nitrate.

Product Use: Industrial, Manufacturing or Laboratory use

Manufacturer: Columbus Chemical Industries, Inc.
N4335 Temkin Rd. Columbus, WI. 53925

For More Information Call: 920-623-2140
(Monday – Friday 8:00-4:30)

IN CASE OF EMERGENCY CALL: CHEMTREC
(24 Hours/Day, 7 Days/Week) 800-424-9300

2. COMPOSITION/INFORMATION ON INGREDIENTS

Weight %	Component	CAS #	EINECS# / ELINCS#	Classification*
68 - 70%	Nitric Acid	7697-37-2	231-714-2	O; R8 -C; R35, **

*Symbol and R phrase according to EC Annex1
** Subject to the reporting requirements of SARA Title III Section 313

3. HAZARDS IDENTIFICATION

Clear, colorless to yellow solution with caustic odor.


R35 – Causes severe burns.
R8 – Contact with combustible material may cause fire.

S1/2, S23, S26, S36, S45

Routes of Entry: Skin, eyes, inhalation and ingestion.

Ingredients found on carcinogen lists:

INGREDIENT NAME	NTP STATUS	IARC STATUS	OSHA LIST	ACGIH
Nitric Acid	Not Listed	Not Listed	Not Listed	Not Listed

4. FIRST AID INFORMATION

Inhalation: Inhalation of mists can cause corrosive action on mucous membranes. Symptoms include burning, choking, coughing, wheezing, laryngitis, shortness of breath, headache or nausea. Move casualty to fresh air and keep at rest. May be fatal if inhaled, may cause delayed pulmonary edema. Get medical attention.

Eyes: Contact rapidly causes severe damage. Symptoms include eye burns, watering eyes. Permanent damage to cornea may result. In case of eye contact, rinse with plenty of water and seek medical attention immediately.

Skin: Severe and rapid corrosion from contact. Extent of damage depends on duration of contact. Symptoms include burning, itching, redness, inflammation and/or swelling of exposed tissues. harmful if absorbed through skin. Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and wash using soap. Get medical attention immediately.

Ingestion: **Do Not Induce Vomiting!** Severe and rapid corrosive burns of the mouth, gullet and gastrointestinal tract will result if swallowed. Symptoms include burning, choking, nausea, vomiting and severe pain. Wash out mouth with water and give a glass of water or milk. Get medical attention immediately.

5. FIRE-FIGHTING MEASURES

FLAMMABLE PROPERTIES:

Flash Point:	Not Flammable
Flash Point method:	Not Applicable
Autoignition Temperature:	Not Applicable
Upper Flame Limit (volume % in air):	Not Applicable
Lower Flame Limit (volume % in air):	Not Applicable

Extinguishing Media: Product is not flammable. Use appropriate media for adjacent fire. Use flooding quantities of water to cool containers, keep away from common metals.

Special fire-fighting procedures: Wear self-contained, approved breathing apparatus and full protective clothing, including eye protection and boots. Material can react violently with water (spattering and misting) and react with metals to produce flammable hydrogen gas.

Hazardous combustion products: Emits toxic fumes under fire conditions. (See also Stability and Reactivity section).

Unusual fire and explosion hazards: Strong Oxidizer! Contact with organic material may cause fire. Material will react with metals to produce flammable hydrogen gas.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: See section 8 for recommendations on the use of personal protective equipment.

Environmental precautions: Cleanup personnel need personal protection from inhalation and skin/eye contact. Evacuate and ventilate the area. Prevent spillage from entering drains. Cautiously add water to spill, taking care to avoid splashing and spattering. Neutralize diluted spill with soda ash or lime. Absorb neutralized spill with vermiculite or other inert absorbent material, then place in a suitable container for disposal. Clean surfaces thoroughly with water to remove residual contamination. Any release to the environment may be subject to federal/national or local reporting requirements. Dispose of all waste or cleanup materials in accordance with local regulations. Containers, even when empty, will retain residue and vapors.

7. HANDLING AND STORAGE

Normal handling: See section 8 for recommendations on the use of personal protective equipment. Use with adequate ventilation. Wash thoroughly after using. Keep container closed when not in use.

Storage: Store in cool, dry well ventilated area. Keep away from incompatible materials (see section 10 for incompatibilities). Drains for storage or use areas for this material should have retention basins for pH adjustment and dilution of spills.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Occupational exposure controls: (consult local authorities for acceptable exposure limits)

Chemical name	Regulatory List	Value and type
Nitric Acid	UK OES	5 mg/m^3 TWA
	STEL	10 mg/m^3 (10 minutes)
	USA OSHA PEL	5 mg/m^3 TWA
	STEL	10 mg/m^3 (15 minutes)
	USA ACGIH	5 mg/m^3 TLV
	USA NIOSH	5 mg/m^3 REL
	STEL	10 mg/m^3 (15 minutes)
	USA OSHA - IDLH	25 ppm
	VME France	5 mg/m^3 TWA 8 hr
	VLE France (STEL)	10 mg/m^3 (15 minutes)

TWA: Time Weighted Average over 8 hours of work.
TLV: Threshold Limit Value over 8 hours of work.
REL: Recommended Exposure Limit
STEL: Short Term Exposure Limit during x number of minutes.
IDLH: Immediately Dangerous to Life or Health

Ventilation: Provide local exhaust, preferably mechanical.

Respiratory protection: If necessary use an approved respirator with acid vapor cartridges.

Eye protection: Wear chemical safety glasses with a face shield for splash protection.

Skin and body protection: Wear neoprene or rubber gloves, apron and other protective clothing appropriate to the risk of exposure.

Other Recommendations: Provide eyewash stations, quick-drench showers and washing facilities accessible to areas of use and handling. Have supplies and equipment for neutralization and running water available.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear, colorless to slight brown liquid
Physical state:	Liquid
Odor:	Acrid, suffocating odor
Odor Threshold:	Unknown
Specific Gravity:	1.4200
pH:	1
Melting Point/Freezing Point:	-42°C (-44°F)
Boiling Point/Range:	122°C (252°F)
Flammability:	Not Flammable (See section 5)
Flash point:	Not Flammable (See section 5)
Evaporation Rate (Butyl Acetate =1):	Not Available
Explosive Limits:	Not Explosive (See section 5)
Vapor Pressure (at 25ºC):	10 mmHg
Vapor Density (air =1):	2.5
Solubility:	Completely soluble in water
Partition coefficient/n-octanol/water:	-2.3 @ 25 ºC
% Volatile:	Not Available
Autoignition Temperature:	See section 5

10. STABILITY AND REACTIVITY

Stability: Stable

Conditions to avoid: Uncontrolled addition of water, contact with combustible materials.

Incompatibility: Moisture, bases, organic material, metals, hydrogen sulfide, carbides, alcohols, organic solvents, carbides, cyanides, sulfides.

Hazardous decomposition products: Oxides of nitrogen.

Hazardous polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Effects: See section 4 for symptoms of exposure and effects. Likely routes of exposure are skin, eyes and inhalation.
Target organs: Teeth, eyes, skin, respiratory system.

Acute Toxicity Data:

Nitric acid	LC_{50} (rat): 0.8 mg/L

Chronic Effects: Not Available

Teratogenicity: None found
Mutagenicity: None found
Embryotoxicity: None found
Synergistic Products/Effects: Not Available

12. ECOLOGICAL INFORMATION

Ecotoxicity (aquatic and terrestrial): Aquatic fish; LC50 (96 hrs): 72 mg/l (Gambusia affinis)

Persistence and Degradability: Not Available

Bioaccumulative Potential: Not Available

Mobility in Soil: Not Available

Other Adverse Effects: Not Available

13. DISPOSAL CONSIDERATIONS

RCRA:
Hazardous waste? Yes   RCRA ID number: DOO2

Waste Residues: Carefully dilute with water, neutralize per spill procedures in section 6. Neutralized material may be flushed to sewer (REGULATIONS PERMITTING!) or disposed of through a licensed contractor. Users should review their operations in terms of the applicable federal/nation or local regulations and consult with appropriate regulatory agencies before discharging or disposing of waste material.

Product containers: Containers, if thoroughly cleaned, preferably by rinsing three times and handling the rinse water as waste residues, may be disposed of or recycled as non-hazardous waste. Users should review their operations in terms of the applicable federal/national or local regulations and consult with appropriate regulatory agencies before discharging or disposing of waste material.

The information offered in section 13 is for the product as shipped. Use and/or alterations to the product may significantly change the characteristics of the material and alter the waste classification and proper disposal methods.

14. TRANSPORTATION INFORMATION

DOT: UN2031, Nitric Acid, 8, pg II

TDG: UN2031, Nitric Acid, 8, pg II

PIN: Not Available

IDMG: UN2031, Nitric Acid, 8, pg II
Marine Pollutant: No

IATA/ICAO: UN2031, Nitric Acid, 8, pg II

RID/ADR: Class 8, Item 2(b), corrosive

15. REGULATORY INFORMATION

TSCA Inventory Status: All ingredients are listed on the TSCA inventory.

Federal and State Regulations:
Pennsylvania RTK: Nitric Acid
Massachusetts RTK: Nitric Acid

SARA 302/304/311/312 extremely hazardous substances: Nitric Acid
SARA 313 toxic chemical notification and release reporting: Nitric Acid
CERCLA: Hazardous Substances: Nitric Acid 1000 lbs

California Proposition 65: No.
WHMIS Canada: Class E - corrosive liquid.
DSCL (EEC): R35 – Causes severe burns, R8 - Contact with combustible material may cause fire.

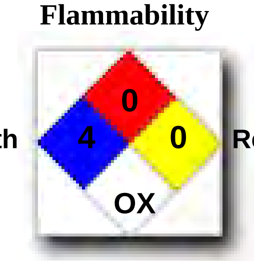
HMIS (U.S.A.)

Health Hazard	3
Fire Hazard	0
Reactivity	2

National Fire Protection Association (U.S.A.)

Flammability

Health



Reactivity

Specific hazard

Protective Equipment:

ADR (Europe):

TDG (Canada):

DSCL (Europe):

1. OTHER INFORMATION

Current Issue Date: November 30, 2005
Previous Issue Date: N/A
Prepared by: Sherry Brock (920) 623-2140

SAFETY DATA SHEET

This Safety Data Sheet (SDS) complies with the United Nations Globally Harmonized System (GHS) of Classification and Labeling, Second revised Edition.

1. Product and Supplier Identification

Product Name: Methanol
GHS Product Identifier: Methanol
CAS Number: 67-56-1
REACH Registration Number: 01-2119433307-44-0031: 01-2119433307-44-0030, for access to the REACH SDS please access it via www.methanex.com

Recommended Use: Solvent, fuel, feedstock

Restrictions on Use: Do not use in a confined area without proper ventilation. Contact lenses may cause further damage in case of splash into eye. Avoid use near heat, flames, sparks, and other sources of ignition.

Product: **Synonyms:**	**Methanol (CH_3OH)** Methyl alcohol, methyl hydrate, wood spirit, methyl hydroxide	**EMERGENCY NUMBERS**
Company Identification:	**Methanex NZ Ltd** **409 Main North Road, SH3** **Motunui** **Private Bag 2011** **New Plymouth – 4342** **New Zealand** **Tel. #: (646)7549700**	**Methanex NZ Tel.#** **0800 361 230** **National Poisons Centre Tel.#** **0800-POISON** **(0800-764-766)** www.poisons.co.nz

2. Hazards Identification

Dangerous Goods: Class3, Subsidiary Risk 6.1, Packing Group II

Classification

Acute Toxicity (Inhalation)	Category 2
Acute Toxicity (Oral, Dermal)	Category 3
Eye Damage/Irritation	Category 1
Skin Corrosion/Irritation	Category 1
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1B
Toxic to Reproduction	Category 2
Specific Target Organ Toxicity (Repeated Exposure)	Category 2
Flammable Liquid	Category 2
Toxic to the Aquatic Environment-Acute Hazard	Category 2

*GHS Classification as determined by OSHA, 2011

Hazardous Substance (HSNO) classification

Flammable Liquid	Category 3.1B
Oral, Inhalation, Dermal	Category 6.1C
Eye Irritant	Category 6.4A
Reproductive/ Developmental Toxicant	Category 6.8B
Target Organ Toxicant	Category 6.9A
Terrestrial Vertebrate Ecotoxicity	Category 9.3C

Label:

GHS02 GHS06 GHS08

Hazard Communication:

DANGER! Highly flammable liquid and vapour. Fatal if inhaled. Toxic if swallowed. Toxic in contact with skin. Causes serious eye damage. May be fatal if swallowed.

WARNING! May cause damage to central nervous system through prolonged or repeated exposure.

Hazards and Precautions:

Colourless liquid, with a mild, characteristic alcohol odour when pure. Crude methanol may have a repulsive, pungent odour. Hygroscopic (moisture absorbing).

Keep away from heat/sparks/open flames/hot surfaces. — No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Wear protective gloves/protective clothing/eye protection/face protection. Do not breathe dust/fume/gas/mist/vapours/spray. Use only outdoors or in a well-ventilated area. Wear respiratory protection. Wear protective gloves/protective clothing/eye protection/face protection. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Avoid breathing dust/fume/gas/mist/vapours/spray. Contaminated work clothing should not be allowed out of the workplace. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required.

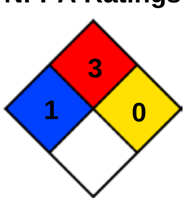
FLAMMABLE LIQUID AND VAPOUR: Burns with a clean, clear flame, which is almost invisible in daylight, or a light blue flame. Can decompose at high temperatures forming carbon monoxide and formaldehyde. Confined space toxicity hazard. Mild central nervous system depressant following inhalation, skin absorption or ingestion. May cause headache, nausea, dizziness, drowsiness, and un-coordination. Severe vision effects, including increased sensitivity to light, blurred vision, and blindness may develop following an 8-24 hour symptom-free period. Coma and death may result.

IRRITANT: Causes eye irritation. Aspiration hazard. Swallowing or vomiting of the liquid may result in aspiration (breathing) into the lungs.

POSSIBLE REPRODUCTIVE HAZARD*:* May cause fetotoxic (toxic to the fetus during the latter stages of pregnancy, often through the placenta) and teratogenic effects (causing malformations of the fetus), based on animal information.

IF SWALLOWED: Call the National Posions Centre or doctor/physician immediately. Rinse mouth. Do not induce vomiting.Get medical advice/attention if you have been exposed or feel unwell after handling this product.

NFPA Ratings (Health, Fire, Reactivity): 1, 3, 0



3. Composition

Component	% (w/w)	Exposure Limits (ACGIH)*	LD_{50}	LC_{50}
Methanol (CAS 67-56-1)	99-100	ACGIH* TLV-TWA: 200 ppm, skin TLV-STEL: 250 ppm, skin PEL-TWA: 200 ppm, skin PEL-STEL: 250 ppm, skin IDLH: 6000 ppm, acute inhalation toxicity to animals TLV Basis, critical effects: neuropathy, vision, central nervous system(CNS)	5628 mg/kg (oral/rat) 15800 mg/kg (dermal/ rabbit)	64000 ppm (inhalation/rat)

*ACGIH, American Conference of Governmental Industrial Hygienists.

Exposure limits may vary from time to time and from one jurisdiction to another. Check with local regulatory agency for the exposure limits in your area.

4. First Aid Measures

Suitable First Aid Actions	
Eye Contact	Remove contact lenses if worn. In case of contact, immediately flush eyes with plenty of clean running water for at least 15 minutes, lifting the upper and lower eyelids occasionally. Obtain medical attention.
Skin Contact	In case of contact, remove contaminated clothing. In a shower, wash affected areas with soap and water for at least 15 minutes. Seek medical attention if irritation occurs or persists. Wash clothing before reuse.
Inhalation	Remove to fresh air, restore or assist breathing if necessary. Obtain medical attention. Call the National Poisons Centre.
Ingestion	Swallowing methanol is potentially life threatening. Onset of symptoms may be delayed for 18 to 24 hours after digestion. If conscious and medical aid is not immediately available, do not induce vomiting. In actual or suspected cases of ingestion, transport to medical facility immediately. Call the National Poisons Centre.

NOTE TO PHYSICIAN: Acute exposure to methanol, either through ingestion or breathing high airborne concentrations can result in symptoms appearing between 40 minutes and 72 hours after exposure. Symptoms and signs are usually limited to the Central Nervous System (CNS), eyes and gastrointestinal tract. Because of the initial CNS's effects of headache, vertigo, lethargy and confusion, there may be an impression of ethanol intoxication. Blurred vision, decreased acuity and photophobia are common complaints. Treatment with ipecac or lavage is indicated in any patient presenting within two hours of ingestion. A profound metabolic acidosis occurs in severe poisoning and serum bicarbonate levels are a more accurate measure of severity than serum methanol levels. Treatment protocols are available from most major hospitals and early collaboration with appropriate hospitals is recommended.

Ethanol significantly decreases the toxicity of methanol because it competes for the same metabolic enzymes, and has been used to treat methanol poisoning.

5. Fire Fighting Measures

Suitable Extinguishing Media:	
	Extinguishment Media Use
Small Fire	Dry chemical, CO_2, water spray
Large Fire	AFFF(R) (Aqueous Film Forming Foam (alcohol resistant)) type with either a 3% or 6% foam proportioning system, Water spray (see note in Unsuitable Extinguishing Media).

Unsuitable Extinguishing Media	
Foam	General purpose synthetic foams or protein foams.
Water	Water may be effective for cooling, but may not be effective for extinguishing a fire because it may not cool methanol below its flash point.

Specific Hazards	
Heat	Methanol vapours may burn with an invisible flame or clean clear flame that is almost invisible in daylight.
Products of Combustion	During a fire, toxic gases and vapours, carbon monoxide, carbon dioxide, formaldehyde may be generated.
Vapours	Vapours can accumulate in confined spaces resulting in a toxicity and flammability hazard. Vapours can flow along surfaces to distant ignition sources and flash back
Solutions	Concentrations of greater that 25% methanol in water can be ignited.
Closed Containers	Closed containers may rupture violently and suddenly release large quantities of methanol when exposed to fire or excessive heat for a sufficient period of time.
Fire/Explosion	Vapours are slightly heavier than air and may travel long distances toward sources of ignition.

Fire Fighting Instructions: Stay upwind and uphill. Isolate and restrict area access. Use fine water spray or fog to control fire spread and cool adjacent structures or containers. Contain fire control water for later disposal. Fire fighters must wear full face, positive pressure, self-contained breathing apparatus or airline and appropriate protective fire fighting clothing as per NFPA. Note that methanol fires may require proximity suits. Take care not to walk through any spilled chemical.

HAZCHEM: 2WE

6. Accidental Release Measures

Overview: Flammable liquid! Can burn without a visible flame. Release can cause an immediate risk of fire and explosion. Eliminate all ignition sources, stop leak and use absorbent materials. If necessary, contain spill by diking. Fluorocarbon alcohol resistant foams may be applied to spill to diminish vapour and fire hazard. Maximize methanol recovery for recycling or re-use. Restrict access to area until completion of cleanup. Ensure cleanup is conducted by trained personnel only. Wear adequate personal protection and remove all sources of ignition. Notify all governmental agencies as required by law.

Precautions	
Personal Protection	Full face, positive pressure self-contained breathing apparatus or airline, and protective clothing must be worn. Protective fire fighting structural clothing is not effective protection from methanol.
Environmental Precautions	Biodegrades easily in water. Methanol in fresh or salt water may have serious effects on aquatic life. A study on methanol's toxic efffects on sewage sludge bacteria reported little effect on digestion at 0.1% while 0.5% methanol retarded digestion. Methanol will be broken down to carbon dioxide and water.
Remedial Measures	Flammable liquid – release/loss of primary containment can cause an immediate fire/explosion hazard. Eliminate all sources of ignition, stop leak and use absorbent materials. Collect liquid with explosion proof pumps. Do not walk through spill product as it may be on fire and not visible.
Small Spills	Soak up spill with non-combustible absorbent material. Recover methanol and dilute with water to reduce fire hazard. Prevent spilled methanol from entering sewers, confined spaces, drains, or waterways. Restrict access to unprotected personnel. Put material in suitable, covered, labeled containers. Flush area with water.
Large Spills	If necessary, contain spill by diking. Alcohol resistant foams may be applied to spill to diminish vapour and fire hazard. Maximize methanol recovery for recycling or reuse. Collect liquid with explosion proof pumps.

Methods and materials for containment and cleaning up

Remove all sources of ignition. Use non-sparking tools. Prevent further leakage or spillage if safe to do so. Dam up. Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust). Sweep up and shovel into suitable containers for disposal. Dispose of in accordance with local regulations.

7. Handling and Storage

Precautions for Handling: No smoking or open flame in storage, use or handling areas. Use explosion proof electrical equipment. Ensure proper electrical grounding procedures are in place.

Storage: Store in totally enclosed equipment, designed to avoid ignition and human contact	
Tanks	Tanks must be grounded, vented, and should have vapour emission controls. Tanks must be diked. A flammable mixture of methanol vapour and air is possible inside a storage tank or transportation tank, and handlers should take appropriate precautions to reduce the risk of ignition. Handlers must eliminate ignition sources or purge the tank with an inert gas such as nitrogen. All equipment must be grounded - bonded when transferring product in order to avoid static discharge from the equipment, and subsequent possible fire.
Incompatible Materials	Avoid storage with incompatible materials. Anhydrous methanol is non-corrosive to most metals at ambient temperatures except for lead, nickel, monel, cast iron and high silicon iron. Coatings of copper (or copper alloys), zinc (including galvanized steel), or aluminum are unsuitable for storage. These materials may be attacked slowly by the methanol. Storage tanks of welded construction are normally satisfactory.
Design	Containers should be designed and built in conformance with good engineering practice for the material being stored. While plastics can be used for short term storage, they are generally not recommended for long-term storage due to deterioration effects and the subsequent risk of contamination.

Corrosion rates for several construction materials:

Material	Corrosion Rate
Cast iron, monel, lead, nickel	<0.508 mm/year
High silicon iron	<0.051 mm/year
Polyethylene	Some attack
Neoprene, phenolic resins, polyesters, natural rubber, butyl rubber	Satisfactory
Polyvinyl chloride, unplasticized	Resistant

8. Exposure Controls, Personal Protection

New Zealand Workplace Exposure Standards

ACGIH* TLV-TWA:	200 ppm, skin (262 mg/m^3)
TLV-STEL	250 ppm, skin (328 mg/m^3)
PEL-TWA	200 ppm, skin
PEL-STEL	250 ppm, skin
IDLH	6000 ppm, acute inhalation toxicity to animals
TLV Basis	critical effects: neuropathy, vision, central nervous system (CNS)

Exposure Controls

Engineering Controls	In confined areas, local and general ventilation should be provided to maintain airborne concentrations below permissable exposure limits. Ventilation systems must be designed according to approved engineering standards.
Respiratory Protection	NIOSH approved supplied air respirator when airborne concentrations exceed exposure limits. **Cartridge type respirators are NOT recommended.** *Emergency or Planned entry into unkown concentrations:* Respirator selection must be done by a qualified person and be based upon a risk assessment of the work activities and exposure levels. Respirator users must be fit tested and clean shaven where the respirator seals to the face. Exposure must be kept at or below the applicable exposure limits and the maximum use concentration of the respirator must not be exceeded. Positive pressure, full-facepiece self-contained breathing apparatus; or Positive pressure, full-facepiece supplied air respirator with an auxiliary positive pressure self-contained breathing apparatus should be considered.
Skin Protection	Butyl and nitrile rubbers are recommended for gloves. Check with manufacturer. Wear chemical resistant pants and jackets, preferably of butyl or nitrile rubber. Check with manufacturer.
Eye and Face Protection	Face shield and chemical splash goggles when transferring is taking place.
Footwear	Chemical resistant and as specified by the workplace.

Environmental Exposure Controls: Do not flush into surface water or sanitary sewer system.

Other: Eyewash and showers should be located near work areas. NOTE: PPE must not be considered a long-term solution to exposure control. PPE usage must be accompanied by employer programs to properly select, maintain, clean, fit and use. Consult a competent industrial hygiene resource to determine hazard potential and/or the PPE manufacturers to ensure adequate protection.

Careful consideration must be made of the added danger of the concentration being in the LEL/UEL range and so there may be a fire/explosion hazard.

9. Physical and Chemical Properties

Appearance: Liquid, clear, colourless
Odour: Mild characteristic alcohol odour
Odour Threshold: detection: 4.2 - 5960 ppm
(geometric mean) 160 ppm
recognition: 53 – 8940 ppm
(geometric mean) 690 ppm
pH: Not applicable
Freezing Point: -97.8°C
Boiling Point: 64.7°C
Boiling Range: Not determined
Flash Point: 11.0°C
Solubility: Completely soluble
Partial Coefficient: Log P (oct) = -0.82
Vapour Pressure: 12.8 kPa @ 20°C
Viscosity: 0.3 cP@ 25°C

Upper Explosive Limit (UEL): 36.5 %
Lower Explosive Limit (LEL): 6%
Auto Ignition Temperature: 464°C
Solubility in other Liquids: Soluble in all proportions in other alcohols, esters, ketones, and most other organic solvents
Critical Temperature: 239.4°C
Specific Gravity: 0.82 @ 20°C
Evaporation Rate: 4.1 (n-butyl acetate =1)
Vapour Density: 1.105 @ 15°C (air = 1)
Decomposition Temperature: Not determined
Sensitivity to Impact: No
Sensitivity to Static Charge: Low
Percent Volatility: 100

10. Stability and Reactivity

Chemical Stability: Stable as supplied.

Hazardous Reactions	Avoid contact with strong oxidizers, strong mineral or organic acids, and strong bases. Contact with these materials may cause a violent or explosive reaction.
Conditions to Avoid	Avoid contact with sparks, heat, open flame, or ignition sources.
Incompatibility	Avoid contact with strong oxidizers, strong mineral or organic acids, and strong bases. Contact with these materials may cause a violent or explosive reaction. May be corrosive to lead, aluminum, magnesium, and platinum. May react with metallic aluminum or magnesium and generate hydrogen gas. May attack some forms of plastic, rubber, and coatings.
Hazardous Decomposition Products	Formaldehyde, carbon oxides

Hazardous Polymerization: Will not occur.

11. Toxicological Information

Acute toxicity Toxic if inhaled. Toxic in contact with skin. Toxic if swallowed.

Methanol (67-56-1)	
ATE (oral)	100000 mg/kg
ATE (dermal)	300000 mg/kg

LD50/oral/rat	1187- 2769 mg/kg
LD50/dermal/rabbit	17000 mg/kg
LC50/inhalation/4h/rat	1282 mg/l/4h

Primary Routes of Entry:

Skin Contact:	Yes
Skin Absorption:	Yes
Eye Contact:	Yes
Ingestion:	Yes
Inhalation:	Yes

Emergency Overview: Colourless liquid, with a mild, characteristic alcohol odour when pure. Crude methanol may have a repulsive, pungent odour. Hygroscopic. Can decompose at high temperatures forming carbon monoxide and formaldehyde. Confined space toxicity hazard. Mild central nervous system depressant following inhalation, skin absorption or ingestion. May cause headache, nausea, dizziness, drowsiness, and incoordination. Severe vision effects, including increased sensitivity to light, blurred vision, and blindness may develop following an 8-24 hour symptom-free period. Coma and death may result. Causes eye irritation. Aspiration hazard. Swallowing or vomiting of the liquid may result in aspiration (breathing) into the lungs. May cause fetotoxic (toxic to the fetus during the latter stages of pregnancy, often through the placenta) and teratogenic effects (causing malformations of the fetus), based on animal information.

Acute Exposure:

Inhalation	Inhalation of high airborne concentrations can also irriate mucous membranes, cause headaches, sleepiness, nausea, confusion, loss of consciousness, digestive and visual disturbances and even death. NOTE: Odour threshhold of methanol is several times higher than the TLV-TWA. Depending upon severity of poisoning and the promptness of treatment, survivors may recover completely or may have permanent blindness, vision disturbances and/or nervous system effects. Concentrations in air exceeding 1000 ppm may cause irritation of the mucous membranes.
Skin Contact	Methanol is moderately irritating to the skin. Methanol can be absorbed through the skin and harmful effects have been reported by this route of entry. Effects are similar to those described in "Inhalation".
Eye Contact	Methanol is a mild to moderate eye irritant. High vapour concentration or liquid contact with eyes causes irritation, tearing and burning.
Ingestion	Swallowing even small amounts of methanol could potentially cause blindness or death. Effects of sub lethal doses may be nausea, headache, abdominal pain, vomiting and visual disturbances ranging from blurred vision to light sensitivity.

Chronic Exposure:

Irritancy	Prolonged contact with skin may defat tissue causing dermititis or aggravate existing skin problems.
Sensitization	None reported
Carcinogenicity	Not listed by IARC, NTP, ACGIH, or OSHA as a carcinogen.
Teratogenicity	Methanol has produced fetotoxicity in rats and teratogenicity in mice exposed by inhalation to high concentrations of methanol vapours.
Reproductive Toxicity	Information available does not suggest that methanol is a reproductive toxin.
Mutagenicity	There is insufficient information available to conclude that methanol is mutagenic.
Synergistic Products	In animals, high concentrations of methanol can increase the toxicity of other chemicals, particularly liver toxins like carbon tetrachloride. Ethanol significantly reduces the toxicity of methanol because it competes for the same metabolic enzymes, and has been usd to treat methanol poisoning.
Potential for Accumulation	Methanol is readily absorbed into the body following inhalation and ingestion. Skin absorption may occur if the skin is broken or exposure is prolonged. Once absorbed, methanol is rapidly distributed to body tissues. A small amount is excreted unchanged in exhaled air and the urine. The rest is first metabolized to formaldehyde, which is then metabolized to formic acid and/or formate. The formic acid and formate are eventually converted to carbon dioxide and water. In humans, methanol clears from the body, after inhalation or oral exposure, with a half-life of 1 day or more for high doses (greater than 1000 mg/kg) or about 1.5-3 hours for low doses (less than 100 mg/kg or 76.5-230 ppm (100-300 mg/m^3).
Medical Conditions Aggravated By Exposure	Persons with pre-existing skin disorders, eye problems, respiratory conditions, or impaired liver or kidney functions may be more susceptible to the effects of this substance.

12. Ecological Information

Environmental toxicity: DO NOT discharge into sewer or waterways.

Component	**Methanol (CAS 67-56-1)**
HSNO Classification	9.3C-Harmful to terrestrial vertebrates
Log Kow	-0.82 - -0.66
Half-life (hr) air	427
Half-life (hr) H2O surface water	5.3-64
Henry's Law constant (atm m3/mol)	1.35E-04
BOD 5 if unstated	0.67-1.12
COD	1.05 -1.50,99%

ThOD	1.05
BCP	0.2 -10

LC50/96h/fish	15400 -29400 mg/l
EC50/48h/daphnia	> 10000 mg/
IC50/72h/algae	ca. 22000 mg/l Selenastrum carpricornutum (Pseudokichnerela subcapitata)

Persistence and degradability	Readily biodegradable
Bioaccumulation	Does not bioaccumulate. Partition coefficient: n-octanol/water 0.77
Mobility in Soil	Mobile in soils
PBT/vPvB	This substance is not considered to be persistent, bioaccumulating nor toxic (PBT). This substance is not considered to be very persistent nor very bioaccumulating (vPvB).
Terrestial Fate	The mobility of methanol in the subsurface will not be significantly limited by adsorption. Sorption of methanol to organic carbon in soil will be minor, and methanol will tend to remain in soil pore water.
Aquatic Fate	Methanol is completely miscible with water. Accordingly, its mobility in the subsurface will not be limited by solubility. Methanol has been shown to undergo rapid biodegradation in a variety of screening studies using sewage seed and activated sludge inoculum, which suggests that biodegradation will occur in aquatic environments where the concentration does not inhibit bacterial activity.
Atmoshere Fate	Methanol has a vapor pressure of 127 mm Hg at 25°C and is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase methanol is degraded in the atmosphere by reaction with photo chemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 17 days.
Other Adverse Affects	Do not flush into surface water or sanitary sewer system.

13. Disposal Considerations

Review federal, provincial or state, and local government requirements prior to disposal. Store material for disposal as indicated in Section #7, ***Handling and Storage***. Disposal by controlled incineration or by secure land fill may be acceptable.

Recycle wherever possible. Large volumes may be suitable for re-distillation or, if contaminated, incinerated. Can be disposed of in a sewage treatment facility. Methanol levels of up to 0.1% act as a food source for bacteria; above this level may be toxic to bacteria. When pumping through sewage collection systems, the level of methanol should be kept below the flammable range (a 25% methanol/water mixture is non-flammable at temperatures below 39°C). 1 ppm of methanol is equivalent to 1.5 ppm BOD loading in the sewage plant.

Container disposal:

Empty containers may contain hazardous residue. Return to supplier for reuse if possible. Never weld, cut or grind empty containers. If disposing of containers, ensure they are well rinsed with water, then disposed of at an authorised landfill. After cleaning, all existing labels should be removed.

14. Transport Information

Dangerous Good Segregation
This product is classification as Dangerous Good Class 3.
Please consult NZS 5433:2077 Transport of Dangerous Goods on Land for information

Land Transport:
Hazard Class: 3(6.1)
UN1230, P.g.II

Air Transport:
Hazard Class: 3(6.1)
Packing Group: II
Packing instruction 305
1 litre maximum per package

Maritime Transport :
Hazard Class: 3(6.1)
UN1230
Packing Group: II
Flash Point = 12°C
EmS No. F-E, S-D
Stowage Category "B", Clear of living quarters

Marine Pollutant: No

Labels
3 - Flammable liquid
6.1 - Toxic substance

Orange plate

15. Regulatory Information

Inventory: NZCIL
Status: Listed
EPA New Zealand Approval Number: HSR001186 METHANOL
Refer to www.ermanz.govt.nz for information on Controls

HSNO CLASSIFICATIONS: 3.1B (Flammable Liquid) 6.1C (Acute Toxicity)
6.4A (Eye Irritant) 6.8B (Reproductive / Developmental Toxicant)
6.9A (Target Organ Toxicant) 9.3C (Terrestrial Vertebrate Ecotoxicity)

HSNO CONTROLS: Tigger quantities for this substance
Approved Handler Test Certificate 250 litres (>5 L containers)
500 litres (≤5 L containers)
Location Test Certificate 50 litres (open container)
100 litres (closed container >5 L)
250 litres (closed container <5 L)
Hazardous Atmosphere Zone 1 litre (open continuously)
5 litres (open occassionally) 25 litres (decanting) 100 litres (closed containers)
Emergency Management Fire Extinguishers (250 L)
Emergency Response Plan (1000 L)
Secondary Containment 1000 litres
Signage 250 litres

16. Other Information

References:

1. International Programme on Chemical Safety, Methanol, Environmental Health Criteria, World Health Organization 1997.
2. Patty's Industrial Hygiene and Toxicology, 5th Edition.
3. Fire Protection Guide to Hazardous Materials, 13th Edition.
4. Lanigan, S., Final report on the Safety Assessment of Methyl Alcohol, International Journal of Toxicology., Volume 20, Supplement 1 (2001).
5. Forsberg, K., Quick Selection Guide to Chemical Protective Clothing.
6. Nelson, B.K., Teratological assessment of Methanol and Ethanol at high inhalation levels in rats, Fundamental and Applied Toxicology, Volume 5.
7. NIOSH Guide to Chemical Hazards
8. Hazardous Substance Data Base (HSDB).
9. Cheminfo.

Original Preparation Date: February 9, 2007

Prepared by: Kel-Ex Agencies Ltd., 319 Lynn Avenue, North Vancouver, B.C., Canada, V7J 2C4

Disclaimer: The information above is believed to be accurate and represents the best information currently available to us. Users should make their own investigations to determine the suitability of the information for their particular purposes. This document is intended as a guide to the appropriate precautionary handling of the material by a properly trained person using this product.

Methanex Corporation and its subsidiaries make no representations or warranties, either express or implied, including without limitation any warranties of merchantability, fitness for a particular purpose with respect to the information set forth herein or the product to which the information refers. Accordingly, Methanex Corp. will not be responsible for damages resulting from use of or reliance upon this information.

This Safety Data Sheet may not be changed, or altered in any way without the expressed knowledge and permission of Methanex Corporation.

Revisions:
Revised and re-issued Dec 20, 2011
Revised and re-issued Dec 5, 2013

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ATTACHMENT C

HEALTH AND SAFETY FORMS

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SITE SPECIFIC SAFETY AND HEALTH PLAN COMPLIANCE AGREEMENT

Project Name: ____

Project Number: ____

I have read and understand the health and safety plan indicated above and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Name	**Signature**	**Employer**	**Date**

TAILGATE SAFETY MEETING LOG PROJECT NAME: PROJECT NO:		
DATE: M Tu W Th F Sa Su TIME:		
WEATHER:		
WORKING CONDITIONS:		
PPE:		
ITEMS DISCUSSED:		
THE FOLLOWING INDIVIDUALS ATTENDED THE DAILY TAILGATE SAFETY MEETING (SIGNATURES)		

SITE SAFETY AND HEALTH OFFICER

DAILY SAFETY INSPECTION

PROJECT:____

N	Y	NA	Item
			Daily safety briefing conducted
			Emergency numbers and route to hospital posted
			FWSHP and project-specific Addenda on-site, available to employees, and complete
			Required exposure monitoring conducted and documented
			Monitoring instruments (PID, OVA, CGI) calibrated daily against known standard and documented
			First aid kit available and inspected weekly
			Personnel wearing PPE required by SSHP for fieldwork (at least safety shoes or boots, safety glasses with side shields, and nitrile or similar gloves to handle potentially contaminated material)
			Personnel using buddy system (maintain visual or verbal contact and able to render aid)
			If temperature >70°F: heat stress training conducted, cool fluids available, pulse rates of personnel wearing Tyvek® are being monitored, work/rest cycle in SSHP being followed
			If temperature <40°F: cold stress training conducted, controls in SSHP implemented
			Personnel using appropriate biological hazard controls (See SSHP)
			Drill rig operating manual on-site
			Drill rigs inspected weekly and documented
			Personnel near drill rig or other overhead hazards wearing hardhats
			Each of two drill rig emergency shutdown devices tested daily
			Employees excluded from under lifted loads
			Unnecessary personnel excluded from hazardous areas, specifically near heavy equipment
			Radius of exclusion zone around drill rig at least equal to mast height
			Personnel wearing hearing protection when within 25 ft of drill rigs, generators, or other noisy equipment
			Containers of flammable liquids closed and labeled properly
			Fully charged fire extinguisher available 25 to 50 ft from flammables storage area and inspected monthly
			Personnel exiting potentially contaminated areas washing hands before eating
			Personnel using steam washer wearing faceshield, hearing protection, heavy duty waterproof gloves, Saranax or rainsuit

DAILY SAFETY INSPECTION

PROJECT:____

N	Y	NA	Item
			Portable electrical equipment plugged to a GFCI
			Electrical wiring covered by insulation or enclosure
			Three wire, UL approved, extension cords used
			Housekeeping adequate (walkways clear of loose, sharp or dangerous objects and trip hazards, work areas clear of objects that might fall on employees)
			Walking/working surfaces safe (not slippery, no unguarded holes, no trip hazards)
			Excavations deeper than 5 ft shored or sloped (if personnel will enter) and in compliance with SSHP
			Moving (rotating) machinery guarded to prevent employee contact
			Fall protection provided for work at elevations greater than 4 ft
			All containers of hazardous material labeled to indicate contents and hazards
			MSDSs for hazardous materials on-site
			All vehicles equipped with two-way radios and cellular phones
			15-min eyewash (accessible and full) within 100 ft of areas where corrosive sample preservatives are poured
			Potable and non-potable water labeled
			Chainsaws have anti kick-back protection, personnel wearing cut resistant gloves, protective chaps
			Visitor access controlled
			Site hazards and controls consistent with SSHP
			Site hazard controls appropriate and sufficient

Actions taken to correct or control any “N” responses

____

Name Signature Date

WEEKLY DRILL RIG CHECKLIST

Date	______________________	**Rig Description**	________________
Project #	______________________	**Serial or License #**	________________
Location	______________________	**Rig Owner**	________________

Item Name	Requirement	OK	No*	Comment
+\ Gdulic V\VWHPV FRQWUROs and OHYHUV	1RIHDNLQJ fLWWLQJV RU FRQQHFWLRQs. /HYHUs DUe in Jood RSHUDWLQJ cRQGLWLRQ. FOXLGOHYHOV DUe IXOl.			
Fuel, Ril, ZDWHU, Dnd FRRODQWlines	No OHDNV.			
Hoses	No OHDNs Ln hoses RU FRQQHFWLRQs. 1o VLJns RI H[FHVVLeYZHDU, NLQNed RU EHQW hoses.			
* DXJes	2SHUDWional and Yisible Wo RSHUDWRU			
(PHUJency Nill VZLWFh and OLIeline	2SHUDWional and accessible Wo RSHUDWRU			
6KHDUpins	,n place.			
'ULYe chains	1o VLJns RI H[FHVVLeYZHDU, EURNen RUGHIHFWLYe OLQN			
2XWULJJHUV	1o OHDNs. 6HWon pads (as QHFHVVDUWo DYoid GDPDJe).			
Cables and URSHV	No IUD\LQJ, ELUGQHVWLQJ, IODWWHQLQJ, sWUDQGLQg. MXVt bH Ebraided RU SURSHUO\FODPped DW FRQQHFWLRQs.			
3XOOH\V, GUXPs and spools	1Re[FHVVLYH wHDr oUcUDFNLQg.			
+RLVWV	3URSHUO spooled cable, UDWed Wo OLWoads.			
'HUULFN/0DVW	/RFNed Ln SRVLWLRn. FUDPH iVQRt FUDFNed RU EHQW			

Item Name	Requirement	OK	No*	Comment
* XDUds	3RZHUWDNe-RIIV (37 2 V) and all URWDWLQJSDUWV GHVLJned ZLWK JXDUds. * XDUds PXVWKDYe ZDUQLQJlabels.			
3DUNLQJEUDNes	6HWand RSHUDWonal.			
: Lndshield ZLSHUV	2 SHUDWLonal.			
/LJKts (head, taiO and UXQQLQJOLJKWV)	2 SHUDWLonal and ZLWKRXWFUDFNed lenses.			
%DFNup DODUP	2 SHUDWLonal, VSRWWHU used.			
6DIHW\HTXLSPHQW	6DIHW\KDUness, ILUH H[WLQJXLVKHU IODUes, VDIHW\UHIOHFWRUV, ILUVWaid NLt, gURXQGLQJwLUe fRr fXHOLQJ, and spill Uesponse HTXLSPHQW (IRUIXHOLQJ&UHSDLUV).			
0 Lscellaneous (as applicable)	'LYHUWHUV\VWHPs; DXJHU and head seals; F\clones; JURXWSODQW JXDUds; HWF (OLVW) • • •			

'HI Lciencies ((\[Slain DOO QHJDWLYH Uesponses Dnd OLVWFRUUHFWLYe DFWLons; all GHILciencies PXVW be FRUUHFWHd EHIRUe Whe ULJ is HQWHUed LQWRVHUYLce):

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____

____

2 WKHU5 HSDLUs RU5 RXWLne 0 DLQWHQance: ____

____

____

,QVSHFWLRQ &RQGXFWHG and 5LJ&HUWLIied E\: ____

(2 ZQHU/2 SHUDWRU) 1DPe and ' DWe

Report Reviewed by: ____

(7(&-Weston) 1DPHDnd 'DWH

DAILY HEALTH AND SAFETY SUMMARY **PROJECT NAME: PROJECT NO:**
NAME: DATE: M Tu W Th F Sa Su TIME:
TASKS PERFORMED:
OFF-NORMAL EVENTS:

HEALTH AND SAFETY MONITORING LOG

PROJECT NAME: **PROJECT NO:**

DATE	INSTRUMENT/NO.	RESULTS	TIME	REMARKS	NAME

Cardno ZERO HARM
EVERY JOB. EVERY DAY.

Global Health, Safety and Environment Incident 1otification 3URFHVV

Purpose: 7o ensXUe cHUWDLn iQFLGHQWVLQYROYLQJHPSOR\HHVDQd aQ\one ZRUNing at, RUaIIHFWed b\, a CarGno-FRQWUROOHd ZRUNSODFe, prRMHFWRUjob sLWH, vLVLWLQJ a CarGQo ofILFe/fDFLOLW\RUVRPeone othHUZLVe on asVLJQPent fRU&DUdno are QRWLIied b\ RHJLRQVto GURup OHYel ZLWKGHILQHGWLPHIUDPHV.

Definitions: 5HIHUto the *ORbusDO+6(*ORVVDU\ on the &DUGQR iQWUDQet.

Priority	Incident	How to Notify
Immediate	)DWDOLWinvROYLQg: • &ardno ePSOR\HH • $Q\one working on oUvLVLWLQJa Cardno-FRQWUROOHdr DGFLQLWVWHUHd wRUNSODFHRU SURMHFWjob VLWH	**Immediately:** 5HJLRQDOGHQHUDO Manager mXVWSURYLGe a YHrbal brLHILQg by cRQWDFWLQg a *Group Contact* Dt right, VWDUWLQJZLth the cRQWDFWOLVWed at 'a,' and if they are not DYDLODEOHFRQWLQXing GRZn the OLVWXQWLO contact is PDGH
Within 24 Hours	:LWKLQ24KRXUVRI the folORZing events: •)DWDOLW\ • Lost TLPe, ReVWULFWHGRU and MHGLFDO 7Uēatment ,QMXULHV • 6HULRXVSeFXULW\,QFLGHQW • +Lgh PotHQWLDO,QFLGHQW • ,QFLdent rHVXOWLQJin a SHUVRn being DGPLWWHGWRKRVSLWDO • 6HULRXVEnvLURQPHQWDO,QFLGHQW • +SE RHJXODWRU\(QIRUFHPent 1RWLFH	**Within 24 hours:** RHJLRQDOSHUDWLRQVManager (or HTXLYDOHnt) or abRYe muVW VHQd the *Global HSE Incident Notification Template* via ePDLOto alO*URXS*ContaFWVat right and GURup H6(4 email DGGUHVV (*URXS+6(4#FDUGQR.com.aX*). **In addition, for Serious Security Incidents:** send the FRPSOHWHG*ORbal HSE ,QFLGHQW1RWLILFDWLRn THPSODWe to the *ORbal SHFXULW\0anager (GDYLd.ricKDUGV#FDUdno.FRm.au).
Monthly Report	0RQWKO\UHSRUWLQJRIthe nXPEer of the foOORZLQg LQFLGHQWV • Lost TLPe InMXU\,QFLGHQWV • 5HVWULFWHGRUk InjXU\,QFLGHQWV • 0edical TUHDWPHQW,QMXU\,QFLGHQWV • 6HULRXVEnvLURQPHQWDO,QFLGHQW • 6HULRXVSeFXULW\,QFLGHQW • 1ear MLVVHV	**Monthly:** As part of ExHFXWLYH Managers' RHSRUWLQJHDch 5egion PXst VXEmit the rHTXLUHd HSE infRUPDWLRQwithin the 2SHUDWLRQDO6SHQFH by the end of the 5WK day of WKHIROORZing PRQWK(refer to Step 1 of the *Executive Reporting Schedule*).

Group Contacts
a. &hief ExHFXWLYH2IILFHU 5LFKDUG&DQQ PXOOHU 7el: +61 7 3877 6966 0ob/Cell: +61 418 711 779 b. *lobal HSSEQ MDQDJHU Brian :DUULFN 7el: +1 949 273 5488 0ob/Cell: +1 949 282 8402 c. *eneral Manager GOREDO %XVLQHVV6HUYLFHV .\lie Sprott 7el: +61 7 3100 2208 0ob/Cell: +61 403 621 780

Cardno Shaping the Future

Global HSE Incident Notification Template

Who completes this form:	*THIS TEMPLATE IS NOT FOR EMPLOYEE USE* 7KLV WHPSODWH LV XVHG RQO\ Ey Cardno 5HJLRQV to SURYLGe ZULWWHQ QRWLILFDWLRQ RI iQFLGHQWV **within 24 hours** WR Group OHYHOs UHTXLUed Ey WKe [Global HSE Incident Notification Process](). (P SOoyees mXVW IROORZ WKH ,'L YLVLon iQFLGHQW UHSRUWLQJ SURFHVV) Rr GHILQLWLRns Rf WHUP V, UHIer to [Global HSE Glossary]() RQ WKe iQWUanet.
Cardno Business Unit/ Division/Region	
Name and position of injured person	
	☐ EPSOR\HH ☐6ub-cRQWUDFWRU ☐9LVLWRU ☐2WKer:
Condition of injured person	Was the person admitted to hospital? ☐<HV ☐1R
HSE incident type/s (Select all that apply)	**Severity Level:** ☐)DWDOLW\ ☐/RVW7LPe ,QMXry/,OOQHVs ☐5HVWULFWHG: ork ,QMXry/,OOQess ☐0 HGLFDO TrHDWPHQW,QMXU\/,OOQHVV **Other categories:** ☐ 6HULRXV HQYLURQP HQWDO,QFLdent ☐ 6HULRXV VHFXULW\ IQFLGHQW ☐ + SE UHJXODWRU\ EnIRUFHP HQW_QRWLFH
Is this incident a "High Potential Incident?"	☐<HV ☐1R — $ ³+Lgh PRWHQWLDO,QFLGHQW´LV DQ LQFLdent (iQMXry or QHar mLVV) WKDW FRXOG HDVLO\ have UHVXOWed LQ D fDWDOLW\ or a OLIH WKUHDWHQLQJ LQMXU\ inMXU\.
If LTI, why was lost time not avoided?	
What happened	
Location	
Date	Time:
Apparent cause/s	
Corrective action taken/determined to date	
Client Name	
Project Name	
Client requirements of Cardno in managing incident (if any)	
Action plan to address client requirements	
Regional GM or Regional Ops Manager	

Refer to [Global HSE Incident Notification Process]() for distribution

Cardno

ZERO HARM

EVERY JOB. EVERY DAY.

HSE Incident Investigation

*ORElD+6 E 3URFHure

All Regions

July 2013

Document CRQWUR

1.0	7 'H c 2012	'D PLHn 7D\Or	. \OLH 6SURW	$QGUZH %XFNOH\
1.1	1 JXl 2013	'D PLHn 7D\Or	. \OLH 6SURW	$QGUZH %XFNOH\

Brief Description

3URFHGXUHor LQYHVWLJDWLng UHFRUGDEOHLQMXULes (ORVW time, UHVWULFWHd Zork and PHGLFDO WUHDWPHQWLQMXULHV) and Kigh SRWHQWLDO LQFLGHQWV

Scope

All 5HJLons PXVW FRPSO\ ZLWK this procedure and Pay LQFRUSRUDWH UHTXLUHPHQWV LQWR Division and 5HJLon-OHYel SURFHGXUHs to DYRLd H[FHVVLYe FURVV UHIHUHQFLQJ.

Requirements

5HFRUGDEOH LQMXULes and Kigh SRWHQWLDO LQFLGHQWV PXVW be LQYHVWLJDWHd ZLWKLn WLPHIUDPes GHILned ZLWKLn WKLs SURFedure WR GHWHUPLne WKHLr cause/s. $SSURSULDWH FRUUHFWLYH DFWLons PXVW be LGHQWLILHG.)LQGLngs PXVW be UHSRUWHd WR VHQLor PDQDJHPent and FRUUHFWLYe DFWLRQ PXVW be WUDFked WR FORVure.

Definitions

5HIer to the [*Oobal HSE *ORVVDU\] on WKe LQWUDnet.

Responsibility Matrix

Incident Type	1. Investigation 2 EMHFWLYe: ,QLWLDO LQYHVWLJDWLRQ ZLWKLn 24 Kours DQd SUHSDUe GUDIt LQYHVWLJDWLRQ UHSRUW	2. Line Management Visit 2 EMHFWLYH 9LVLW RIILFH/sLWH DQd UHYLew GUDIt LQYHVWLJDWLRQ UHSRUW SULRr WR SUHVHQWLQJ WR WKe UHYLew WHam	3. Review 2 EMHFWLYe: +Rd a GLVFXVVLon and SURYLGe SRVLWLYH/ FRQVWUXFWLYe IHHGEDFk on LQYHVWLJDWLon and SURSRVed FRUUHFWLYe DFWLons	4. Final Report
• Lost Time Injury • Serious Security Incident • Serious Environmental Incident • High Potential Incident	,QYHVWLJDWLRQ WHDP: >)LUVWLQH VXSHUYLVRr/ PDQDJHU > BUDQFK RU %XVLQHss 8QLW 0DQDJHU (WHDP OHDGer) > 'LYLVLRn HSE 0DQDJHU/$GYLVRr	> 'LYLVLRQ 0DQDJHU RU $UHa 0DQDJHU (RU GHOHJDWHG WR D VXLWDEOH VHQLRr PDQDJHU)	5HYLew WHDP: > *HQHUDO 0DQDJHU > RU 5HJLRQDO 2SHUDWLRns 0DQDJHU > 5HJLRQal +SE 0DQDJHU > / HJal, ZKHUe UHTXLUHd	> *HQHUDO 0DQDJHU VXEPits ILQDl UHSRUW (SRVWHYLHZ) WR 0DQDJLng 'LUHFWRU *Uoup 2SHUDWLRns 0DQDJer, 'LYLVLon 0DQDJer *Uoup 6HUYLFHs and *URXS +6(0DQDJHU **within 10 business days of incident** > 5HJLRQal GM prHVents UHSort DQd Ney ILQGLngs WR ([HFXWLYe 7eam GXULng Qext PRQWKO\ PHHWLng
• Restricted Work Injury • Medical Treatment Injury	,QYHVWLJDWLRQ WHDP: >)LUVWLQH VXSHUYLVRr/ PDQDJHU > BUDQFK RU %XVLQHss 8QLW 0DQDJHU (WHDP OHDGer) > 'LYLVLRn HSE 0DQDJHU/$GYLVRr	> %8 0DQDJHU	5HYLew WHDP: > 'LYLVLRQ 0DQDJHU RU $UHa 0DQDJHU > RU 5HJLRQDO 2SHUDWLRns 0DQDJHU > 5HJLRQal +SE 0DQDJHU > / HJal, ZKHUe UHTXLUHd	> 'LYLVLon 0DQDJHU VXEPits ILQDl UHSRUW (SRVWHYLHZ) WR *HQHUDO 0DQDJer, 5HJLRQal 2SHUDWLRns 0DQDJer and 5HJLRQal +SE 0DQDJHU **within 10 business days of incident** > *HQHUDO 0DQDJHU UHDGV WR SUHVent UHSRrt and Ney fLQGLQJs WR ([HFXWLYe 7eam GXULQJ Qext PRQWKO\ PHHWLQJ.

Process Flow

1. Incident Occurs	> 5HFRUGHGEOe IQMXU\ (MHGLFDl 7UHDWPHQt ,QMXUy, RHVWULFWHd WRrk IQMXUy, / RVt 7LPe InMXU\) > +LJh 3RWHQWLDl ,QFLGHQW,6HULous 6HFXULW\,QFLGHQt, 6HULous (QYLURQPHQWDl ,QFLGHQW
2. Initial Notification	> ,QYROYed SHUVRQQel PXVt IROORw WKeir GLYLVLon/UHJLRQDl LQFLGHQt UHSRUWLQg SURFHVV. > : UlWWHQ QRWLILFDWLRn is SURYLGed WR *URXp 0DQDJHl ZLWKLn 24 KRXUVEy RHJLRQDl 2 SHUDWLons 0DQDJHr Ds UHTXLUHd by WKH * OREal + SE ,QFLGent NRWLILFDWLRn 3URFHVV > &DUGQo In-hRXVe OHJal DGYLFe PXVt Ee VRXJht EHIRUe FRPPHQFLQg Dn LQYHVWLJDWLRn LQWRan LQFLGent WKat FRXOd SRWHQWLDOOy OHad WR SURVHFXWLon or OLWLJDWLRQ
3. Starting the Investigation	)LUVt OLQe VXSHUYLVRr/PDQDJer FRPPHQFHV LQYHVWLJDWLRn ZLWKLn 24 hRXUV: > 1RPLQDWHs DSSURSULDWeWeam PHPEers > 7eam EHJLns LQLWLDl IDFt ILQGLQJ
4. Investigation	,QYHVWLJDWLRn Weam DQDO\VHs IDFts Rf LQFLGent & SUHSDUHs a drDIt LQYHVWLJDWLRn UHSort (FOLFN KHUH IRU WHPSODWH) ZKLFK: > ,GHQWLILHs WKe cDXVHV; DQd > ,QFOXGHs FRUUHFWLYe DFWLRns IRr HDFh FDXVe to pUHYHQt LQFLGent UHRFFXUUHQFH
5. Line Management Visit	/LQe PDQDJer (fRr /7 ,V, +Lgh 3RWHQWLDl ,QFLGHQW,6HULous 6HFXULW\,QFLGHQW,6HULous (QYLURQPHQWDl ,QFLGents – ' LYLVLon 0DQDJer/(0 R $Uea 0DQDJer (RUGHOHJDWHd WR a VXLWDEOe VHQLRr PDQDJer); IRr 5: Is DQd 07 Is – BU 0DQDJer) YLVLts WKe UHOHYDnt RIILFH/sLWe DQd: > 5HYLews GUDIt UHSort IRr DFFXUDFy, LGHQWLILFDWLon Rf FDXVHs DQd GHYHORSPHQt Rf VRXQd FRUUHFWLYe DFWLons > (QVXUHs SHUVRns ZKo DUe UHVSRQVLEOe IRr LPSOHPHQWLQg FRUUHFWLYe DFWLRns DUe PDGe DZDUH, DQd DJUeed GXe GDWHs DUe REWDLQed > 3UHVents ILQGLQJs SUHVHQWHd WR UHYLew WHDP
6. Review and Final Report	5HYLew WHDP: > 5HYLews UHSort IRr DFFXUDFy, LGHQWLILFDWLon Rf FDXVHs DQd GHYHORSPHnt Rf VRXQd FRUUHFWLYe DFWLons > $SSURves or UHF\FOHs WR LQYHVWLJDWLRn Weam ZLWK VSHFLIic DGYLFe UHJDUGLQJ SUREOHms > $SSURves DQd VXEPits ILQDl UHSRUW
7. Implementation of Corrective Actions	5HJLRQDl +6E 0DQDJer PRQLWRUs LPSOHPHQWDWLRn Rf FRUUHFWLYe DFWLRQs DQd SURYLGHs PRQWKO\ Vtatus WR * HQHUal 0DQDJer and * Uoup + SE 0DQDJer
8. Communication	> 5HJLRQDl HSE 0DQDJer GLVWULEXWHs VXPPDU\ Rf LQFLGHQt & key OHDUQLQJV. > All ILUVt OLQe VXSHUYLVRUV/PDQDJers GLVFXVV Ney IHDWXULQJs ZLWK DSSURSULDWe SHUVRQQel and FRRUGLQDWe ORFDl LPSOHPHQWDWLRn Rf FRUUHFWLYe DFWLRQV Ds DSSURSULDWe.

Related documents:

* OREDl HSE *ORVVDU\

* OREDl HSE 0DQDJHPent) UDPHZRUN (rHIer VHFWLRns 10.3 – 10.7)

* OREDl HSE ,QFLdent 1RWLILFDWLRn 3Uocess

,QFLdent ,QYHVWLJDWLRn) RUP Report 7HPSODWH

Incident Investigation Final Report

Title:

Division/Business Unit/Office affected:

Date and time of incident:

Date of investigation:

Investigation Team members name and position:

Review Team members name and position:

---

1. Incident Summary:

A short SDUDJUDSK thaW briHIO\ GHVFULEHV the iQFLGHQW

2. Initiating Event:

7he initiDl fDLOure that trLJJHUHG the iQFLGHQW or led tR itV dLVFRYHU\

3. Incident Description:

A chroQRORJ\ of the inFLdent. 7his VHFWLRQ sKRXOd iQFOude a deVFULSWLRQ of KRZ the iQFLGHQW was GLVFRYered, the IDFWV of the inFLGHQW, WHQWDWLYH key cRPSRQent nuPEer and name of any eTXLSPHQW that faLOHd or SHUIRUPHd abQRUPDOO\, VDIHW\ V\VWHP reVSRQVe inIRUPDWLRQ, cRQWURO syVWem DFWLRQ, VLJQLILFDQW huPDQ acWLRQV aQG intervHQWLRQ, toxLc, radLRDFWLYH, or otKHUZise hD]DUGRXs mDWHrial reOHDse data, and LPSRUWDQW plant SDUDPHWHU. TKLV VHFWLRQ VKRXOd aOVo LQFOude DQ\ spHFial FRQVLGHUDWLRQV VXFK as uQH[SODLQHG or uQH[pected EHKDYLRr of HTXLSPent or peRple, LQDGHTXate or degUDGLQg eTXLSPHQW, VLJQLILFDQW miVXQGHUVWDQGLQgs E\ persoQQHO, vLRODWLRQ of WHFKQLFDO sSHFLILFDWLRQV or GHVLgn OLPLWV, or IDLOXUe of SUHYLRXV FRUUHFWLYH DFWLRQV to prHYHQW the UHFXUUHQFH of the LQFLGHnt.

4. Immediate Corrective Actions:

$FWLRQ tDNHQ to SODFe the SODQW or syVWem in a sale FRQGLWLRQ

5. Causes and Corrective Actions*:

	Cause	Corrective Action	Person Responsible	Target Date
1				
2				
3				
4				
5				

2QFe approved, +6 (0 anager LV WR HQWHU the cRUUHFWLYe DFWLRn LQWR the Group +6 (,QFLdent &RUUHFWLYH $FWLRQ 5HJLVWer.

6. Lessons Learned:

7he lesVRQV that were learQHG about the QHHd for FRUUHFWLYe actLRQV and any leVVRQV aboXW those FRUUHFWLYe aFWLRQV that need to be paVVed oQ to wRUNHUV, VXSHUYLsors, and PDQDJHUV. The Pethod for FRPPXQLFDWLQJ leVVRQV leaUQed to wRUNHUV, VXSHUYLsors DQG PDQDJHUV VKRXOG be VSHFLILHG DORQJ with the perVRn reVSRQVLEOe for enVuring the OHVVRQV OHDUQed are FRPPXQLFated. In aGGLWLRQ, the OHVVRQV OHDUQed VKRXOd hDYe a due dDWe for the cRPSOHWLRQ of the cRPPXQLFDWLRn, and a VSHFLILFiW of thRVH HLWKHU by QDme or E\ job WLWOH, OHDGLQJ FRQWUDFWRU to recHLYe the OHVVRns OHDUQed.

7. References and Attachments:

List of all reIHUHQce and DWWDFKPHQWV, CRSLHV of DSSURSULDWe SURFHGXUHV, IRUPV, cRPSXter SULQWRXW, LQVWUXPHQt cKDUWV, and VWDWHPHQts of iQYROYed pHUVRQQHl shRuld EH attDFKed fRr a rHIHUHQFH.

8. Report approved by:

1DPHV DQG siJQDWXUH of tKRVe apprRYing the reSRUW

9. Distribution list:

1DPHV for report GLVWULEXWLRQ

(For Safety Staff only)	REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT *(For Use of this Form See Help Menu and USACE Suppl to AR 385-40)*	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. Name *(Last, First, MI)*

b. AGE

c. SEX ☐ MALE ☐ FEMALE

d. SOCIAL SECURITY NUMBER

e. GRADE

f. JOB SERIES/TITLE

g. DUTY STATUS AT TIME OF ACCIDENT
☐ ON DUTY ☐ TDY ☐ OFF DUTY

h. EMPLOYMENT STATUS AT TIME OF ACCIDENT
☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER
☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL
☐ TEMPORARY ☐ STUDENT
☐ OTHER *(Specify)* ______

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(month/day/year)*

b. TIME OF ACCIDENT *(Military time)* hrs

c. EXACT LOCATION OF ACCIDENT

d. CONTRACTOR'S NAME
(1) PRIME:
(2) SUBCONTRACTOR:

e. CONTRACT NUMBER ______
☐ CIVIL WORKS ☐ MILITARY
☐ OTHER *(Specify)* ______

f. TYPE OF CONTRACT
☐ CONSTRUCTION ☐ SERVICE
☐ A/E ☐ DREDGE
☐ OTHER *(Specify)* ______

g. HAZARDOUS/TOXIC WASTE ACTIVITY
☐ SUPERFUND ☐ DERP
☐ IRP ☐ OTHER *(Specify)* ______

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY ______ (CODE) #

b. TYPE OF CONSTRUCTION EQUIPMENT ______ (CODE) #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY ______ (CODE) #

b. ESTIMATED DAYS LOST

c. ESTIMATED DAYS HOSPIT-ALIZED

d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED
PRIMARY ______ (CODE) #
SECONDARY ______ (CODE) #

f. NATURE OF ILLNESS/INJURY ______ (CODE) #

g. TYPE AND SOURCE OF INJURY/ILLNESS
TYPE ______ (CODE) #
SOURCE ______ (CODE) #

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT ______ (CODE) #

b. PERSONAL FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE
☐ PICKUP/VAN ☐ AUTOMOBILE
☐ TRUCK ☐ OTHER *(Specify)* ______

b. TYPE OF COLLISION
☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END
☐ BROADSIDE ☐ ROLL OVER ☐ BACKING
☐ OTHER *(Specify)* ______

c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
(1) FRONT SEAT			
(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT ______ (CODE) #

b. TYPE OF COLLISION/MISHAP ______ (CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)	YES	NO	a. *(CONTINUED)*	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐	CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐	OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐	SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐	PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐	DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐	b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?		
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐	☐ YES *(If yes, attach a copy.)* ☐ NO		

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)		
c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT CORPS ______ CONTRACTOR ______	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL

16. MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

*U.S. GOVERNMENT PRINTING OFFICE: 1993-0-791-757

10. ACCIDENT DESCRIPTION *(Continuation)*

13a. DIRECT CAUSE *(Continuation)*

13b. INDIRECT CAUSES *(Continuation)*

14. ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S) *(Continuation)*

ATTACHMENT D

CORPORATE HEALTH AND SAFETY POLICY STATEMENT

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To: All Cardno Government Services Division Employees
Subject: Cardno, Government Services Division's Health and Safety Policy

It has always been and shall continue to be Cardno, Government Services Division's policy to provide and maintain a safe and healthful working environment and to take steps necessary to prevent injury to our employees. Our employees are considered our most important asset; therefore, prevention of job-related injuries and illnesses is given precedence over other considerations within the company. As part of the Cardno organization, we have incorporated the Cardno Zero Harm program into our Health and Safety paradigm.

Safety is everyone's responsibility. Managers are responsible for providing the resources necessary to maintain a safe working environment and for ensuring implementation of, and compliance with, the company's health and safety policies, which are in compliance with federal, state, and local safety regulations. Supervisors are responsible for implementing health and safety policies and ensuring that day-to-day activities are conducted in a safe and healthy manner.

Lynne Black, the Cardno, Government Services Division Health and Safety Manager (HSM), has been given the authority and responsibility for implementing and maintaining the Health and Safety Program for Cardno, Government Services Division. However, the most important and effective person in our effort to eliminate and reduce injuries is you, our employee. You are responsible for adhering to established health and safety policies and for performing tasks in a manner that does not endanger yourself, other employees, or property. We need your help in eliminating causes of injuries, such as unsafe work conditions and unsafe work practices. We ask that you immediately report any unsafe conditions and/or work practices to your supervisor. In addition, we encourage you to submit possible corrective action to be taken.

Our safety policies are based on past experience and current standards, and are also an integral part of the company's personnel policies. This means that compliance with the policies is a condition of employment and must be taken seriously. Failure to comply is sufficient grounds for disciplinary action or for termination of employment.

We must be aware of the hazards that lead to occupational injury and illness and think about our safety and well being, as well as that of our fellow employees and the company. Working together we will succeed in having a safe, healthful, and profitable workplace from which we all will benefit.

Lynne Black 03/31/2015
Lynne Black Date
Cardno, Government Services Division Health and Safety Manager

I have and read and understand Cardno, Government Services Division's General Health and Safety Program and the portions of Parts 2 and 3 (Specific Health and Safety Programs and the Safe Work Practices) that apply to my job duties.

Employee Name (print and sign) Date

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APPENDIX C

AOC-SPECIFIC EVALUATIONS

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Eastern Portion RVAAP						
CCRVAAP-69	Building 1048	The Building 1048 Fire Station (CC RVAAP-69) AOC was located in the former plant administration area in the northwest quadrant of the intersection of George Road and South Service Road. In 1968, the fire station was referred to as the Fire and Guard Building, and consisted of 12,130 square feet. The fire station building was demolished in late 2008, and the site currently remains undeveloped. The AOC consists of the ground area located west/northwest of the former building. The area is currently marked with Siebert stakes. Reportedly, it was common practice for the fire department to clean out fire extinguishers behind the west side of the fire building, and to allow the contents of the fire extinguishers (carbon tetrachloride) to spill onto the ground surface. The area of potential impact (ground surface west of the building) is approximately 28,000 square ft.	Additional sampling is scheduled for spring 2015 to define nature and extent of contamination for Carbon tetrachloride. An HRR was completed in December 2011. A PBA contract was awarded in FY11 to address investigation and remediation of the 14 CR sites at RVAAP, including the three areas in this site. This site is currently undergoing an RI.	2015 Field change notice (includes surface soil sample results, approval not found)	2012 Final SI and RI Work Plan	Site documents are all related to project and work planning. No GW data was located in available documents.
CC RVAAP-70	East Classification Y	Classification yards were used for the switching and maintenance of railroad cars. This yard was equipped with a locomotive repair building (Round House), an herbicide storage shed, several outbuildings, a washrack area, and a storage tank area. The herbicide shed contained a mobile herbicide tank. The AOC area consists of the following areas within the East Classification Yard: storage tank area, herbicide shed, Round House building, and former washrack area.	An HRR was completed in December 2011. According to the HRR, a heating oil fuel spill occurred in 1986 within the vicinity of the storage tank area. The area was reportedly cleaned up; however, no final cleanup report was found. This area is now overgrown with vegetation. Staining from past operations was found within the Round House building. No visible evidence of impacts (stained soil, stressed vegetation) was noted in the vicinity of the herbicide shed or washrack. The HRR recommended further investigation for all four areas within the East Classification Yard. Field work for the SI was completed in December 2012. The Pre-draft report was submitted in February 2013. Draft SI Report (2015):Surface soil constituents exceeding bkg and or more FWCUG: benzo(a)anthracene, benzo(a)pyrene, benzo(a)fluoranthene, indeno(1,2,3-c,d)pyrene, arochlor 1242, arsenic, lead. Subsurface soil constituents exceeding bkg and or more FWCUG: benzo(a)anthracene, benzo(a)pyrene, benzo(a)fluoranthene, C10-C20 DRO, cobalt.	Draft SI 2015 (no approval document found)	2012 Final SI and RI Work Plan	Draft SI Report (2015): No potential SRCs were identified in the surface or subsurface soil sampled as part of this SI, which included the following areas: Former Fuel Oil Spill Area, Building 47-40 Round House (Exterior of Building and Interior Repair Pit), Former Herbicide Storage Shed, and Outdoor Wash Rack Area. - No potential SRCs were identified in the dry sediment collected from the two drainage ditches located to the east and west of Building 47-40 at the CC RVAAP-70 AOC. The results of the SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at this AOC.

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CC RVAAP-72	Facility Wide USTs	CC RVAAP-72 consists of 58 underground storage tanks (USTs) located throughout the facility. USTs were located throughout RVAAP operational production areas including load lines, maintenance areas, gate houses, water works, power houses and fueling stations. Approximately 45 of the UST were installed in 1941 and the remaining were installed between 1941 and 1981. The USTs ranged in size from 100 gallons to 20,000 gallons and were used for storage of gasoline, diesel fuel, No. 5 heating oil, and No. 6 fuel oil. All USTs included as part of CC-RVAAP-72 are inactive and suspected to be removed. Petroleum impacted soils and/or groundwater may exist at the former UST sites.	The SI report recommends No further Action.	2015 Final SI (approved)	2015 Final SI (approved)	Final SI: No potential contamination was identified in the subsurface soil sampled at the 24 former UST locations that are the subject of this SI at CC RVAAP-72 FWUSTs. -The results of this SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at CC RVAAP-72 FWUSTs. -Twenty-three of the former 24 USTs (subject of this SI) have prior documentation, geophysical testing, or soil boring results showing that USTs no longer remain in-place. Further action is warranted at the location of the former UST RV-46 in the area of the EM and GPR anomalies to confirm or complete UST removal from the site in accordance with BUSTR UST closure requirements. SI conclusions indicate that NFA is warranted for soil at the CC RVAAP-72 FWUSTs.
CC RVAAP-73	Facility-Wide Coal	Installation records document the former presence of 17 coal storage locations at Ravenna Army Ammunition Plant (RVAAP), all of which are included in CC RVAAP-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 square ft (about five acres).	During a property visit conducted as part of the historical records review, visual evidence of previously undocumented coal storage was found approximately 2,000 feet south of the East Classification Yard and at the Building U-16 boiler house in the Depot Area. Available historical aerial photographs and site observations indicate that coal residue may still remain on or at the ground surface at the above-described locations. As such, the surface soils may be impacted by typical coal contaminants (PAHs, metals). A historical records review was completed in December 2011 and included investigation into the 17 documented coal storage sites and the additional two undocumented sites. Remnants of coal were noted at the following locations during the historical records review: North Line Coal Tipple, Sand Creek Coal Tipple, Building U-16, and the undocumented coal location south of the East Classification Yard. Stressed vegetation was noted at the North Line Coal Tipple. No remnants or stressed vegetation was noted at any other coal sites. Further investigation was recommended for the following coal sites: North Line Coal Tipple, Sand Creek Coal Tipple, Building U-16 coal area, and the undocumented coal storage area south of the East Classification Yard.	2015 Draft RI (no approval document found)	2012 Final SI and RI Work Plan	Draft RI (no approval document found): The RI conducted at CC RVAAP-73 Facility-Wide Coal Storage has adequately characterized surface and subsurface soils contained within this AOC. Based on the results of this RI, which included an evaluation of contamination fate and transport, an HHRA, and an ERA, No Further Action is obtained at CC RVAAP-73 Facility-Wide Coal Storage for soil. Records review report for 2010 Phase I RI says: No groundwater samples were collected as part of project. Leaching of potential soil contaminants to groundwater, with subsequent lateral migration to surface water discharge points or other surface water exposure points, are potential migration pathways for the CR site, which may require further evaluation.

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CC RVAAP-79	DLA Ore Storage S	Various ores were historically stored (stock-piled) at this facility for the General Services Administration (GSA). The Defense Logistics Agency (DLA), Defense National Stockpile Center leased space at the Ravenna facility for the storage of the ore materials on the ground and in ASTs, which are addressed by CC RVAAP-79. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils. The following GSA materials were stock-piled on the ground surface: brass ingots, chemical chrome ore, copper ingots, ferrochrome ore, ferro manganese ore, and metallurgical manganese ore. The following GSA materials were stored in Strategic Material Tanks: magnesium, kyanite, antimony sulfide, asbestos (raw), cobalt rutile sand, cobalt zircon sand, monazite sand, nickel cathodes, rutile sand, silicon carbide, talc, and zircon sand ore. The monazite sand contained radioactive element Thorium 232.	The RI Work Plan was approved in October 2012. The anticipated exit strategy for this site includes completion of the RI/FS followed by soil excavation with off-site disposal. Groundwater monitoring requirements are carried in RVAAP-66, Facility-wide Groundwater. The reasonably anticipated future land use will consist of OHARNG Military Training.	Final SI & RI Work Plan, Oct 2012	Final SI & RI Work Plan, Oct 2012	Final Initial Assessment (2012, no approval document found): There is only one detected sample result that exceeds the applicable screening criteria. This sample was collected east of Building AC-165 where the analytical result for Manganese of 1520 mg/kg exceeds the surface soil background concentration of 1450 mg/kg. This sample is a field duplicate of sample DL2ss- 001M-0001-SO which has a Manganese concentration of 803 mg/kg, which is well below the background value. This is likely attributed to the variation of naturally occurring manganese in the soil. The analytical result concentration of 1520 mg/kg is only slightly greater than the surface soil background concentration of 1450 mg/kg, and is well below the subsurface soil background concentration of 3030 mg/kg. Therefore, the concentrations of chemicals detected in the soils do not pose unacceptable risks. Groundwater is a potential exposure pathway, however, groundwater sampling and analysis is being addressed under a separate facility-wide contract and is not included in the SAP.
CC RVAAP-80	Group 2 Propellant Can Tops	This area consists of approximately 539,572 square feet (12.4 acres). Propellant can tops were identified at the ground surface at the southern end of the former Group 2 Ammunition Storage Area. The area is addressed by CC RVAAP-80. The tops were observed by OHARNG trainees in fall 2008 in the vegetative area located immediately south of the ammunition storage magazines in the vicinity of the railroad spur lines. As a result, the Louisville District USACE performed an initial geophysical survey of the southern area ground surface. Results of the initial investigation revealed multiple magnetic anomalies in the surface and near surface soils. On-site UXO personnel visually identified the surface anomalies as propellant can lids or tops.	A Final investigation Report was produced and submitted the Ohio EPA requested additional work . A geophysical survey and sampling activities were conducted in 2011. The geophysical survey revealed five anomaly cluster areas exist at the surface or within near surface soils (within 9 inches) at the site. Additional single (i.e. not clustered) anomalies appear throughout the AOC. No signs of disturbance within the subsurface lithology (signs of excavation or dumping) were noted based upon the geophysical investigation. Surface soil samples were collected within the boundaries of three of five selected anomaly clusters in order to assess potential releases of propellants. None of the samples reflected detectable concentrations of COCs above facility-wide cleanup goals.	Revised Draft Project Work Plan 2015 (no approval document found)	Final Investigation Report for Compliance (2012, approval not found, but comments completed)	Historical documentation reviewed to date for this CRS does not contain conclusions or recommendations related to groundwater.

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Central Portion RVAAP						
CC RVAAP-68	Electric Substations	Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. The East Substation is located close to the intersection of Remalia Road and Load Line No. 2 Road. The substation comprises an area of approximately 12,300 square ft, which includes the land surrounding Building 25-27. There are no documented releases. However, stained concrete was noted in the building during the historical records review. Target analytes noted in the HRR included Target Analyte List (TAL) metals, PCBs, and SVOCs. The West Substation is located west of Load Line 5 on Fuze & Booster Service Road. The substation comprises an area of approximately 3,000 square ft, which includes the area north/northeast of Building 28-28 This AOC excludes Building 28-28. One spill of approximately 500 gallons of transformer fluid occurred on the north side of the building. The impacted area was cleaned up by Emerald Environmental in 1997. Possible impacted soils may exist outside the building around the former transformers. No visual evidence of impacts was noted during the historical records review, Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. Substation No. 3 is located in the Fuze & Booster area between Load Lines 10 and 11. The substation comprises an area of approximately 10,000 square ft. The substation and all transformer equipment have been removed from the site. There are no documented releases and no visual evidence of impacts was noted during the historical records review. Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs.	An HRR was completed in December 2011. A PBA contract was awarded in FY11 to address investigation and remediation of the 14 CR sites at RVAAP, including the three areas in this site. This site is currently undergoing an RI.	2015 Draft RI (no approval document found)	Final SI and RI Work Plan, Oct 2012	Draft 2015 RI: "The conclusions of the soil screening analysis are that all SRCs in soil are currently eliminated as potential risks to groundwater. Final contaminant migration COCs were not identified at any of the three substations. Naphthalene was the only COPC identified as a potential Contaminant Migration COPC. From Final Historical Records review report for 2010 Phase I RI: No groundwater samples were collected as part of this project and no facility-wide groundwater monitoring wells are located in the immediate vicinity of the former substations. Leaching of PCBs from soil to groundwater is not a likely contaminant migration pathway due to low solubility and high sorption coefficients within vadose zone thicknesses ranging from approximately 8 ft at the East Substation, 11 ft at the West Substation, and 6 ft at Substation No. 3.

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CC RVAAP-74	Bldg 1034 Motor Pool Hydraulic Lift	An in-ground hydraulic floor lift system located at Building 1034 has been identified and included in CC RVAAP-74. The hydraulic floor lift system is depicted in a 1969 drawing as a twin-post lift system constructed of metal. The below-grade system consists of a cast in concrete L- shaped pit measuring approximately 12 feet in length and four feet in length, three feet in width, and four feet in height. The pit is reportedly buried at depths ranging from four feet bgs to approximately eight feet bgs. The twin-post lift reportedly has a clearance of six ft between the floor surface and the bottom of the lift (height in the air). The floor lift system remains in place, and has reportedly exhibited a slow leak of hydraulic fluids for an extended period of time. The potential COCs associated with the floor lift system are total petroleum hydrocarbons, PAHs, and PCBs.	A HRR was completed in December 2011. The review investigated the oil water separator and the former degreasing activities related to Building 1034. No documentation related to spills or release from the oil water separator was found. Interviews revealed that approximately 300 gallons of hydraulic oil were added to the lift unit over approximately 10 years. Hydraulic oil was observed within the unit. The report recommended further investigation for the hydraulic lift. No sampling was recommended in conjunction with the former degreasing activities at the site.	Draft 2015 RI (no approval document found)	Final SI and RI Work Plan, Oct 2012	Draft 2015 RI: "Based on the results of CC RVAAP-74 Building 1034 Motor Pool Hydraulic Lift RI sampling activities, inorganic and organic SRCs exist in subsurface soil. These SRCs were further evaluated to determine if residual concentrations in soil pose a risk to groundwater. Five SVOCs were retained as initial contaminant migration COPCs because their concentrations exceed the chemical-specific generic SSLs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and naphthalene. However, none of these initial contaminant migration COPC concentrations exceed the site-specific SSLs. Therefore, the fate and transport soil screening analysis indicates that contaminant migration COPCs are not likely to leach from the soil to the groundwater in significant concentrations. Conclusions based on the soil screening analysis are that all SRCs in soil are eliminated as potential risks to any downgradient receptors. " Historical Records review report for 2010 Phase I RI: No groundwater samples were collected as part of this project. Leaching of potential soil contaminants to groundwater, with subsequent lateral migration to either surface water discharge or other surface water exposure points, are potential contaminant migration pathways for the CR site, which may require further evaluation.
CC RVAAP-75	George Rd STP Me	CC RVAAP-75 is related to a former mercury spill at the George Road sewage treatment plant (STP). The STP was used to treat industrial and residential effluent, including pink water from the production lines. Reportedly a pint-sized jar of mercury was spilled into a floor drain in the building. The mercury was never recovered.	An HRR was completed in December 2011. The report indicated that interviewees verified that a pint-size jar of mercury was spilled into a floor drain at the facility. Building schematics show the floor drain leads outside the building and ties into a 15 inch vitrified clay pipe which appears to be channeled back into the treatment system. Interviewees also indicated that the floor drains likely have a P-trap which may have caught the spilled mercury. The HRR recommended further investigation including inspection of the piping and pipe trap. A PBA contract was awarded in FY11 to address investigation and remediation of the 14 CR sites at RVAAP, including this one. The base award included an SI for this site. Field work for the SI was completed in December 2012. The Pre-draft report was submitted in February 2013.	Draft 2015 Site Inspection (no approval document found).	2012 Final SI and RI Work Plan	Draft 2015 SI:"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." No groundwater samples were collected as part of this SI as the groundwater at the facility is being evaluated on a facility-wide basis (CC RVAAP-66 Facility-Wide Groundwater). The SI analytical data did not identify mercury as a COPC in subsurface soil at this AOC, as the reported concentrations were all below either the detection limits or FWCUGs for this chemical. No COPCs were identified as part of this SI. Any future potential groundwater pathway will be evaluated as part of the investigative activities under CC RVAAP-66. Based on the findings of the SI, further evaluation of groundwater at this AOC is not warranted.

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CC RVAAP-77	BLDG 1037 Laundry Waste Water Sump	CC RVAAP-77 consists of a former below ground concrete sump located on the north side of Building 1037. The sump had a capacity of approximately 5,765 gallons. The unit was previously used as a settling tank for the discharge of laundry rinse water. Wash water was emptied approximately 12 times during eight hours of operation and rinsing three times each eight hours. The wash water entering the tank prior to the rinse water discharge had sufficient settling time so that the increase in rate from the rinse water did not disturb the settled matter on the tank bottom. Rinse water was then sent to CC RVAAP-75 (George Road Sewage Treatment Plant). Wastes of concern are TNT and RDX. The concrete wastewater sump was removed in 2009.	Fieldwork for the SI was completed in December 2012. The Pre-draft report was submitted in February 2013.	Final 2015 SI (approved)	Final 2015 SI (approved)	Final SI: " No potential contaminants were identified in the surface or subsurface soil sampled at this AOC. The results of this SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at this AOC. The results of this SI indicate that NFA is warranted for soil at the CC RVAAP-77 Building 1037 Laundry Waste Water Sump."
CC RVAAP-78	Quarry Pond Surfac	The Quarry Pond Surface Dump (CC RVAAP-78) consists of an area of former dumping along a small topographic ridge located north and northeast of the northern-most quarry pond within the Fuze and Booster Quarry. The potentially impacted area consists of approximately 8,750 (250 feet by 35 feet) square feet. The debris pile appears to have an average thickness of about five feet (where present). Contents of the debris pile appear to consist of potential ACM, construction debris, scrap metal, and other unknown materials. A former burn location is also present along the northeastern portion of the surface dump and is characterized by ground charring. The Quarry Pond Surface Dump appears to be a possible northern extension of the existing Fuze and Booster Quarry AOC (RVAAP-16), which operated from 1945 through 1993. Constituents of concern include explosives, propellants, VOCs, SVOCs, metals, asbestos, and PCBs in soil and groundwater.	Final SI and RI Work Plan 2012 (approved). RI/IRA in progress.	Final SI and RI Work Plan 2012	Final SI and RI Work Plan 2012 (approved)	Draft 2012 SI:"Based on the historical research in Section 3.2 of the HRR, sample results from groundwater monitoring wells near CC-78 indicate minor adverse impacts. Based on these results and the site's location relative to groundwater bearing units and geologic setting, there is a low likelihood of a release to groundwater from the migration of contaminants through soil and the underlying rock."

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CC RVAAP-83	Former Bldgs 1031 & 1039	Former Buildings 1031 and 1039 (CC RVAAP-83) consist of the former Hospital Building and former Laboratory Building, respectively. Both buildings were located within the Administration Area of the former RVAAP facility. **Building 1031 - Former Hospital Building** This building was constructed in 1942 and functioned as the facility hospital until it closed in 1988. The building was demolished in 2008. The former building was approximately 13,500 square feet. The west end of the Hospital Building included a gauge lab. The gauge lab was used for the development of large scale photos for a period of about 1.5 years in the early-1970s after the laboratory at Building 1039 was closed. **Building 1039 - Former Laboratory Building** This former Laboratory Building measured approximately 16,500 square ft. The structure contained three powder test rooms for the routine analyses of lead azide, mercury fulminate, and percussion element mixes. The laboratory was used for the testing of Load Line materials. During operations, the building contained and operated a photography laboratory, a chemistry laboratory, and a medical x-ray facility. The photo laboratory was historically used for all large scale photo development activities until its closure in the early-1970s. Waste x-ray acid/silver mix solutions were reportedly disposed in the sanitary George Road sewage treatment system. The Defense Property Disposal Organization/Defense Reutilization and Marketing Office termed the waste as a reclaimed precious metal resource.	Building 1031: This site was investigated as part of a HRR in 2011/2012. The May 2012 Final HRR report concluded that NFA was required at this AOC based on a review of available resources. Building 1039: The laboratory building was demolished by Lakeshore Engineering Services, Inc. during the time period of May 2006 through July 2007. Following demolition, all unpainted and uncontaminated brick and concrete was crushed and recycled off-site. The basement of Building 1039 was filled with clean soil and was then seeded with grass seed. There was no regulatory review of the work conducted. Site Related Constituent (SRCs) of concern are related to the former generation of x-ray acid/silver mix solutions, and the laboratory analysis of powder test room materials (lead azide, mercury fulminate), percussion element mixes, paints, shellac, metals, fuels, and tapes or adhesives. The potential historical disposal of these materials through the sanitary waste system is of environmental concern. The historical sanitary lines were constructed of clay pipe, and failure of clay pipe is common. Potential SRCs for the sanitary system at the former Laboratory Building are VOCs, SVOCs, TAL metals, radioactive materials, explosives, and propellants.	Final SI Report 2015 (approved)	Final SI Report 2015 (approved)	Final SI Report: "The conclusions of this SI conducted at the Former Building 1039 at CC RVAAP-83 are as follows: -No potential contaminants were identified in subsurface soil sampled at this AOC. -The results of this SI indicate that the subsurface soil is not contaminated; therefore, soil is not a source of groundwater contamination at this AOC. The results of this SI indicate that No Further Action (NFA) is warranted for soil at the Former Building 1039 at CC RVAAP-83. Since no additional investigation was previously granted at the Former Building 1031 hospital building, the entire AOC, consisting of both former buildings sites, at CC RVAAP-83 is recommended for NFA" Final historical records review report found that: Waste water at Former Buildings 1031 and 1039 was conveyed to the George Road Treatment System. No USTs or ASTs are associated with these former buildings. Based on the records review of the available data on these historical practices at the site, and the shallow soil conditions present beneath the site, it is considered that groundwater approximately 6-ft bgs at Former Building 1031 and approximately 12-ft bgs at Former Building 1039, has been unlikely impacted by the past activities at either of the former building sites due to lack of evidence of a release of SRCs to soil with potential leaching to groundwater.

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Western Portion RVAAP						
CC RVAAP-71	Barn No. 5	Barn No. 5 was formerly located on the south central portion of the RVAAP close to the Post No. 6 gate. A letter dated May 13, 1964, documents the release of approximately 20 barrels of gasoline (840 gallons) to the ground surface inside of the south fence south of Barn No. 5. Reportedly, the release occurred from a buried pipeline that runs parallel to, and outside of, the RVAAP fence line at this location. This release is addressed by CC RVAAP-71. The area of potential impact consists of approximately 0.6 acres, which includes the footprint of the former barn area and the land between the former barn and the fence line. Potential COCs consist of VOCs, SVOCs, and lead.	2015 Final SI: "Subsurface soil was evaluated at CC RVAAP-71 Barn No. 5 Petroleum Release to a maximum depth of 13 ft bgs. - A total of twenty-seven SRCs were identified consisting of one VOC, seventeen SVOC PAHs, three metals, one pesticide and five TPH GRO/DRO carbon chain compounds. - Only two of the twenty-seven SRCs exceeded FWCUGs as presented below. 1. Benzo(a)pyrene was reported at a concentration exceeding the Resident Receptor FWCUG by 1.0 µg/kg at boring location SB14 in the 1 - 7 ft bgs interval. 2. Aluminum was reported at a concentration exceeding the Resident Receptor and National Guard Trainee FWCUGs of 7,380 mg/kg and 3,496 mg/kg, respectively at soil boring SB11 in the 1 - 7 ft bgs interval. - No SRCs, other than benzo(a)pyrene and aluminum were reported exceeding the Resident Receptor or National Guard Trainee FWCUG in any of the samples collected . - There were no BUSTR exceedances of gasoline-constituents related with the 1964 gasoline release reported in any of the subsurface soil samples collected .	2015 Final SI (approved)	2015 Final SI (approved)	2015 Final SI: - The two SRCs that exceeded FWCUGs are not considered to be chemicals related to the gasoline release or historical practices at CC RVAAP-71. Therefore, no COPCs were identified in the subsurface soil sampled at CC RVAAP-71 Barn No. 5 Petroleum Release. - Groundwater associated with CC RVAAP-71 is currently being addressed separately under RVAAP-66 Facility-Wide Groundwater. The results of this SI indicated that NFA is warranted at CC RVAAP-71 Barn No. 5 Petroleum Release AOC." "No groundwater samples were collected as part of this SI since the groundwater associated with CC RVAAP-71 is being evaluated under the RVAAP-66 Facility-Wide Groundwater."

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CC RVAAP- 76	Depot Area	The Depot Area (CC RVAAP-76) consists of multiple historical support buildings used for former operations including: fueling stations, locomotive repair shop, motor repair shop, petroleum storage building, solid waste incinerator, demilitarization activities at Building U-10, service station and an aboveground storage tank (AST) associated with Building U-5.The steel 400 gallon AST located between Depot Buildings U-5 and U-4 has been removed, but the soils beneath and around the former tank are stained. The tank sat on crushed slag next to the motor oil storage shed. Waste oil from the motor pool area was stored in the AST until it was removed by an oil reclaimer. The AST was in operation from 1983 through 1993. In 1993, the contents of the AST were removed and the tank remained inactive until its removal (after 1996).	A HRR was completed in December 2011. The report indicated that demilitarization activities occurred at Building U-10. It also indicated that the AST had been removed but its concrete supports still remain. No visual evidence of impacts (stained soil, stressed vegetation) was observed at the former AST site. Interviewees noted a historical spill from a Buffalo Tank containing waste oil which was cleaned up within a day. No documentation related to this spill was identified. A spill report was found documenting the discovery of 12 paint cans during a UST investigation. The cans were removed in 1991. Various maintenance activities occurred throughout the Depot Area. No documentation regarding spills related to maintenance activities was found. Eleven USTs were formerly operated at the Depot Area. These will be evaluated as part of CC-RVAAP-72. The following sites within the Depot Area were recommended for further investigation: Building U-4 POL Area, Building U-5 Locomotive Repair Shop, Building U-20 Incinerator, Building U-10 (demilitarization activities), Building A-3 Service Garage, Building U-3 Service Station (Kerosene UST), Building A-2 Motor Repair Facility, Bolton Barn (Tank Maintenance) Paint Can Burial Area, and ditch lines within the operational areas. RI field work was completed in December 2012.	2013 Draft RI/FS (no approval document found)	Final SI and RI Work Plan 2012	Draft RI/FS: Initial COMPCs identified as a leaching risk included Arsenic, Barium, Lead, Manganese, Benzo(a)anthracene, Benzo(a)pyrene, benzo(b)fluoranthene, and crysene. "The refined CMCOPCs was then used for the numerical fate and transport modeling performed at CC RVAAP-76. A vertical and lateral leach travel time analyses were conducted which showed no travel time less than 1,000 years. Therefore no additional leaching modeling was necessary. Conclusions based on soil screening evaluation are that all SRCs in soil are eliminated as potential risks to groundwater.

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Eastern Portion RVAAP						
RVAAP-001-R-01	Ramsdell Quarry	During the period 1946 to 1950, the 13.4 acre RVAAP-001-R-01 (Ramsdell Quarry) was used to thermally treat waste explosives and napalm bombs from Load Line 1. No historic information has been located for the period of 1950-1976. From 1976, a portion of the site was used as a nonhazardous solid waste landfill, which was permitted as a sanitary landfill in 1978 by the state of Ohio until its closure in 1990. Wastes may have included domestic, commercial, and industrial solid wastes, including explsoves, napalm, gasoline, acid dip liquor, annealind residue (e.g., sulfuric acid, shell casings, sodium orthosilicate, chromic acid, and alkali), aluminum chloride, and inert material. The landfill is not part of the MRS. The MRS is comprised of two separate areas: a northern area where OB/OD operations were conducted in a former quarry, and a southern area that contains a small inactive quarry and wooded area where installation personnel had found munitions debris. The northern quarry area is collocated with an IRP AOC. Munition debris was identified as part of the field investigation of the IRP site, RVAAP-01. There are two sites Area one and Area two. Area one is the actual quarry, Area two is south of the railroad tracks. Area one is recommended for NFA. Area two is recommended for a FS to be conducted.	The Final SI was completed in May of FY08. For the SI fieldwork, a magnetometer and metal detector assisted UXO survey was conducted in the northern quarry area and at the southern quarry area, where little historical data exists. Subsurface anomalies were detected at the northern quarry, specifically around the pond; however, no evidence of MEC was observed at the MRS. Large caliber munitions debris (MD) was found at two locations in the southern quarry during the SI field work. The potential presence of MEC in the pond in the northern quarry area (Area 1) and MC in the southern quarry area (Area 2) will require additional investigation under future CERCLA actions. The RI work plan for this MRS was completed and approved and fieldwork has been completed.	Draft RI, Sept 2014 The site is at Final RI phase. Area one is NFA, Area two is recommended for a FS. RTCs to comments sent to OEPA 3/31/15. RTCs approved June 17, 2015.	Only 1 available technical doc: 2015 Final RI (approved)	Final 2015 RI (approved): RI only sampled surface soils. "The detected SRCs in surface soil at Area 2 do not pose potential risks to the human and ecological receptors at the MRS." evaluation for fate and transport of the chemicals indicates that that groundwater has likely not been impacted from past munitions-related activities at the MRS. The depth to groundwater at the MRS ranges from approximately 0 to 39.5 feet bgs with groundwater elevations between 971 and 994 feet amsl. The quarry pond at Area 1 is significantly lower than the surrounding landfill and groundwater and surface water has the potential to interact at this portion of the MRS. Groundwater at Area 2 is consistently deeper at approximately 30 feet bgs across this portion of the MRS. "Detected analytes considered as MC that exceeded either the MCLs or RSLs consisted of aluminum, iron, bis(2-ethylhexyl)phthalate, dibenzo(ah)anthracene, and indeno(123-cd)pyrene. Out of these detected constituents in groundwater, only bis(2-ethylhexyl)phthalate was identified as a SRC in surface soil as part of the RI." "Based on the evaluation of the most recent groundwater sampling events at the MRS, it appears that SRCs identified in surface soil have not migrated to shallow groundwater in bedrock."
RVAAP-002-R-01	Erie Burning Grounds	From 1941 to 1951, bulk, obsolete, off-spec propellants, conventional explosives, rags, and large explosive contaminated items were thermally treated by open burning on ground surface. Final Report accepted by OEPA 9/22/2015. A FS is recommended to deal with MC and MEC. The MRS is collocated with an IRP AOC and is 33.9 acres.	Final SI was completed in May of FY08. Contaminants of concern: MEC, MC. Media of Concern: Sediment. Final RI reports sampling to date consists of surface water, wet sediment, and subsurface soil. RI fieldwork was completed in 2012. The RI report will be issued in 2014.	RI, 2014 The RI has been approved a FS is recommended to deal with MC and MEC.	Only doc available is 2014 Final RI (approved) contains fate and transport info, but no GW sample results	From Final 2014 RI (approved): Summary of fate and transport suggests that the principal pathway is infiltration through unsaturated soil, sediment, and surface water to groundwater (water table is generally on 2-3 ft bgs). Site-related chemicals collected during RI field activities (screened using HH cleanup goals for RAAP) include **surface water:** barium, cr+3, copper, iron, lead, strontium, zinc **Wet Sediment**: nitrocellulose, aluminum, antimony, barium, cadmium, cr+3, cr+6, copper, iron, lead, mercury, strontium, TNT, 4-amino-2,6-DNT, arochlor-1254, benzo(b)fluoranthene, benzoic acid, chrysene, dibenzofuran, fluoranthene, phenanthrene, and pyrene **Subsurface soil**: cadmium and strontium Groundwater at the Erie Burning Grounds MRS generally flows in a southerly direction. The depth to groundwater at the MRS ranges from approximately 2 to 3 feet bgs with a groundwater elevation between 937 and 939 feet amsl. ""No groundwater samples were collected at the Erie Burning Grounds MRS during the RI field work, and the MC exposure pathway for groundwater was considered incomplete for all receptors." No soil modelling data is available.

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RVAAP-050-R-01	Atlas Scrap Yard	The Atlas Scrap Yard (RVAAP-050-R-01), which is collocated with IRP AOC RVAAP-50, consists of mostly open land that contains a network of roads. Originally used as a construction camp, the site, which is 66 acres, was formerly used for scrap storage and currently consists of scattered piles of debris.	Site is at Final RI phase. The site is NFA closure under MMRP. During the 2004 - 2005 IRP RI, scrap and munitions debris was discovered in the southwest corner of the site. Most of the scrap was removed under a separate contract. Accessible areas were later surveyed during the MMRP SI. The final MMRP SI was completed in May 2008. No MEC or munitions debris were found lying on the ground surface, and only a few scattered subsurface anomalies were detected. In the north-central section, no MEC or MD was observed lying on the ground surface around or on top of the debris piles. No MEC or MD was observed lying on the ground surface in the east-central section of the site. Areas known to have been previously used for storage of MEC and MD were calculated to be roughly two acres. RVAAP-50 addresses IR concerns at this location. A Draft RI was issued in June 2013.	Final 2014 RI (approved)	Final 2014 RI	Final 2014 RI: "The RI was prepared in accordance with the project DQOs and included evaluations for explosives hazards and potential sources of MC that may pose threats to likely receptors. The following statements can be made for the Atlas Scrap Yard MRS based on the results of the RI field activities: • A total of 6.1 acres were investigated at the 66-acre MRS during the RI, which exceeds the proposed spatial coverage of 5.6 acres. • The nature and extent of MEC and MD has been adequately defined at the MRS. • No physical evidence of MEC or MD was identified during the RI field activities and an explosive safety hazard is not anticipated to exist at the MRS. • MC sampling was not warranted since no MEC or MD was found at the MRS during the RI field activities. After evaluating the RI results, it is determined that the DQOs for the Atlas Scrap Yard MRS have been satisfied and the MRS has been adequately characterized. No Further Action is recommended for the Atlas Scrap Yard MRS under the MMRP, and the next course of action will be to proceed to a No Further Action Proposed Plan." No soil modeling data was available.
RVAAP-063-R-01	Group 8	The 2.6 acre Group 8 MRS (RVAAP-063-R-01) consists of most of the area between Buildings 846 and 849. This area is disturbed land that may have historically been used for debris and rubbish burning. In 1996, one loaded anti-personnel fragmentation bomb (referred to as a hammerhead anti-personnel bomb) was found at the site. MEC, MD and MC were identified during the MMRP SI.	Site is at a Final RI phase report received 5/20/2015. Final RI approved July 16, 2015. FS required COCs exceed residential and NGT. MD in the subsurface. The PBA (PBA09) was awarded in June 2009 and contains an option for an RI at RVAAP-063-R-01 that is scheduled to be completed. The work plans have been approved and the fieldwork has been completed. The Draft RI was issued in April 2013.	2015 Final RI (approved)	2015 Final RI (approved)	Final RI: "Based on the aforementioned soil conditions, the low concentrations of explosives, and that metals, SVOCs, and PCBs are expected to remain in the top several inches of soil on the ground surface or in subsurface soils beneath the concentrated areas of buried MD where they were deposited." "• Complete DGM coverage was performed at the MRS for the RI and nearly 97 percent coverage of the 2.65 acres MRS was achieved. • Buried MPPEH was encountered at various locations throughout the MRS at depths ranging between 1 inch and 4 feet bgs and was determined to be MD. • No MEC was encountered during the RI field activities; however, the MEC items identified at the MRS prior to the RI and the amount, types, distribution, and depth of MD encountered during the intrusive investigations are taken into consideration, and an explosive hazard may be present at the MRS. • The HHRA indicates that detected COCs in surface soil present potential risks to the Resident Receptor that is evaluated for Unrestricted (Residential) Land Use and the National Guard Trainee, the Representative Receptor for the future land use at the MRS. • The ERA indicates that detected COPECs in surface soil have the potential for localized impacts to soil invertebrates and small range receptors."

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Central Portion RVAAP						
RVAAP-004-R-01	Open Demolition Area #2 MRS	The 35.4 acre Open Demolition Area #2 was used from 1948 until 1991 to detonate large caliber munitions and off- specification bulk explosives and for burial of white phosphorus and bombs of unknown type. The MRS is collocated with an IRP AOC (RVAAP-04). The MRS consists of the former demolition area, Burial Sites 1 and 2, Rocket Ridge, the Bomb Disposal Area located adjacent to the northwestern section of the MRS, and all areas in between. The depth to groundwater at the MRS ranges between 4 to 30 feet bgs and the past munitions OB/OD and burial activities at the MRS occurred at the higher elevations of the MRS, away from Sand Creek where the lower depths to groundwater are found. Evaluation of the groundwater beneath the Open Demolition Area #2 MRS is included as part of the facility-wide groundwater monitoring program. There are COCs, MD, and MC on the site. A FS is recommended to be completed for the site. A RTC to OEPA comments on MFR were sent Jan 21, 2015 an approval was received from OEPA on 24 Feb 2015.	Site is at Final RI phase. A FS is recommended. The final MFR was approved by OEPA on 6/2/2015. Received approval for the Draft Action memorandum TCRA Dated August 14 approval letter dated 9/29/15.	Latest deliverable was the Final FY2013/2015 Annual Sand Creek Monitoring , latest relevant deliverable was 2015 Final RI (approved)	2015 Final FY2013/2015 Annual Sand Creek Stream Monitoring (OEPA documented receipt and closure, report did not require OEPA review) 2015 Final RI was most recent, relevant approved document	2015 Final RI: "Groundwater beneath the RVAAP is evaluated on a facility-wide basis and MRS-specific sampling was not intended for an MRS being investigated under the MMRP unless there is a likely significant impact from a MEC source. Although SRCs in the unconsolidated soil may have migrated to the shallow groundwater, it is not expected that likely human or ecological receptors will come into contact with the groundwater at the MRS and the MC exposure pathway for groundwater is considered incomplete for all receptors." No soil modelling data is available. "Of the SRCs detected in soil at the MRS, perchlorate, nitrocellulose, PETN, RDX, and tetryl are generally considered have medium to high mobility in soil. The chemicals were retained as SRCs since they were detected explosive analytes; however, the detected concentrations were sporadic within the surface and subsurface soil and the results are considered to be low. TNT, aminodinitrolulenes and 2,4-dinitrotoluene are explosives that tend to sorb to the organic fraction in soil rather than leaching into groundwater or surface water runoff." "Detected analytes considered as MC that exceeded either the MCLs or RSLs consisted of iron, RDX, and bis(2-ethylhexyl)phthalate. All three of these analytes were identified as SRCs in surface and subsurface soil as part of the RI."

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RVAAP-008-R-01	Load Line #1 MRS	During the period 1946 to 1950, the 13.4 acre RVAAP-001-R-01 (Ramsdell Quarry) was used to thermally treat waste explosives and napalm bombs. No historic information has been located for the period of 1950-1976. From 1976, a portion of the site was used as a nonhazardous solid waste landfill, which was permitted as a sanitary landfill in 1978 by the state of Ohio until its closure in 1990. The landfill is not part of the MRS. The MRS is comprised of two separate areas: a northern area where OB/OD operations were conducted in a former quarry, and a southern area that contains a small inactive quarry and wooded area where installation personnel had found munitions debris. The northern quarry area is collocated with an IRP AOC. Munition debris was identified as part of the field investigation of the IRP site, RVAAP-01. The original site was renamed 1A so a new site could be set up where propellants were located on the surface. Prior to the HRR , the MRS was considered as the entire 164-acre Load Line #1. It was determined in the HRR that the potential presence of MEC and/or MC was restricted to the areas associated with former buildings CB-13/CB-13B, the area near the former elevated building foundation slab at CB-14, the former popping furnace, and areas where triple-base propellant have historically been found. It was recommended in the HRR that the MRS be reduced from 164 acres to 4.63 acres at the northern end of Load Line #1 where the propellants were identified. The principle sources of MEC at the Load Line #1A MRS were reported to be accidental releases during the loading of munitions during World War II and the Korean War. These activities resulted in the potential for MEC and MD, including propellants, to be present in surface soil at the Load Line #1A MRS.	Final ROD approved 9/21/2015 Instrument-assisted nonintrusive visual survey coverage was performed over the entire Load Line #1A MRS during the RI and no subsurface anomalies were detected. • No physical evidence of MEC or MD was found on the ground surface during the RI and no explosive hazard is anticipated to be present at the MRS. • Although no MEC source was found during the RI, ISM surface soil samples were analyzed for MC and represent 100 percent coverage of the MRS. • Detected concentrations of SRCs in surface soil (0 to 0.5 feet) do not pose potential risks to human or ecological receptors; therefore, no further action is required for MC at this MRS. 2014 Final RI was approved. Final RI: "The most recent groundwater elevations and sampling data collected throughout the Load Line #1 AOC were evaluated for fate and transport. The depth to groundwater at the nearest well location to the MRS (approximately 400 feet to the southeast) is 32 feet bgs. Several inorganics were detected exceeding the screening criteria at the Load Line #1 AOC; however, lead was not identified as a SRC indicating that groundwater has not been impacted by the presence of elevated lead concentrations in surface soil at the MRS. Although, the impact of nitroguanidine on the groundwater directly beneath the MRS has not been evaluated, groundwater results from the July 2011 sampling event that included samples collected at the Load Line #1 AOC, exhibited elevated concentrations of explosives but no propellants. Although mobile in soil, it does not appear that nitroguanidine in surface soil at the MRS has impacted groundwater beneath Load Line #1."	LL1 MRS site 1A is complete and closed as a NFA. A new site was opened and is starting the CERCLA MRS system. Draft NFA submitted 2015 (no approval document found)	2015 Draft NFA Proposed Plan	From 2015 Draft NFA Proposed Plan: "No evidence of MEC was found at the Load Line #IA MRS during the RI field work that was conducted under the MMRP. The MRS was further evaluated for MC at locations specified in the Final Work Plan for Military Munitions Response Program Remedial Investigation Environmental Services (Shaw, 2011) and no COCs or COPECs that presented potential risks to human or environmental receptors were found. Based on these results, no risks associated with exposures to MEC or MC are present and the U.S. Army, in consultation with the Ohio EPA, is recommending NF A under the MMRP for the Load Line #IA MRS."
RVAAP-012-R-01	Load Line 12 MRS	Site status under review.	No historical assessment documents have been found to date for this MRS.	Not applicable	Not applicable	Not applicable

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RVAAP-016-R-01	Fuze and Booster Quarry	The 4.9 acre Fuze and Booster Quarry (RVAAP-016-R-01) site consists of three elongated ponds separated by berms which were constructed within an abandoned rock quarry. The ponds were used for open burning of various types of munitions from 1945 to 1975. The site is collocated with an IRP AOC (RVAAP-16). "Groundwater flow at the Fuze and Booster Quarry MRS is generally towards the large wetland complex to the west of the quarry ponds. Monitoring wells surrounding the north pond were installed in the sandstone bedrock, and monitoring wells around the central and southern pond were installed in the unconsolidated glacial sediment. Based on the groundwater elevations in these wells (between approximately 1,118 and 1,126 feet amsl near the south and north ponds, respectively) in comparison to the topography at the bottoms of the ponds (approximately 125 feet amsl), the ponds appear to be hydraulically connected to the groundwater table in both the saturated soil and bedrock (SAIC and SpecPro, 2005)."	The final SI was completed in May of FY08 and recommended an RI. Surface water and sediment are being addressed under the MMRP. From 2014 Draft RI: No MEC and a minimal amount of MD were found during the RI field work and there does not appear to be a significant source for MC at the MRS. Although SRCs considered as potential MC were detected in wet sediment that was sampled during the RI field work, evaluation for fate and transport of the SRCs, as well as review of IRP data sets for groundwater in the Phase I/Phase II RI, indicates that that groundwater has not been impacted from historical munitions-related activities at the MRS. GW flow at the Fuze and Booster Quarry MRS is generally towards the west . Based on the groundwater elevations in these wells (between approximately 1,118 and 1,126 feet amsl near the south and north ponds, respectively) in comparison to the topography at the bottoms of the ponds (approximately 125 feet amsl), the ponds appear to be hydraulically connected to the groundwater table in both the saturated soil and bedrock.	Accident Prevention Plan Addendum for Asbestos Abatement for MMRP (July 2013). Site is at a Final RI phase. RTCs approved on 27 MAY 2015. The final RI was approved on June 18.2015. A FS is recommended for the site.	2015 Final RI	From 2015 Final RI (approved): "Although SRCs considered as potential MC were detected in wet sediment that was sampled during the RI field work, evaluation for fate and transport of the SRCs, as well as review of IRP data sets for groundwater in the Phase I/Phase II RI (SAIC and SpecPro, 2005), indicates that that groundwater has not been impacted from historical munitions-related activities at the MRS. . . No groundwater samples were collected at the Fuze and Booster Quarry MRS during the RI field work, and the MC exposure pathway for groundwater is considered incomplete for all receptors."
RVAAP-019-R-01	Landfill North of Winklepeck	The Landfill North of Winklepeck MRS (RVAAP-019-R-01) encompasses a 2.3 acre area that lies adjacent and downstream from the former landfill (which is in actuality, a dump). The MRS footprint was reconfigured during the historical records review to exclude the former landfill, which is covered with soil and the dump area is considered to be a Response Complete site under the MMRP Based on the SI, it includes the area adjacent and along the length of the former landfill extending down and including the unnamed stream. This area includes the location where the flare canisters and suspected booster cups were found.	The site is closed under a NFA for the RI and a NFA PP and ROD needs to be completed. The Final SI was completed in May 2008. No MEC was discovered during the SI. A PBA was awarded in FY09 for RVAAP-019-R-01 to address remedial investigation work for this site. No release of MEC or MC was identified at the site. RVAAP-19 addresses IR concerns at this location.	The site is at Final RI has been approved by the OEPA 4/20/2015 Next is the PP and ROD	2015 Final RI	2015 Final RI: " • All accessible areas at the MRS were investigated during the RI. • Inaccessible areas could not be investigated due to obstacles (deadfall), wetland/marshes, and thick vegetation along the edges of these areas. • An intrusive investigation was not warranted because no physical evidence of MEC was identified on the ground surface. • MC sampling was not warranted because no MEC was found at the MRS during the RI field activities; therefore, no further action is required for MC at this MRS. Based on the results of the RI field work, it is concluded that the nature and extent of MEC and MC at the Landfill North of Winklepeck MRS have been adequately characterized and the DQOs presented in the Work Plan (Shaw, 2011) have been satisfied. No explosive safety hazards or potential sources of MC have been identified at the MRS. The recommended next course of action under the MMRP for the Landfill North of Winklepeck MRS will be to proceed to a No Further Action Proposed Plan." No soil modeling data is available "As no MEC source was identified during the RI field activities at the Landfill North of Winklepeck MRS, MC sampling was not warranted at the MRS . Based on these findings, the MC CSM was revised to reflect incomplete pathways for all receptors."
RVAAP-032-R-01	40mm Firing Range	The 1.3 acre 40mm Firing Range (RVAAP-032-R-01) is a former test range for the 40mm cartridge and is surrounded by forest. The MRS was used from 1969 to 1971. The site is collocated with an IRP site (RVAAP-32). The impact area was located in the western portion of the site while the firing point was sited at the opposite end. MEC was reported to be present beyond the impact area, on the slope that leads down to the Fuze and Booster Quarry.	Final RI issued April 30 2015 The final SI was completed in May 2008. MEC was not discovered during the SI; however, munitions debris was found scattered from the target point to a point approximately 100 ft beyond the former impact area. A FS is recommended for this site due to the uncertainty of MEC being present.	Final 2015 RI (only available document, approved)	Final 2015 RI	Final RI: "Since no MEC was encountered during the RI field activities, a significant release of MC from the areas where individual or small amounts of MD were found is unlikely. Additionally, no MC-related SRCs were identified during the RI and a discussion of fate and transport of MC at the Investigation Area was unwarranted."

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RVAAP-033-R-01	Firestone Test Facility	The 0.4 acre Firestone Test Facility (RVAAP-033-R-01) consisted of two buildings used as test chambers for tube-launched, optically-tracked, wire-guided missiles and Dragon missiles. In addition, shaped charges were tested in a small nearby pond. The site was used from the late-1960s to 1993. The former test chambers have been demolished and all of the debris removed. The test chamber foundations remain. Another suspect area was included in the SI fieldwork that consists of a small clearing and piles of dirt and large timbers. The site is collocated with an IRP AOC Load Line 6 (RVAAP-33).	The Final SI was completed in May of FY08. The RI field work was completed and no MEC or MC was identified. The RI report will be completed in FY13. The site is at Final NFA PP phase. The Draft PP was approved on April 14, 2014. Final approval for the PP was received on 5/21/2015 Received preliminary draft ROD on 7/6/15. Draft ROD was approved by OEPA on 7/27/2015 with no comments. Final ROD approval received 9/21/2015.	Final RI report (Aug 2014) The site met the NFA residential closure status.	Final 2015 NFA proposal (approved). Final 2014 RI (approved)	Final NFA proposal (approved) : The estimated groundwater flow direction at the MRS is to the east-southeast . From Final 2014 approved RI: The chemicals identified as SRCs following the screening process consisted of the antimony, cadmium, chromium, copper, and strontium in surface soil; aluminum, antimony, cadmium, copper, lead, and strontium in sediment; and chromium, copper, lead, and strontium in surface water. No concentrations of explosives or propellants were detected in any of the environmental samples collected at the Firestone Test Facility MRS. No MEC or MD was found during the RI field activities and although SRCs were identified during the RI through the data screening process, the concentrations were considered low and it is unlikely that groundwater has been impacted. No groundwater samples were collected at the Firestone Test Facility MRS during the RI field work and the MC exposure pathway for groundwater is incomplete for all receptors. Based on the high pH of soil conditions, and given that inorganic SRCs are expected to remain in the top several inches of soil where they were deposited, subsurface soils or groundwater conditions have most likely not been impacted.
RVAAP-034-R-01	Sand Creek Dump	The Sand Creek Dump is a munitions response site collated with an IRP site Sand Creek Disposal Road Landfill (RVAAP-34). The MRS portion of the site is 0.9 acres in size. This site was identified in the SI as a smaller area located within the IR site. There is no MC or MEC potential in the area. The site is being closed under a NFA.	During a surface IRA performed for the Sand Creek Disposal Road Landfill in October 2003, two 75mm inert projectiles were discovered at this site. MEC was not discovered during the SI; however, one empty 105mm projectile was discovered in Sand Creek downstream of the former dump. The MMRP SI was completed in FY08. Final RI was submitted on MAR 25 2015.The approval of the final Report was received on 04-06-2015	Final ROD to OEPA 9/29/15 for approval and signature.	2015 NFA proposed plan (OEPA reviewed with no comments),	2015 NFA PP: "No evidence of MEC or source of MC was found at the Sand Creek Dump MRS during the RI field work that was conducted under the MMRP. Based on these results, no risks associated with exposures to MEC or MC are present and the U.S. Army, in consultation with the Ohio EPA, is recommending NFA under the MMRP for the Sand Creek Dump MRS. The overall recommendation of NFA under the MMRP is protective of the human and environmental receptors identified for the MRS."
RVAAP-046-R-01	Building #F-15 and F-16	Site status under review.	No historical assessment documents have been found to date for this MRS.	Not applicable	Not applicable	Not applicable
RVAAP-048-R-01	Anchor Test Area	Site status under review.	No historical assessment documents have been found to date for this MRS.	Not applicable	Not applicable	Not applicable
RVAAP-060-R-01	Block D Igloo	The Block D Igloo MRS resulted when fuzed bombs in Igloo 7-D-15 (D Block) exploded on Mar. 24, 1943. The initial 3,000-foot radial MRS boundary was established by the USACE, Huntsville District to capture the probable debris field resulting from the explosion and was based on the type of munitions stored in the bunker at the time of the explosion. In 1943 a response action was performed by USACE immediately after the explosion. As described below, the area of this site was adjusted based on the 2008 SI findings.	The RI has been finalized and approved a FS is recommended for this site. The final SI was completed in May 2008. Materials potentially presenting an explosive hazard were identified during the RI fieldwork.	2015 Final RI (approved)	2015 Final RI (approved)	2015 Final RI: SRCs are "...expected to remain in the top several inches of soil where they were deposited, subsurface soils or groundwater conditions have most likely not be impacted."

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RVAAP-062-R-01	Water Works #4 Dump	The Water Works #4 Dump is an approximate 0.77 acre open area located immediately west of Water Works No.4 and Load Line 7, in the southwestern portion of RVAAP. The site boundary identified in the US Army Closed, Transferred, and Transferring range/site inventory was not accurate. The actual site is located approximately 400 ft to the east.	The final SI was completed in May 2008. During the MMRP SI, no MEC or MC was identified, although further characterization is needed to confirm presence/absence. Munitions debris was found during the MMRP SI and several subsurface anomalies were also detected in the open field. No sampling of MC was conducted. RI/FS: after site investigation no MEC was found. There is not potential for explosives. The site is recommended for closure under the NFA.	Draft NFA ROD 2015 is most recent deliverable (no approval document found).	Final 2015 NFA proposal (approved). Final 2015 RI (approved)	Final 2015 approved NFA proposal : groundwater elevation at the MRS and the immediate vicinity appears to be at a potentiometric high at approximately 1,100 feet amsl. The groundwater appears to flow in all directions from this higher formation.
Western Portion RVAAP						
RVAAP-061-R-01	Block D Igloo-TD	The Block D Igloo (RVAAP-061-R-01) site resulted when fuzed bombs in Igloo 7-D-15 ("D" Block) exploded on Mar. 24, 1943. The transferred (TD) in the site name indicates that this is land that is located outside of the installation property boundary. The initial 3,000-foot radial MRS boundary was established by the USACE, Huntsville District to capture the probable debris field resulting from the explosion and was based on the type of munitions stored in the bunker at the time of the explosion. The 2008 historical records review identified 19.25 acres for the off-site portion. This area was investigated during the 2008 MMRP SI and it was determined that NFA was required to address MEC or MC.	The 2008 HRR identified 19.25 acres for the off-site portion. This area was investigated during the 2008 SI and it was determined that NFA was required to address MEC or MC, however, the 2008 SI did identify a new area of land that potentially contained debris. The new area consisted of 14.13 acres. The PBA (PBA09) was awarded in June 2009. The site was evaluated during the RI and it was determined that the MRS boundary from the SI was revised. A Technical Memorandum was prepared and coordinated with the Ohio EPA presenting rationale for the revised boundary. The RI will be combined with the RI for RVAAP-060-R-01.	No documents available		

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Eastern Portion RVAAP						
RVAAP-01	Ramsdell Quarry Landfill	Unlined landfill in former quarry excavated to the underlying Sharon Sandstone/Conglomerate. A pool of water is intermittently present at the bottom of the quarry at approximately 10.7 meters (35 ft) below ground surface (bgs). This landfill was used from 1941 to 1989. During the period of 1946 to 1950 the site was used as a land-surface burning site to thermally destroy waste explosives from Load Line 1 and napalm bombs. From 1976 to 1989, a portion of the site was used strictly as a nonhazardous solid waste landfill. No historical information has been located for 1950 to 1976. The landfill ceased operation in September 1989. Wastes may have included domestic, commercial, and industrial solid wastes, including explsoves, napalm, gasoline, acid dip liquor, annealind residue (e.g., sulfuric acid, shell casings, sodium orthosilicate, chromic acid, and alkali), aluminum chloride, and inert material. Closure of the landfill was completed in May 1990 under state of Ohio solid waste regulations. LUCs in place including fencing to restrict exposure. Part of RVAAP Five Year Review process.	Final ROD for Soil and Dry Sediment (March 2009): "Groundwater contaminant migration was modeled as part of the FS. The modeling included an evaluation of potential leaching of contaminants from soil to groundwater. Also, the potential for contaminants to migrate from sources to the RQL boundary was evaluated. Modeling results indicate that some metals, explosives, and one SVOC may leach from soil to groundwater. None of these contaminants were predicted by the modeling results to migrate beyond the RQL boundary at concentrations above risk-based concentrations or drinking water maximum contaminant levels. Therefore, soil remediation for protection of groundwater is not required at RQL." Final ROD Amendment in March 2013 to address asbestos containing material as part of removal remedy.	Final Remedial Action Report for Soil and Dry Sediment: -PAH and ACM impacted material removed for off-site disposal -no additional work for soil and dry sediment necessary except inclusion into the five year review.	Final RAR for Soil and Dry Sediment; January 2015	Final RAR for Soil and Dry Sediment: "the Army will manage future land use at RQL as Restricted Access due to residual, non-exposed asbestos in soil, residual PAH contamination above residential facility-wide CUGs, and the closed landfill. The Army will implement LUCs described in the LUCRD presented in the RQL RD and conduct CERCLA five-year reviews. Other media (i.e., surface water, wet sediment, and groundwater) and MEC will be addressed as part of future actions."
RVAAP-02	Erie Burning Grounds (EBG)	See MMRP site RVAAP-002-R-01 Erie Burning Grounds (current designation for this site). The water table at EBG is typically less than 10 ft, GW flow from north to south across the AOC consistent with surface drainage patterns. A high degree of interaction exists between groundwater and surface water. Results of slug tests performed during the Phase II RI reveal moderately high horizontal hydraulic conductivities in the unconsolidated material underlying EBG.	No further action under CERCLA is necessary for soil and dry sediment at EBG. Groundwater and surface water at EBG will be addressed under future CERCLA decisions. Land use controls will not be implemented as part of this decision as no contaminants of concern (COCs) were identified in soil and dry sediment for the representative receptor (Hunter/Trapper and Fire/Dust Suppression Worker) and Resident Subsistence Farmer. However, land use controls may be implemented under the Military Munitions Response Program (MMRP), as part of future response actions for munitions and explosives of concern (MEC). 2005 RI: Explosives were not detected, Metals were detected above background. SVOCs and VOCs were also detected.	Closed under IRP moved to MMRP.'NFA ROD, 2007	2007 NFA ROD for soil and sed (approved). 2005 RI (approval not found) contains GW info	2007 NFA ROD: The fate and transport analysis concluded that soil contaminants at EBG are not predicted to leach to groundwater beneath the AOC at concentrations above risk-based criteria or migrate beyond the AOC (USACE 2006). Therefore, soil remediation for protection of groundwater is not required at EBG.

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RVAAP-08	Load Line 1	Load Line 1 (RVAAP-08) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond, known as Criggy's Pond. Wash-down water from the melt-pour buildings would, in some instances, be swept out through doorways onto the ground surrounding the buildings. The load line also was used for the demilitarization of projectiles and the production and reconditioning of anti-tank mines from 1973 -1974.	The following remedial actions have occurred at the site: 1. Structures underwent demolition between FY00 and FY09. 2. The final Interim ROD addressing only soil and dry sediment was signed by the Army and Ohio EPA in July 2007. 4. Contaminated soils were removed from Load Line 1 and transported off-site for disposal in September 2010. The Final Remediation Completion Report for Load Line 1 was approved on March 25, 2011. 5. Underslab subsurface incremental sampling was conducted in August 2010. The sampling report documenting this sampling and the USACE-led 2009 sampling event was finalized in March 2011. 6. Additional characterization sampling was completed in July 2011. Phase II RI (June 2003) groundwater conclusions: • Isolated detections and relatively low explosives concentrations near the main process areas indicate that migration of explosives from soil to groundwater is minimal. • MWs within the main process areas appear to have been impacted by metals . • Minor detections of SVOCs and PCBs/pesticides near the main process areas indicate that migration of these contaminants from soil to groundwater is minimal. • VOCs were detected in MWs and blank samples indicating concentrations may not be site related. • Modeling indicates some of the explosives compounds are expected to leach from the contaminated surface soils into the GW with predicted concentrations exceeding the GW RGOs in the source areas. However, the potential for off-AOC migration of these contaminants (via the GW pathway) at LL 1 is not significant. Migration of most of the constituents is attenuated because of moderate to high retardation factors. • Metal, PCB, and PAH contaminants within the LL 1 subsurface soils are not expected to leach to GW beneath the sources within the modeled time frame of 1,000 years. • The extensive system of storm and sanitary sewers represents a possible preferred migration pathway for water-borne contaminants. Leaks from the pipes may rapidly introduce contaminants from surface soils to the GW.	ROD in place, sites reopened to achieve industrial or residential closure without dig restrictions.	2013 Final Characterization Report of Surface and Subsurface Incremental Sampling Methodology (does not contain relevant GW information).	No significant GW conclusions in any of most recent docs for this site, recent reporting concerns subslab, subsurface, and surface soils. 2015 Draft RI SAP: Soil, Sed, and SW sampling to resolve data gaps is planned. If the AOC fails to meet unrestricted land use then an FS will be completed to evaluate cleanup options. 2012 Five Year Review Report (approval not located, but OEPA comments dated Nov 2012): "the monitoring of groundwater immediately after remedial action at Load Lines 1-4 was not performed in accordance with the ROD. Due to the lack of groundwater monitoring data, no evaluation of constituent trends in groundwater could be performed to ascertain whether or not groundwater was impacted by the soil remedial action." Groundwater conclusions from the 2003 Phase II RI are included under assessment history.

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RVAAP-09	Load Line 2	Load Line 2 (RVAAP-09) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would, in some instances, be swept out through doorways onto the ground surrounding the buildings. The settling pond, known as Kelley's Pond, was an unlined triangular-shaped pond approximately one acre in size with an average depth of four feet. Water from the impoundment discharged to a stream that ultimately exited the installation.	Contaminated soils were removed at Load Lines 2 and 3 in June 2010. The Final Remediation Completion Report for Load Lines 2 and 3 was approved on Jan. 11, 2011. Underslab subsurface incremental sampling was conducted in August 2010. The sampling report documenting this sampling and the USACE-led 2009 sampling event was finalized in March 2011. Additional characterization sampling was completed in July 2011. Phase II (2004) GW Conclusions: GW within the AOC did not exhibit evidence of widespread contamination. Explosives were detected only sporadically, with the highest and most consistent concentrations present in the southern portion of the load lines near Kelly's Pond (Did not exceed EPA PRGs). Inorganic SRCs were identified in most wells, with maximum concentrations in the southern portion of the AOC and in the Explosives Handling Area Aggregate. SVOCs were not detected. Trace levels of one PCB, pesticides, and VOCs were sporadically detected in groundwater. The Load Line 2 groundwater aggregate was evaluated to identify COCs. Comparisons of Load Line 2 COCs in groundwater to screening RGOs show that metals, pesticides, PCBs, explosives, and VOCs exceed RGOs for some receptors. SESOIL Modeling: Metals and RDX were identified as CMCOPCs based on source loading predicted by the leachability analysis near the selected primary source (Building DB-4 vicinity). The SESOIL modeling results indicate that these constituents may leach from surface soil to GW with concentrations beneath the source area above groundwater MCLs or RBCs. The timeframe for metals constituents to reach peak concentrations in GW beneath the source ranged from 149 to 647 years. The projected timeframe for RDX to achieve peak concentrations is 3 years, suggesting that such leaching has already occurred. The leaching modeling is conservative and migration of these constituents may be attenuated because of moderate to high retardation factors for these constituents. AT123D Modeling: No inorganics, pesticides, or PCBs were predicted to reach any receptor points at concentrations greater than MCLs or RBCs within the 1,000-year modeling period. RDX was the only constituent predicted to reach each of the selected receptor locations with peak concentrations in excess of RBCs at the AOC boundary in 37 years, at Kelly's Pond in 169 years, and the RVAAP boundary in 214 years.	ROD in place sites reopened to achieve industrial or residential closure without dig restrictions. Draft PBA 13 RI SAP Addendum submitted Jan 2015 (no approval document found, not related to GW)	2013 Final Characterization Report of Surface and Subsurface Incremental Sampling Methodology (does not contain relevant GW information).	No significant GW conclusions in any of most recent docs for this site, recent reporting concerns subslab, subsurface, and surface soils. 2015 Draft RI SAP: Soil, Sed, and SW sampling to resolve data gaps is planned. If the AOC fails to meet unrestricted land use then an FS will be completed to evaluate cleanup options. 2012 Five Year Review Report (approval not located, but OEPA comments dated Nov 2012): "the monitoring of groundwater immediately after remedial action at Load Lines 1-4 was not performed in accordance with the ROD. Due to the lack of groundwater monitoring data, no evaluation of constituent trends in groundwater could be performed to ascertain whether or not groundwater was impacted by the soil remedial action." Groundwater conclusions from the 2003 Phase I RI are included under assessment history.

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RVAAP-10	Load Line 3	Load Line 3 (RVAAP-10) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would, in some instances, be swept out through doorways onto the ground surrounding the buildings. Water from the impoundment discharged to a stream that flowed in a northerly direction and ultimately discharged into RVAAP-29 Cobbs Pond. Predominant GW flow direction is to the East.	The following remedial actions have occurred at the site: 1. Structures underwent demolition between FY00 and FY09. 2. The final Interim ROD addressing only soil and dry sediment was signed by the Army and Ohio EPA in July 2007. 3. Contaminated soils from Load Lines 2 and 3 in June 2010. The Final Remediation Completion Report for Load Lines 2 and 3 was approved on Jan. 11, 2011. 4. Underslab subsurface incremental sampling was conducted in August 2010. The sampling report documenting this sampling and the USACE-led 2009 sampling event was finalized in March 2011. 5. Additional characterization sampling was completed in July 2011. Phase II RI (2004) GW conclusions: GW within the AOC contains elevated concentrations of several explosive compounds and minor contributions of cobalt and manganese; however, inorganic constituent occurrence and distribution above background criteria were sporadic. Low concentrations of VOCs and SVOCs were observed. The Load Line 3 groundwater aggregate was evaluated to identify COCs. Comparisons of Load Line 3 COCs in groundwater to screening RGOs show that explosives, metals, pesticides, and VOCs exceed the RGOs for the National Guard and/or Resident Farmer receptor scenarios. SESOIL Modeling: one metal, and explosives were identified as initial CMCOPCs based on source loading predicted by the leachability analysis near the source (Building EA-4A) and were selected for SESOIL modeling. The SESOIL modeling results indicate that RDX may leach from surface soil to groundwater with concentrations beneath the source area exceeding its groundwater MCL or RBC. The predicted time for peak groundwater concentration for RDX was 12 years, which based on site history, may have already occurred. RDX was identified in groundwater at a concentration lower than the predicted value. The leaching model is conservative and migration of these constituents may be attenuated because of moderate to high retardation factors for these constituents. AT123D Modeling results available as well- results indicated migration to boundaries and receptors exceeding MCLs or RBCs was unlikely.	ROD in place sites reopened to achieve industrial or residential closure without dig restrictions. Draft PBA 13 RI SAP Addendum submitted Jan 2015 (no approval document found, not related to GW)	2013 Final Characterization Report of Surface and Subsurface Incremental Sampling Methodology (does not contain relevant GW information).	No significant GW conclusions in any of most recent docs for this site, recent reporting concerns subslab, subsurface, and surface soils. Groundwater conclusions from the 2003 Phase II RI are included under assessment history. 2015 Draft RI SAP: Soil, Sed, and SW sampling to resolve data gaps is planned. If the AOC fails to meet unrestricted land use then an FS will be completed to evaluate cleanup options. 2012 Five Year Review Report (approval not located, but OEPA comments dated Nov 2012): "the monitoring of groundwater immediately after remedial action at Load Lines 1-4 was not performed in accordance with the ROD. Due to the lack of groundwater monitoring data, no evaluation of constituent trends in groundwater could be performed to ascertain whether or not groundwater was impacted by the soil remedial action."

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RVAAP-12	Load Line 12	From 1941-1943 and 1946-1950, ammonium nitrate was produced at Load Line 12 (RVAAP-12). From 1949 to 1993, munitions were periodically demilitarized at this AOC. Building wash-down water and wastewater from the bomb melt out facility operations was collected in a house gutter system, and flowed through a piping system to two stainless steel tanks. The first tank was used for settling, and the second tank was used for filtration. Prior to the 1980s, the water leaked under the building and ponded there. Building wash-down water from Building F-904 was also swept out through doorways onto the ground surrounding the building. After 1981, the water was treated in the Load Line 12 wastewater treatment system, which discharged to an on-site pond then discharged to a receiving stream that ultimately entered into RVAAP-29, Cobbs Ponds. The COCs at this site include explosive compounds, nitrates and heavy metals. Media of concern include soil, surface water, sediment and groundwater.	The ROD was signed by the Ohio EPA and the US Army in October 2009, and the remedial design (RD) was finalized in the first quarter of FY10. A removal action was completed in the fourth quarter of FY10. Additional characterization sampling was conducted in June-July 2011. Phase II RI (2005) GW contaminant nature and extent: • With the exception of nitrocellulose, the number and concentrations of explosives and propellants identified as SRCs in the 2004/2005 data were generally lower than those observed in 2000. Nitrocellulose was detected in two wells where it had not been previously present and increased by a factor of three in one source area (Building 901) well. • Metals exceed primary drinking water MCLs and RVAAP facility-wide background value at several wells. • Recent monitoring data continue to show that SVOCs, PCBs/pesticides, and VOCs are minor contaminants in Load Line 12 groundwater. • Monitoring data from well along the southern boundary of the AOC continue to show that contaminants are not migrating off of the site toward the facility boundary. Nitrate concentrations decreased at several locations showing previously elevated concentrations. Nitrate continued to be detected only in wells adjacent to primary ammonium nitrate production areas. However, adjacent to former Building 901, the maximum AOC-wide concentrations increased over the intervening time period between the 2000 and 2004 sampling events.	ROD in place sites reopened to achieve industrial or residential closure without dig restrictions. 'Final characterization sampling report of surface and subsurface ISM, Mar 2013	Under review	No significant GW conclusions in any of most recent docs for this site, recent reporting concerns subslab, subsurface, and surface soils. 2015 Draft RI SAP: Soil sampling to resolve data gaps is planned. If the AOC fails to meet unrestricted land use then an FS will be completed to evaluate cleanup options. Sediment and SW are being evaluated under the PBA08. GW Results available in Phase II report: Potentiometric data from existing and newly installed wells confirmed the presence of a potentiometric low that bisects the southern half of Load Line 12. • Recent monitoring data continue to show that SVOCs, PCBs/pesticides, and VOCs are minor contaminants in Load Line 12 groundwater. • Monitoring data from well along the southern boundary of the AOC continue to show that contaminants are not migrating off of the site toward the facility boundary.
RVAAP-13	Building 1200-Dilution/Settling Pond	From approximately 1941 to 1971, ammunition was demilitarized by steaming out munitions rounds at building 1200 (RVAAP-13). The steam decontamination generated pink water, which drained to a man-made ditch. The ditch discharged into a 0.5-acre sedimentation pond, and the overflow from this pond discharged into Sand Creek. The site buildings have been demolished and all foundations and footings were removed.	Phase 1 RI (1998) GW Conclusions (approval not found, but comment response was completed): No widespread contamination was detected in soil. No inorganics above background or explosives were detected in soil. PAHs were detected in 1 soil sample. Low concentrations of explosives were found in drainage sediments. Groundwater samples were not collected. The RI was completed in 2012. The Final RI/FS determined this site will achieve unrestricted use.	2015 Final RAP for Soil, Sed, and SW (approved)	2015 Final RAP for Soil, Sed, and SW	From Final RAP: "The selected remedy [Alternative 2: Attain Unrestricted (Residential) Land Use] attained and exceeded the RAO by remediating manganese in surface soil to a depth of 1 ft bgs at ISM locations B12ss-016M, B12ss-017M, and B12ss-022M. No remedial actions were required for subsurface soil, sediment, or surface water. No remedial actions were required to protect ecological resources or groundwater."
RVAAP-18	Load Line 12 Pink Waste Water Treatment	This AOC was combined with RAAVP-12 in reports. After 1981 waste water produced at Load Line 12 was treated here. The treatment system discharged to an on-site pond then discharged to a receiving stream that ultimately entered into RVAAP-29, Cobbs Ponds.	See RVAAP-12	Phase 1 RI Report 1998 (approval not found, but comment response completed)	Phase 1 RI Report 1998 (comment response completed)	See RVAAP-12
RVAAP-20	Sand Creek Sewage Treatment Plant	Site status under review.	No historical assessment documents have been located for this AOC.	Not applicable.	Not applicable.	Not applicable.
RVAPP-23	Unit Training Equipment Site	Site status under review.	No historical assessment documents have been located for this AOC.	Not applicable.	Not applicable.	Not applicable.
RVAAP-27	Building 854-PCB Storage	NFA in 1999.	No historical assessment documents have been located for this AOC.	1999 NFA	199 NFA letter	1999 NFA Approval letter was the only document available for this site. No additional cleanup with regard to PCBs is required and the building is closed.

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RVAAP-29	Upper and Lower Cobbs Ponds	RVAAP-29 is comprised of approximately five acres (Upper Cobbs Pond) and four acres (Lower Cobbs Pond). The Upper and Lower Cobbs Ponds are unlined ponds that contain abundant fish and wildlife. A ponded area known as "a backwater area" is located south of Upper Cobbs Pond. This area, approximately one acre, was created by beaver activity and was not present during facility operations. The Upper and Lower Cobbs Ponds were used as sedimentation basins for Load Line 12 (RVAAP-12) and Load Line 3 (RVAAP10) wastewater effluent from 1941 to 1971 and storm water runoff. Waste types associated with this site include, but are not limited to, TNT, RDX, HMX, Composition B, lead, chromium, mercury, and aluminum chloride. Currently fishing at Cobbs Pond is catch and release only.	2005 Phase II RI Conclusions: GW is presumed to flow to the NW. TAL metals in GW were detected above background and PRGs. • No explosives, propellants, cyanide, VOCs, PCBs, or nitrates/nitrites were detected above detection limits. • an SVOC was detected in the duplicate of sample, but not in the original sample. No background values were established for SVOCs in groundwater. • One pesticide endrin was detected below the PRG. No background values were established for pesticides in groundwater. 2012 RI Fate and Transport conclusions: " SESOIL modeling predicted the maximum leachate concentrations of arsenic, barium, selenium, and 31 thallium below their respective source areas may exceed the USEPA MCLs/RSLs, FWCUG receptors, and the RVAAP facility-wide background concentrations for unconsolidated groundwater at a future point in time. No COMPCs were identified from sediment samples."" Based on AT123D model results, the maximum predicted concentrations of arsenic and selenium in groundwater beneath the source areas were predicted to exceed the screening criteria, and the chemicals were modeled to the downgradient receptor locations (i.e., surface water at the Backwater Area and Upper Cobbs Pond for arsenic and selenium, respectively)."	Report at Draft Phase II RI/FS for soil, sed, and SW (submitted 2012, no approval document found)	Final 2008 Supplemental SAP (approval not found, but comment response completed in 2009)	2012 RI: "Scope of this report does not include full evaluation of groundwater contaminant nature and extent, risk assessment, and remedial alternatives (if required). Groundwater will be evaluated as an individual AOC for the entire facility (designated as RVAAP-66) and addressed in a separate report." "Fate and transport modeling indicates soil and sediment remediation to protect groundwater resources is not warranted. Remedial actions specific to groundwater media at the AOC will be evaluated in a separate report. " "Nine inorganic (arsenic, barium, cadmium, hexavalent chromium, cobalt, lead, selenium, thallium, and vanadium) and four organic [benz(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and beta-BHC] SRCs exceeded their GSSLs"
RVAAP-31	Ore Pile Retention Pond	Being addressed under a CR site as CC-RVAAP-79	See CC-RVAAP-79	See CC-RVAAP-79	See CC-RVAAP-79	See CC-RVAAP-79
RVAAP-34	Sand Creek Disposal Road Landfill	RVAAP-34 was reported by former workers at RVAAP to have been an open dump for materials including, but not limited to, concrete, wood, asbestos debris, lab bottles, 55-gallon drums and fluorescent light tubes. Debris was disposed at the surface, but became covered by vegetation. The site is approximately 2.7 acres and located adjacent to Sand Creek. The dates of operation of this site are unknown, but believed to be between 1950 and 1960. This site used to carry the facility-wide non-groundwater LTM and programmatic support requirements. These requirements are now carried in Program Management and RVAAP-66. MMRP issues will be addressed separately under RVAAP-034-R-01.	A surface soil and debris removal (IRA) was completed in summer 2003. The IRA was documented in a report submitted in April 2004. An FY08 DQO study was awarded to determine data gaps for the FY03 IRA. Following the DQO study, the recommended geophysical magnetometer study and soil sampling were conducted in the fourth quarter of FY10 and first quarter of FY11. A Draft RI was submitted to Ohio EPA in 2016.	Completing SI and RI for site. Most recent deliverable is a 2013 Draft Proposed Plan (no approval document found)	2010 Final Geophysical Prove-Out Report (not relevant to GW)	2013 Proposed Plan (approval not found) : "The evaluation for the remediation alternatives in the FS addressed surface and subsurface soils at the Sand Creek Site only and the selected remedy was required to be protective of groundwater with respect to the anticipated future land use. . . no further action is required for surface water and sediment at the AOC. Groundwater will be addressed in a separate decision under the RVAAP-66 Facility-Wide Groundwater AOC" 2016 Phase 1 RI (approval not found): "there are no groundwater data available for the AOC and impact to groundwater, if any, is unknown." "2,4,6-trinitrotoluene, 2-amino-4,6- 2 dinitrotoluene, nitroguanidine, cadmium, mercury, dibenzofuran, 1,4 dichlorobenzene, 3 carbazole, pentachlorophenol, benzene, alpha-BHC, beta-BHC, and lindane. These 4 CMCOPCs have the potential to reach the water table within 1,000 years based on the 5 screening analysis results"
RVAAP-37	Pesticide Storage Building T-4452	Being addressed under CR site as CC-RVAAP-70	Closure for Pesticide Building was approved in 2000.	2000 Final Closure Report for Pesticide Storage Building (approved)	2000 Final Closure Report for Pesticide Storage Building (approved)	The most recent document for RVAAP-37 is an approval letter for the Pesticide Building Closure Report. Please refer to CC-RVAAP-70 for additional details. Closure letter referred to the demolition of the building and removal/decontamination of all contents. Final RCRA closure FI Report: reported pesticides in surface and subsurface soils. No GW samples or modelling was mentioned.

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RVAAP-49	Central Burn Pits	The CBP is an approximately 20-acre AOC used early in RVAAP history as a construction yard by Cleveland Builders Supply. Multiple areas within the site were later used to burn non-explosive combustible scrap, and to dump construction/industrial waste. Sand Creek forms the west boundary of the AOC. There are several (approximately 15) debris piles located in the central portion of the site, and another near the western edge of the AOC.	Results of the Supplemental Phase II RI indicated two debris piles (designated as Piles M and N, Figure 3) were high enough to warrant further action. The U.S. Army and Ohio EPA remediated these two debris piles under a Non-Time Critical Removal Action (TCRA) due to likelihood of contaminant dispersal and migration from the piles to surrounding environmental media. The removal action followed the guidelines of USEPA	Final Project Management Plan for PBA submitted in 2010 (approval not found, comment response completed 2010, no new media conclusions presented, just summarized)	Final ROD for soil and Dry Sed 2009 (Comment response completed 2009, approval not found)	2010 Management Plan: No Further Action for soil and dry sediment. 2009 Final ROD: "Contamination of other media (groundwater, surface water, and wet sediment) and other AOCs are known to be present at the RVAAP. However, those media and AOCs are being addressed separately from this ROD."
RVAAP-51	Dump Along Paris-Windham Road	RVAAP-51 (Dump Along Paris-Windham Road) is adjacent to the Sand Creek flood plain and was used as an open dump for miscellaneous materials, including transite siding. The dates of operation for the landfill are unknown. Site may require possible cap or fencing to restrict access.	Collection and analyses of surface water, sediment and biological samples occurred in Sand Creek adjacent to the site. There were no detections above background levels identified in the RVAAP-specific surface water and sediment. Biological samples collected in Sand Creek under a separate initiative and in the vicinity of the dump reflected excellent stream quality. Debris removal was completed in January 2004. Confirmation sampling detected PAHs and asbestos close to the road within the embankment. No attempt was made to remove remaining debris within the roadbed embankment as it would have compromised the stability of Paris-Windham Road.	Final SC and FFS from 2014 is the most recent available document.	A final Focused Feasibility Study has been approved on MAR 19 2015	2014 SC/FFS:" GW data do not exist for the vicinity of this AOC; therefore, only a qualitative evaluation of potential impacts of residual soil contaminants on groundwater quality is included in the SC portion of this document. The U.S. Army will address groundwater at this AOC under a future decision for the RVAAP Facility-Wide Groundwater AOC (RVAAP-66)."

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Central Portion RVAAP						
RVAAP-03	Open Demolition Area #1	RVAAP-03 (Open Demolition Area 1), consisting of approximately six acres, was used to thermally treat munitions by OB/OD. The site now consists of a circular one-ft berm surrounding a grassed area of approximately 1.5 acres. The entire AOC is located within the National Advisory Committee on Aeronautics (NACA) Test Area. Contaminants of Concern (COCs) include explosive compounds and metals. The 1989 report from Jacobs Engineering indicates that munition fragments including scrap metal, small arms primers, and fuzes were found outside the bermed area and that the area was operational from 1941 through 1949.	In July 2001 a BRAC-funded IRA involving removal of approximately six acres of surface hot spots containing high levels of metals and explosives was completed. In December 2001 a final phase I RI report was completed. Site closeout documentation was initiated in FY03. Concern remained over potential MEC kick-outs and push-out material beyond the IRA area. A geophysical investigation was conducted in FY10 to investigate the potential MEC kick-outs/push-outs outside the IRA area. Results of the geophysical investigation were received in the fourth quarter of FY10 and the final report was published in January 2011. A Draft RI/FS was completed in August 2012. A subsequent contract was awarded to conduct a feasibility study, proposed plan, and record of decision with completion expected by the end of FY13. From 2001 Phase I (no approval found): groundwater characterization was limited in the Phase I RI until more source area data were collected. In addition, potential SRCs based on operations history (e.g., inorganics, explosives, and propellants) are readily attenuated or have low mobility in groundwater. Trace levels of 1,3-dinitrobenzene (1,3-DNB), acetone, and carbon disulfide were observed in the groundwater screening sample collected from station DA1-027. Copper concentrations in the unfiltered sample were slightly in excess of its background criterion; however, the concentration in filtered groundwater was less than background. Based on these screening data, no clear evidence exists that leaching to groundwater has occurred at station DA1-027. These limited data do not necessarily represent conditions in other portions of the AOC. From Phase II: Screening of soil data against migration to GW criteria showed that 2,4-DNT, antimony, arsenic, barium, 13 cadmium, chromium, and zinc concentrations were greater than their respective criteria.	Open Demolition Area #1 Site is at the Draft RI/FS phase. Additional work may include industrial the FS was LUCs to include no dig and for MMRP. Under study. Draft 2012 RI was the most recent soil doc (no approval document found). Draft PP 2013 was the most recent site document submitted (no approval document found)	Final DQO Report 2009 (approval not located, but comment response completed in 2009, no relevant GW information)	Draft PP 2013: "Sediment and surface water were not evaluated, since there is no permanent surface water or sediment at ODA1 and ODA1 was not determined to be a source of impact to nearby sediment and surface water. Therefore, no further action is necessary for these media and remedial alternatives only address soil. Groundwater will be addressed in a separate decision under the RVAAP Facility-Wide Groundwater Area of Concern (AOC; RVAAP -66)."
RVAAP-04	Open Demolition Area #2	Moved to MMRP program see RVAAP-004-R-01	Phase I RI for High Priority Areas of Concern, report in 1998. Final RCRA Closure Field Investigation Report, 1998. Phase II RI, report in 2005. Phase II RI Addendum, report in 2006.	Final RAR 2014 (approved)	Final RAR 2014	Moved to MMRP program see RVAAP-004-R-01
RVAAP-05	Winklepeck Burning Grounds	The Winklepeck Burning Grounds (RVAAP-05), consisted of approximately 216 acres and, operated from 1948 to 1998. Prior to 1980, there were open-burning activities performed in unlined pits, pads, and sometimes on the roads within the 216-acre area. Materials that were burned included: RDX, antimony sulfide, Composition B, lead azide, TNT, propellants, black powder, waste oils, sludge from the load lines, domestic wastes, explosively contaminated wastes (e.g. rags, papers, cardboard) and small amounts of laboratory chemicals. The pre-1980 burning was conducted on bare ground and resulting ash was abandoned in-place. Munitions, munitions debris (primarily scrap metal) and explosive constituents are present at the site. From 1980-1998, burning of scrap explosives, propellants, and explosively contaminated materials was conducted within raised refractory-lined trays located within a 1.5-acre area.	In 1994, the Army notified Ohio EPA of their intent to withdraw the Part B permit application. The burn trays along with the 90-day storage unit, Building 1601, were closed in accordance with Ohio EPA guidance in 1998. The deactivation furnace soils were transferred from the RCRA to the CERCLA program under the Director's Final Findings & Orders in June 2004. A limited MEC clean-up took place within various portions of the site during 2004, 2005, 2008, and 2009. Additional sampling was conducted in Fall 2012 in support of the upcoming multi-purpose machine gun range. Additional cleanup consisting of soil excavation will be required to support construction of a multi-purpose machine gun range which will partially overlap with the existing Mark 19 range. Additional sampling results and analysis of the previously selected remedy with additional soil excavation is documented in the Draft RI/FS Supplement which was submitted to the Ohio EPA in January 2014. Draft RI/FS 2014: "The exact source of some inorganics in soil at WBG are unknown. Contaminated soils within and adjacent to the former burning pads are potential secondary sources of contamination to sediment, SW, and GW. . . The former burn pads are expected to be the primary source of contamination, specifically at the surface where the burning occurred. If contamination was not found at the surface of a former burn pad, it is not expected to be found below or adjacent to that burn pad."	The Draft RD was approved with a clarification. Letter dated July 27, 2015. Most recent available doc was Final FY 2015 2nd Quarter LUC Inspection (no approval document found)	2014 Draft RD (approval letter not found, but referenced by other docs)	2015: ROD ESD: "The selected and implemented remedy for WBG addressed residual chemical contaminants in soil and dry sediment only. No perennial streams exist within the AOC and surface water flow within drainage ditches occurs only during storm events. Therefore, surface water was not and is not an exposure media at WBG and all sediment within the AOC boundary is classified as dry. Therefore, wet sediment, surface water, and groundwater were not addressed in the scope of the selected remedy. Groundwater is being addressed under the facility-wide groundwater AOC (RVAAP-66). Potential remedial actions for groundwater at WBG will be addressed under separate future decisions."

Appendix C
Status Summary for Compliance Restoration Sites
RI Work Plan for Facility-Wide Groundwater, RVAAP-66
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Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-07	Building 1601 Hazardous Storage	Closed Being addressed under Winklepeck. Building 1601 was a RCRA storage facility off of Road D in the central portion of the base. He facility was used in conjunction with RVAAP's demilitarization by open ground burning, and open detonated munitions. Building 1601 consists of a 484 square foot remote control concrete structure. The structure was previously covered by soil.	Building 1601 was used as a RCRA storage facility form 1984 to 1994.	1999 Closure, Completion of Partial Closure Report (approved, only the approval letter is available)	1999 Closure, Completion of Partial Closure Report	1998 Closure Activities Work Plan included composite wastewater samples from building decontamination and 7 subsurface soil samples from beneath cracks in the building and 2 were collected from under the asphalt drive. Results are not available. 2015 LUIC indicates that land use controls were part of the closure agreement. It is not known if impacts to GW are present.
RVAAP-11	Load Line 4	Load Line 4 (RVAAP-11) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would, in some instances, be swept out through doorways onto the ground surrounding the buildings. The on-site settling pond, known as Load Line 4 Pond, was an unlined earthen impoundment approximately one acre, based on a Geographic Information Systems approximation. Water from the impoundment discharged to a stream that ultimately exited through the southern side of the installation.	The following remedial actions have occurred at the site: 1. Structures underwent demolition between FY00 and FY09. 2. The final Interim ROD addressing only soil and dry sediment was signed by the Army and Ohio EPA in July 2007. 4. No additional remediation was required at Load Line 4. 5. Underslab subsurface incremental sampling was conducted in August 2010. The sampling report documenting this sampling and the USACE-led 2009 sampling event was finalized in March 2011. 6. Additional characterization sampling was completed in July 2011.Phase II RI GW Conclusions: Groundwater within the AOC contains few contaminants that can be related to historical operations. Low concentrations of metals identified as SRCs were observed; however, their occurrence and distribution above background criteria was sporadic. SVOCs and VOCs were detected at low levels in groundwater samples collected from monitoring wells in Load Line 4. Two COCs were identified for the National Guard Trainee. One COC (arsenic) is a carcinogen and the other COC (manganese) is a non-carcinogen. These COCs were also identified for the On-Site Residential Farmer scenarios. For these groundwater COCs, ratios of EPCs to RGOs indicate that estimated cancer risks would be slightly greater than 10-5 for the National Guard Trainee and slightly greater than 10-4 for the residential farmer scenarios. These are hypothetical future scenarios; no receptors are currently using groundwater from the AOC for any purpose. Leaching and GW pathways: Theoretical numerical modeling of leaching potential for soil source areas indicates that only chromium, selenium, and RDX may be expected to leach from the contaminated surface soil into the groundwater and reach concentrations exceeding groundwater MCLs or RBCs. The absence of these constituents and lack of overall substantial contamination in groundwater at Load Line 4 suggest that retardation processes (e.g., sorption, degradation, etc.) effectively attenuate contaminants within the vadose zone. Iron and manganese were observed in groundwater above secondary MCLs; therefore, they were also considered as CMCOPCs.	Final characterization sampling report of surface and subsurface ISM, Mar 2013 (no GW info).	Final characterization sampling report of surface and subsurface ISM, Mar 2013 (no GW info).	No significant GW conclusions in any of most recent docs for this site, recent reporting concerns subslab, subsurface, and surface soils. 2015 Draft RI SAP: Soil, Sed, and SW sampling to resolve data gaps is planned. If the AOC fails to meet unrestricted land use then an FS will be completed to evaluate cleanup options. 2012 Five Year Review Report (approval not located, but OEPA comments dated Nov 2012): "the monitoring of groundwater immediately after remedial action at Load Lines 1-4 was not performed in accordance with the ROD. Due to the lack of groundwater monitoring data, no evaluation of constituent trends in groundwater could be performed to ascertain whether or not groundwater was impacted by the soil remedial action." Groundwater conclusions from the 2003 Phase I RI are included under assessment history.
RVAAP-14	Load Line 6 Evaporation Unit	Being addressed under LL-6	No assessment documents are available for this AOC.	1993 Closure Report (approved, only the OEPA approval letter is available)	1993 Closure Report	Closure report indicates that tank was closed according to specifications, there are no conclusions relating to groundwater.
RVAPP-15	Load Line 6 Treatment Plant	Being addressed under LL-6	No assessment documents are available for this AOC.	Not applicable.	Not applicable.	Not applicable.

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Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-16	Fuze and Booster Quarry Landfills/Ponds	The 4.9 acre Fuze and Booster Quarry site consists of three elongated ponds separated by berms which were constructed within an abandoned rock quarry. The ponds were used for open burning of various types of munitions from 1945 to 1975.	Final 2005 Phase I/II RI groundwater sampling results: Unconsolidated Aquifer: explosives/propellants were detected in five of the six monitoring wells screened in the unconsolidated materials at FBQ. Inorganic SRCs detected above background in all six unconsolidated monitoring wells were barium and manganese. Aluminum and nickel were detected in three, zinc and cobalt in two, and copper and cadmium in one. The SVOCs caprolactum (three of six samples) and bis(2-ethylhexyl) phthalate (three of six samples) were detected in the monitoring well samples. Detected VOCs included: 1,1,1-Trichloethane; 1,1-DCE; Acetone; and carbon disulfide. Homewood Aquifer: six explosive/propellant compounds were detected: 2,4,6-TNT; 2,4-DNT; 2-Amino-4,6-DNT; 4-Amino-2,6-DNT; Nitrobenzene; Nitrocellulose. Barium and manganese were detected in all six bedrock screened monitoring wells. Zinc was detected in four of the wells, cobalt in three of the samples, nickel in two of the samples, and aluminum and hexavalent chromium in one of the samples. SVOCs included caprolactum, bis(2-ethylhexyl) phthalate, benzylbutyl phthalate, and di-n-butyl phthalate (one of six samples) were detected in the bedrock monitoring well samples. VOCs included acetone and TCE.	2010 Final RAP (approval not found, but comments response completed)	2010 Final RAP (approval not found, but comments response completed)	2010 RAP : "The selected remedy for soil and dry sediment at the Fuze and Booster Quarry Landfill/Ponds, as documented in the ROD for Soil and Dry Sediment at the Fuze and Booster Quarry Landfill/Ponds, was to excavate contaminated dry sediment within the drainage ditch aggregate to achieve a manganese CUG of 1,950 mg/kg for the most reasonably anticipated land use (National Guard Trainee). . . As this remedial action achieved objectives to allow for residential land use, land use controls, CERCLA five-year reviews, or O&M sampling are not required for soil and dry sediment at FBQ. Other media (i.e., surface water, wet sediment, and groundwater) and MEC will be addressed as part of future actions."
RVAAP-17	Deactivation Furnace	A site description was not provided in the only historical document found to date (1998 RCRA Closure Report).	Metals in soil were characterized through sampling in 1997, results documented in the 1998 Final RCRA Closure Report.	1998 Final RCRA Closure Report (approval not found)	Not applicable.	1998 Closure Report: "No explosives or propellants were detected in either the soil boring samples or the surface composite samples. This finding corroborates the 1991-1993 sampling data that showed no detectable quantities of explosives remaining in DFA soils." Saturated soils indicative of a water table aquifer were present in both borings, encountered at 9.6 and 12 ft bgs in well sorted sand.
RVAAP-19	Landfill North of Winklepeck Burning Grounds	RVAAP-19 is a 2.5-acre unlined and unpermitted landfill (a non-regulated solid waste disposal unit), which operated from 1969 to 1976 and is located upgradient of a wetland. The general appearance of the site suggests that a trench and fill method type of operation was used for waste disposal. Waste types possibly associated with this landfill include booster cups, aluminum liners, municipal waste, explosive and munitions waste and ash, and scrap metal from the Winklepeck Burning Grounds (RVAAP-05). The landfill was covered with soil in 1978. Site recommended for Restricted Access.	Four groundwater monitoring wells were installed at the AOC to an average depth of 23 ft bgs. Monitoring wells LNWmw-024 through LNWmw-026 monitor the unconsolidated groundwater. Monitoring well LNWmw-027 monitors the bedrock groundwater. Bedrock underneath the AOC consists of a black sandy shale that contains thin coal, underclay, sandstone, and siderite zones (Sharon Shale) from 1.6 ft bgs to 21.65 ft bgs. The potentiometric surface shows the groundwater flow pattern away from the center of the landfill to the northeast and to the southeast. Draft Soil RI/FS (2012):"Two explosives (nitroglycerin and tetryl) and two propellants (nitrocellulose and nitroguanidine) were identified as SRCs in surface soil at LNWBG. Nine inorganic chemicals were identified as SRCs in surface soil at LNWBG. Detections of inorganic chemicals above their respective screening criteria were widespread throughout the AOC. The highest number of inorganic SRCs above background concentrations and the greatest number detected at their maximum concentration were observed at the north-central portion of the AOC."	Site is at RI/FS phase. Draft RI/FS for soil , sed, and SW submitted in 2012 (approval not found)	Final 2008 PBA Workplan (approval letter not found, but comment response completed, no relevant GW info)	Draft Soil RI/FS(2012): "the following contaminant release mechanisms and migration pathways have been identified at the AOC: • Contaminant leaching from soil to the water table (vertical migration) and lateral transport to the 21 East Tributary"
RVAAP-22	George Road Sewage Treatment Plant	Being addressed under the CR project as CC-RVAAP-75.	See CC-RVAAP-75	See CC-RVAAP-75	See CC-RVAAP-75	See CC-RVAAP-75
RVAAP-25	Building 1034 Motor Pool	Being addressed under the CR project as CC-RVAAP-74	See CC-RVAAP-74	See CC-RVAAP-74	See CC-RVAAP-74	See CC-RVAAP-74
RVAAP-26	Fuze and Booster Area Settling Tanks	Addressed under FBQ (RVAAP-016)	See RVAAP-016	See RVAAP-016	See RVAAP-016	See RVAAP-016

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Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-28	Mustard Agent Burial Site	Site includes three potential disposal areas. Area 1: Records indicate that in 1969 an Explosive Ordnance Disposal Unit excavated a suspected mustard agent burial site near the west end of the NACA crash strip. Recovered from the site in 1969 were one 190-liter (50 gallon) drum and seven rusty canisters. All recovered items were empty and no evidence of contamination was found. Area 2: Another suspected area, located to the southwest across Hinckley Creek, is presently marked by reflective Seibert stakes. Area 3: An additional potential burial area located at the west end of the NACA crash strip was suggested by a member of the public and investigated in FY08.	Area 2: Surface soil samples collected in 1996 as part of the Relative Risk Site Evaluation (RRSE) conducted by US Army Center for Health Promotion and Preventative Medicine contained no thiodiglycol (mustard agent breakdown product). There were two non-intrusive geophysical surveys (EM-31, and EM-61) completed in 1998. The two surveys identified the demarcated area with positive metallic responses. Many responses may be related to artificial features (e.g. rusted fencing) at or near the ground surface. A follow-on FY08 contract was awarded to perform a DQO study and an additional geophysical survey that included areas on the north and south sides of the test crash strip. The geophysical survey work and report were completed in the fourth quarter of FY10 and the study detected additional unidentified anomalies. 2006 Final Report on GW sampling. □	Latest deliverable was a 2015 Site Investigation Report (approval not found).	Most recent approval was 2010 Final Sampling and Analysis Plan (not GW relevant). Soil RI not found, Geophysical investigation 2008 report was approved (more recent geophysical mapping report in 2011 without approval).	Final Site RI 2015: Groundwater monitoring is ongoing. In 2006, additional wells were installed and sampled for mustard agent and associated breakdown products. The chemical analysis reported no detections of mustard agent or breakdown products. 2006 sampling detected PCB-1260, benzoic acid, 2-butanone,and nitrocellulose (also in blank) detections were below limits. Barium and Nickel were also detected above background. An additional groundwater monitoring event was conducted in October 2011, also with no detections reported. Data collected to date has not confirmed the presence of mustard gas or chemical agents identification kits with mustard gas.
RVAAP-30	Load Line 7 Pink Waste Water Treatment	The Load Line 7 Treatment Plant was a pink water treatment plant in operation from 1989 to 1993. This AOC was closed out in January 2000.	No historical assessment documents have been located for this AOC (see RVAAP-40)	Not applicable.	Not applicable.	Not applicable.
RVAAP-32	40 MM Firing Range	The 1.3 acre 40mm Firing Range (RVAAP-032-R-01) is a former test range for the 40mm cartridge and is surrounded by forest. The MRS was used from 1969 to 1971.The impact area was located in the western portion of the site while the firing point was sited at the opposite end. MEC was reported to be present beyond the impact area, on the slope that leads down to the Fuze and Booster Quarry. Site is being addressed under the MMRP as RVAAP-032-R-01	Draft Evaluation 2006: The following 12 COPCs were identified in soil including: • 5 metals retained as COPCs because the maximum detected concentration exceeds the USEPA's Region 9 Residential PRG (arsenic) or 1/10th the USEPA Region 9 Residential PRG [aluminum, chromium, thallium, and vanadium (shallow and deep surface (0-3 ft bgs)soil only)]; • 1 explosive (nitrocellulose) retained because no PRG was available; and • 6 SVOCs retained because the maximum detection limit exceeds the USEPA Region 9 Residential PRG [benzo(a)pyrene, bis(2-chloroethyl)ether (deep surface and subsurface soil only), dibenz(a,h)anthracene, hexachlorobenzene, and n-nitroso-di-n- propylene] or 1/10th the USEPA Region 9 Residential PRG (2-methyl-4,6-dinitrophenol). All 6 of these SVOCs were non-detect in all soil samples.	Draft Evaluation of Chemical Residuum 2006 (approval not found, but comment response completed)	Draft Evaluation of Chemical Residuum 2006 (approval not found, but comment response completed)	Draft Evaluation 2006:"In summary the 40 mm Range is recommended as a "no further action location". This recommendation is based on the following: • Land Use Controls (e.g., no digging nor use of groundwater) will be institutionalized for the site and will reduce the potential for contact with low levels of chemicals identified at the site. • Results of the human health and ecological risk characterization performed on the relatively low concentrations of chemicals present, and the depth at which these analytes were found (0-3 ft bgs), indicate that there is no unacceptable risk likely to occur. o Initial sampling evidenced no subsurface action from prior use . Shallow rock is close to the surface with refusal (0-1 ft bgs) . Further surface detects did not evidence residuum, nor source release to subsurface (below 3'). • Further, groundwater is addressed facility-wide and developed to allow an exit strategy permitting a cyclic review of the 'no-use' groundwater control."

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RVAAP-33	Load Line 6	Load Line 6 (RVAAP-33) is approximately 45 acres and operated primarily as a fuze assembly line from 1941 to 1945. Demolition of all Load Line 6 buildings was completed July 2006. A portion of the AOC was reactivated in 1950 when the Firestone Defense Products Division became a tenant which lasted until the late-1980s. During this time frame Firestone sold its Defense Products Division to Physics International. Three years later, Physics International became a subsidiary of Olin Corporation and Olin remained as a tenant until early-1993. Throughout the history of the tenant occupancy the work regimen remained the same. As reported by former workers at RVAAP, Load Line 6 was a classified experimental test facility for munitions. Shaped charges were constructed and tested under contract for the Department of Defense. The site consisted of a pond (underwater test chamber), two above ground test-firing chambers, and several buildings. The test chamber foundation and the concrete blocks around the test pond remain at the site. No original file documentation exists for this site. The contaminants of potential concern are explosives and metals.	2007 Phase 1 RI: One propellant (nitrocellulose), two SVOCs (4–nitroaniline and bis(2–ethylhexyl) phthalate), and 27 metals (including antimony, arsenic, copper, manganese, and selenium) were detected at 28 concentrations greater than RVAAP installation background criteria, Region 9 tap water PRGs 29 or both.	Draft Phase II RI report for soil, sediment, and SW (Nov 2011)	2007 Phase I (includes relevant groundwater data, approval not found, but report mentions that 2003 workplan for Phase I was approved).	Draft Phase II: COPCs: Metals and PAHs detected above background concentrations. Groundwater pathways conclusion: Based on RVAAP facility-wide potentiometric data, the direction of groundwater flow at Load Line 6 is to the east. The groundwater table occurs near the unconsolidated glacial overburden/bedrock interface at an estimated average depth of 17 ft bgs. Depth to sandstone bedrock at the AOC ranges from 13-20 ft bgs. Contaminant leaching pathways from soil to the water table are through poorly sorted interbedded clayey to silty sand glacial till. Fate and transport modeling results predict selenium may leach from surface soil at concentrations above MCLs/RSLs. However, the maximum predicted concentration in groundwater at the water table beneath the source will be less than the MCL (0.05 mg/L). Based on the modeling results, migration of contaminants via the groundwater pathway is not expected. .
RVAAP-35	Building 1037 Laundry Waste Water Sump	Site status under review.	No historical assessment documents have been located for this AOC.	Not applicable.	Not applicable.	Not applicable.
RVAAP-36	Pistol Range	The 1.2 acre Pistol Range is located in the north-central region of RVAAP, west of George Road, east of Greenleaf Road and due north of the Winklepeck Burning Grounds. (See Figure 2 of the Sampling and Analysis Plan Addendum.) The Pistol Range was initially constructed for use by the installation's security personnel who were completing their pistol qualifications. The shooting qualifier stood on the south side of the creek and shot over the creek toward targets on the north side. A soil embankment or berm on the north side of the creek acted as a backstop for the bullets. The embankment is approximately 165 ft. long by 48 ft. high and is located 150 to 200 feet from the edge of the creek. The Pistol Range was used regularly from 1941 to 1993 by the Army and the local police departments, and currently is inactive.	2007 Final Characterization of 14 AOCs report: Surface Soil (0-1 ft) • Explosives, Pesticides, PCBs, VOCs, SVOCs and Propellants were below the Region 9 residential PRG values. • Inorganics exceeded RVAAP background and/or Region 9 residential PRGs at all surface soil sample locations. Sediment • Explosives, Pesticides, PCBs, VOCs, SVOCs and Propellants were below the Region 9 residential PRG values. • Inorganics exceeded RVAAP background and/or Region 9 residential PRGs at all surface soil sample locations. Surface Water • One chemical (Arsenic) exceeded the Region 9 tap water PRG at the one surface water sample location at the Pistol Range.	2007 Final Characterization of 14 AOCs (approval not found)	Approved document not found	No conclusions related to groundwater or potential impact to groundwater from other impacted environmental media are included in documents reviewed to date.

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RVAAP-39	Load Line 5	RVAAP-39 (Load Line 5) operated from 1941 to 1945 to produce fuzes for artillery projectiles. Load Line 5 was deactivated and its equipment was removed in 1945.	Since 1978, Load Line 5 has been included in various assessments and investigations. A key evaluation was conducted in conjunction with the removal of buildings, including slabs and foundations in FY07. An underslab soil and dry sediment survey was completed by USACE during this effort and the report was finalized in 2009. The findings indicated that of all 13 process buildings evaluated for surface soil contamination, only two required additional evaluation for contaminant releases. Buildings 1F-12 the fuze testing building) had the SVOC, benzo (a) anthracene identified as a COPC and Building 1F-10 (the detonator service magazine) had chromium identified as a COPC.	Site at Draft RI phase. Recommended NFA 'Draft RI report for soil, sediment, and SW (Jan 2012, no approval document found, includes GW modeling data) Buildings, slabs removed. Soil/ sediment survey complete. Under study	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	Included in 2012 Draft RI :Fate and transport conclusion: SESOIL modeling predicted the maximum concentrations of selenium and naphthalene in leachate below their respective source areas may exceed their respective screening criteria at a future point in time. Therefore, these chemicals were designated as final CMCOPCs and evaluated with lateral transport modeling (i.e., AT123D). Three initial CMCOPCs (4-nitrotoluene, benzenemethanol, and beta-BHC) were eliminated from further consideration as SESOIL did not predict they would leach at concentrations that exceeded MCLs/RSLs, FWCUGs, or RVAAP facility-wide background concentrations. Based on AT123D modeling, the maximum predicted concentrations of selenium and benzo(b)fluoranthene in groundwater beneath the source areas exceeded the screening criteria but did not exceed the screening criteria at the downgradient receptor location (i.e., unnamed tributary to the Mahoning River); therefore, they were eliminated as CMCOCs. Groundwater Pathways: Transport modeling indicates some chemicals may leach from 7 soil and migrate to the groundwater table at concentrations exceeding MCLs/RSLs beneath their 8 respective sources; however, these chemicals are not predicted to migrate laterally and reach the 9 nearest downgradient surface water receptor (unnamed tributary to the Mahoning River at distance of 10 approximately 500 ft) at concentrations exceeding MCL/RSLs. Further evaluation of groundwater at 11 the AOC will be detailed in a separate report.

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Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-40	Load Line 7	Load Line 7, formerly known as Booster Line #1, is a 37-acre fenced AOC located on the west side of Fuze and Booster Spur Road, south of Load Line 11, and northeast of Water Works #4 in the south- central portion of RVAAP. A fence exists as the perimeter boundary of the AOC. From 1941 to 1945, Load Line 7 operated at full capacity to produce booster charges for artillery projectiles. At the end of World War II, Load Line 7 was deactivated, and the process equipment was removed. In 1968, Load Line 7 was modified for the production of M-406 High Explosive and M- 407A1 practice 40mm projectiles. Load Line 7 was reactivated from 1969 to 1970. During this time, 16,000,000 40mm projectiles were assembled and produced at Load Line 7. In 1970, Load Line 7 was deactivated, and the process equipment was removed. Topographic relief at the AOC is moderate, with a topographic high on the western boundary of the AOC that slopes downward to the topographic low in the northeastern boundary of the AOC. Ground elevations within Load Line 7 range from approximately 1,110-1,146 ft above mean sea level (amsl). Surface water follows topographic relief and drains into ditches that exit the AOC.	2011 Draft RI/FS: "Fifty-one SRCs were identified in surface soil. Inorganic chemicals (16 metals and nitrate) and SVOCs) [in total, 16 of which were PAHs] were the predominant SRCs observed. Detections of inorganic chemicals above their respective screening criteria were widespread throughout the AOC. . . No pesticides were identified as SRCs in surface soil at Load Line 7. . . There were 27 SRCs identified in subsurface soil: 7 inorganic chemicals, 15 SVOCs (all PAHs), 4 explosives, and 1 VOC (2-butanone). Concentrations of inorganic SRCs in subsurface soil were observed above background concentrations throughout Load Line 7.	Draft RI/FS for Soil, Sed, and SW submitted 2011 (approval not found)	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	Draft RI/FS: "Based on the soil screening analyses and fate and transport modeling, all SRCs found in surface and subsurface soil samples evaluated through the stepwise fate and transport screening evaluation were eliminated as posing future impacts to groundwater."
RVAAP-41	Load Line 8	Load Line 8, formerly known as Booster Line #2, is a 44-acre fenced AOC located on Fuze and 6 Booster Road, west of Load Line 6, and south of the former 40 mm Test Area in the south-central 7 portion of RVAAP. From 1941 to 1945, Load Line 8 operated at full capacity to produce booster 8 charges for artillery projectiles. At the end of World War II, Load Line 8 was deactivated, and the 9 process equipment was removed. Load Line 8 has not been used since 1945.	From 2012 Soil, Sed, and SW RI: 4 CMCOPs in soil (arsenic, selenium, and napthalene) and 8 CMCOPCs in sediment (benz(a)anthracene, benzo(b)fluoranthene, cadmium, chromium, lead, mercury, naphthalene, and selenium).	Site is at a Draft RI phase. NFA recommended.	2009 Final Investigation of under slab surface soils etc. (no approval letter, but OEPA email saying changes looked good and requesting final). .	From 2012 Soil, Sed, and SW RI: AT123D modelling results showed the maximum predicted concentrations of all final CMCOPCs will not exceed MCLs/RSLs, FWCUGs, or facility-wide background concentrations at the downgradient receptor. On this basis, these eleven chemicals were eliminated from further consideration as CMCOCs. Comparison of modeling results to 2009 observed groundwater sampling data collected within Load Line 8 confirms AT123D results. Arsenic was the only final CMCOPC detected in an AOC monitoring well (LL8mw-003 with a concentration of 0.0035 mg/L), which was below the facility-wide background concentration of 24 0.0117 mg/L.

Appendix C
Status Summary for Compliance Restoration Sites
RI Work Plan for Facility-Wide Groundwater, RVAAP-66
January 2016

Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-42	Load Line 9	RVAAP-42 (Load Line 9) operated from 1941 to 1945 to produce detonators. Load Line 9 was deactivated and its equipment removed in 1945.	Limited samples collected and analyzed in 2000 indicated low levels (below 2 percent) of lead azide in sediment and surface water in the sumps. The removal of buildings, including slabs and foundations, was completed in FY07. A Phase I RI investigative survey was completed in the last quarter FY06. From 2007 Phase 1: Nitrocellulose and five metals (antimony, cobalt, copper, iron, and manganese) were detected in 7 groundwater samples (and 1 duplicate) at concentrations exceeding the RVAAP-specific consolidated bedrock background criteria, the Region 9 tap water PRG or both. However, the nitrocellulose concentrations results were qualified as estimated (J), or (B) .	Draft Phase II RI/FS Report for soil, sediment, and SW (Dec 2011, no approval document found)	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	From 2011 RI Draft: Fate and transport modeling for soil identified eight initial CMCOPCs in soil (arsenic, thallium, naphthalene, cadmium, copper, manganese, selenium, and mercury) and two CMCOPCs in sediment (mercury and nitroguanadine). Transport modeling results predicts concentrations in groundwater beneath source areas for arsenic, napthalene, and mercury in soil and mercury and nitroguanadine in sediment will exceed screening criteria beneath the source areas; therefore, they were evaluated using lateral transport modeling. These chemicals did not exceed the screening criteria at the downgradient receptor location (tributary to Sand Creek) and were eliminated as CMCOCs. Further evaluation of groundwater at the AOC will be performed in a separate report.
RVAAP-43	Load Line 10	RVAAP-43 (Load Line 10) operated from 1941 to 1945 to produce percussion elements. Load Line 10 went on standby status in 1945. From 1951 to 1957, Load Line10 produced primers and percussion elements. From 1969 to 1971, Load Line10 was reactivated, and produced munitions primers. The load line has been inactive since that time frame.	From 2014 Phase II Draft 2 RI: Fate and transport: Revised Draft 2 RI: The AT123D model predicted maximum future groundwater concentrations for the final soil CMCOPCs alpha-chlordane, gamma-chlordane, PETN, 3-nitrotoluene, 4-amino-2,6-DNT, 2,6-DNT, phenanthrene, naphthalene, dibenzofuran, 2-methylnaphthalene, and selenium exceed groundwater screening criteria beneath soil source areas, but do not exceed groundwater screening criteria at the downgradient receptor location (unnamed tributary to Sand Creek 1,875 ft north of the AOC). Predicted groundwater concentrations of the final sediment CMCOPCs cadmium, benz(a)anthracene, benzo(b)fluoranthene, and nitroguanidine also do not exceed groundwater screening criteria at the downgradient receptor location (unnamed tributary 1,000 ft south of the AOC). GW pathways: Transport modeling indicates four chemicals may leach from soil and migrate to the groundwater table at concentrations exceeding MCLs/RSLs beneath their respective sources (selenium, naphthalene, alpha-chlordane, and gamma-chlordane); however, these chemicals are not predicted to migrate laterally and reach the nearest surface water receptor (Sand Creek at a distance of 1,875 ft) at concentrations exceeding MCL/RSLs. Sediment screening analysis does not indicate any CMCOCs for the sediment to groundwater transport pathway.	Site is at a Phase II RI phase. 'Revised Draft 2 RI report of soil, sediment, and SW (Apr 2014, no approval document found, contains modelling)	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	From 2014 Phase II Draft 2 RI: Based on the modeling results, impacts to surface water features due to migration of contaminants in groundwater are not expected. Further evaluation of groundwater at the AOC will be performed in a separate report for groundwater.
RVAAP-44	Load Line 11	RVAAP-44 (Load Line 11) operated from 1941 to 1945 to produce primers for artillery projectiles. Load Line 11 was placed on standby in 1945. From 1951 to 1957, Load Line11 was used to produce primers and fuzes.	The removal of lead/asbestos-lined sumps, lead-contaminated sediments, and solvent-contaminated soils occurred during an IRA in 2001. The Final IRA report was completed in April 2004. Several of the sewer lines were intentionally plugged with grout to prevent migration of contaminants. The SI/Phase I RI was completed in FY05 prior to demolition of the buildings. The complete removal of buildings, including slabs and foundations, occurred in FY05.	Site is at Draft RI phase. NFA Recommended. Draft Phase II RI for Soil, Sed, and SW 2012 (approval not found)	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	Draft Phase II 2012: "SESOIL modeling predicted the maximum leachate concentrations of arsenic in the FPA and arsenic and manganese in the NPA in leachate below their respective source areas may exceed the USEPA MCLs/RSLs, FWCUG receptors for National Guard Trainee, and the RVAAP facility-wide background concentrations for groundwater at a future point in time" AT123D modelling eliminated the analyzed constituents as COMPCs. "Observed groundwater concentrations from Load Line 11 monitoring wells provide confirmation of modeling results."

Appendix C
Status Summary for Compliance Restoration Sites
RI Work Plan for Facility-Wide Groundwater, RVAAP-66
January 2016

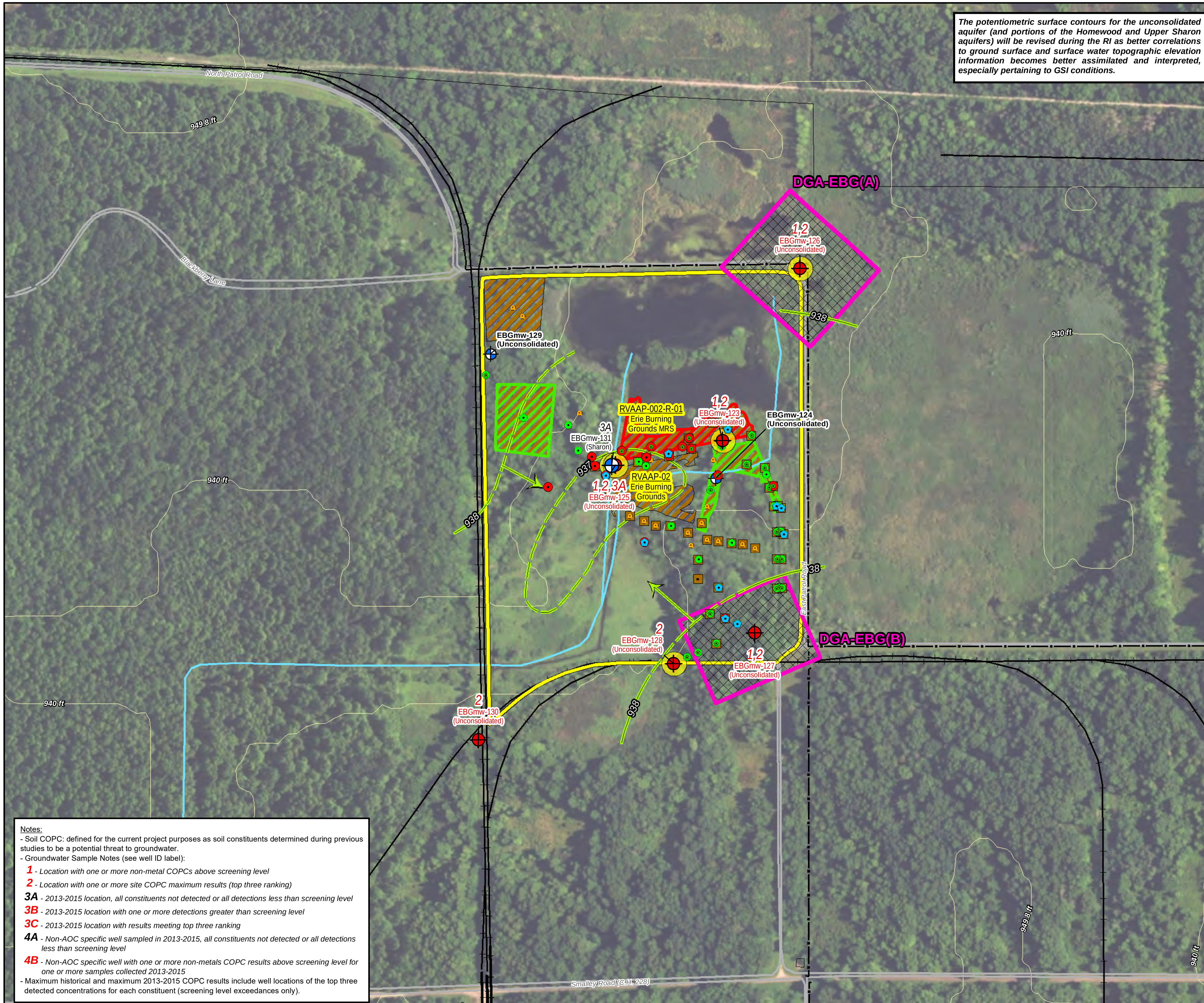
Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-45	Wet Storage Area	RVAAP-45 (Wet Storage Area) was used from 1941 to 1945 to store primary explosives in water-filled tanks and metal carboys. There is no documentation of any spills in the area. Four of the six igloos were demolished in spring 2003-2004.	Characterization of 14 AOCs in 2004-2005. Phase II RI for soil, sediment and surface water, draft report in 2011.	Site is at DRAFT RI phase. NFA recommended. Draft Phase 2 RI for Soil, Sed, and SW 2011 (approval not found)	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	Draft Phase 2 RI (2011): "Based on the sediment and soil screening analyses and fate and transport modeling, all SRCs found in the sediment, surface soil, and subsurface soil samples evaluated through the stepwise fate and transport screening evaluation presented here are eliminated as posing future impacts to groundwater."
RVAAP-46	Building F-15 and F-16	RVAAP-46 (Building F-15 and F-16) was used during World War II, the Korean Conflict and Vietnam War to test disassembly processes and munitions surveillance. Quantities and types of materials utilized as well as exact dates of testing are unknown.	The site was transferred to ARNG in May 1999. An SI/Phase I RI (2005-2006) found metals, explosives, SVOCs in soil and surface water above the agreed upon screening criteria. The Phase I RI did not investigate groundwater. All buildings, foundations, and slabs were removed from both sites in the fourth quarter of FY09. Following removal, confirmation sampling within and outside the buildings footprints was completed in the first quarter of FY10. Analytical results were evaluated in FY11 to determine any cleanup strategy (e.g. soil removal, clean closure, no further action).	Draft Phase II RI for Soil, Sed, and SW 2011 (approval not found)	Final S&A of Soils below floor slabs 2010 (approved, contains soil sampling results)	Draft Phase II RI: " The scope of this report does not include full evaluation of groundwater contaminant nature and extent, risk assessment, and remedial alternatives (if required). Groundwater will be evaluated as an individual AOC for the entire facility (designated at RVAAP-66) and addressed in a separate report....Based on the soil screening analyses and fate and transport modeling, all SRCs found in the surface soil and subsurface soil samples and evaluated through the stepwise fate and transport screening evaluation presented here are eliminated as posing future impacts to groundwater."
RVAAP-47	Building T-5301	Building T-5301 (designated as RVAAP-47) was located on the east side of George Road at the entrance to the Winklepeck Burning Grounds (VVBG). A small Guard Post (Building T-3402) was located adjacent to George Road and the gravel driveway that led up to Building T-5301. Originally built as a smokehouse, Building T25301 was utilized to decontaminate and steam clean small miscellaneous production equipment of explosives and propellants as the equipment left the WBG. The quantity of decontamination fluids wastes produced is unknown. In addition, the dates of usage of this building are unknown, but would roughly correspond to dates of production occurring at the installation, i.e., intermittently from World War II to Vietnam. The building was essentially a 25-foot by 25-foot sheet-metal structure with a concrete block wall extending approximately 3 feet above ground surface. Transite asbestos sheets were used to partition the building into two separate areas - a larger cleaning area and a small area for boilers. Within the interior of the building there was a floor drain that exited out of the southern wall of the building and materials would have discharged into two concrete sedimentation basins that drained, via a ditch, towards Sand Creek located to the southeast.	The IRA at Building T-5301 consisted of the following major activities: The decontamination and dismantling of the contents of Building T-5301 and the structures adjoining T-5301. The excavation and transportation of the excavated soil to the bioremediation treatment facility for the remediation of explosives-contaminated soils. Confirmation Sampling. The assessment of the existing groundwater well for use as a non-potable water construction/decontamination source during future IRP activities. The back-filling of the excavation with soil that was approved for use by the Ohio EPA after testing for VOCs, SVOCs, pesticides/PCBs, explosives, and propellants. Stabilization and restoration of the site to its original grade and mulching/seeding.	Closure, NFA Statement 2000 (approved)	Closure, NFA Statement 2000 (approved)	NFA Statement: "Contaminant detections in the soil medium were excavated to non-detect for explosives and organics, and to concentrations consistent with the installation-specific background for TAL metals. In some instances, bedrock was encountered and the excavation was halted. Groundwater and sediments were non-detect for explosives and consistent with the installation-wide background for TAL metals. On the flood plain to Sand Creek, low concentrations of lead (61.4 mglkg) were left in place in order to avoid the disruption of the ecological environment. This was done only subsequent to discussion with and concurrence by the Ohio EPA. If, in the future, it is determined that the excavation of some sediment would be required, this would be done in conjunction with the installation-wide surface water and sediment endeavor that is planned for the future."

Appendix C
Status Summary for Compliance Restoration Sites
RI Work Plan for Facility-Wide Groundwater, RVAAP-66
January 2016

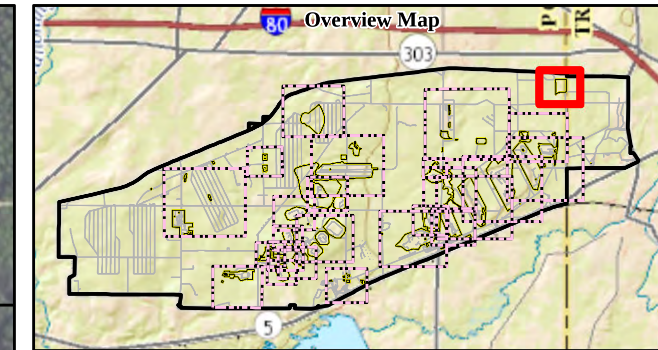
Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-48	Anchor Test Area	RVAAP-48 (Anchor Test Area) is located in the central part of the installation. Limited information is known about this research and development area, including dates of operation. It is believed that the site was used for testing explosively driven soil anchoring devices. It currently consists of several dirt mounds with a nearby sand pit (approximately six by 30 feet).	RI/FS Report conclusions (2012 Final RI/FS for soil, sed, and SW): SESOIL modeling predicted the maximum concentration of arsenic (0.953 mg/L) in leachate below its source area would exceed the screening criteria (facility-wide background concentration of 0.0117 mg/L) at a future point in time. However, based on the soil screening analyses and fate and transport modeling, all SRCs found in the surface and subsurface soil samples and evaluated through the stepwise fate and transport screening evaluation presented here are eliminated as posing future impacts to groundwater. The estimated direction of groundwater flow at Anchor Test Area is to the east based on RVAAP facility-wide potentiometric data. The groundwater table occurs within unconsolidated glacial overburden at depths of 8.7-13 ft bgs, based on 2010 soil boring data. Contaminant leaching pathways from soil to the water table are through interbedded clayey to sandy glacial till. Fate and Anchor Test Area Remedial Investigation/Feasibility Study Report Page 8-5 transport modeling results indicate that only arsenic may leach from surface soil in sample area ATAss-005M and migrate to groundwater below the source at concentrations above MCLs/RSLs and FWCUGs. However, the maximum predicted concentration in the groundwater table at the downgradient receptor (wetland area southeast of the AOC) is predicted to be less than the facility-wide background concentration. Additionally, migration of arsenic is likely to be attenuated within the unconsolidated zone because of moderate to high retardation factors within the unconsolidated zone.	Final remedial design for soil, sediment, and surface water, Aug 2014. Site has been remediated to residential cleanup standards. Most recent Soil RI is 2012 Final RI/FS for Soil, sed, and SW (no approval document found, contains modelling data).	2014 Final ROD for Soil, SW, and Sed. (comment response completed in 2014)	RI/FS Report conclusions (2012 Final RI/FS for soil, sed, and SW): Based on the modeling results, migration of contaminants via the groundwater pathway is not expected.
Western Portion RVAAP						
RVAAP-06	C Block Quarry	Block Quarry is a 0.96-acre AOC located between roads 3C and 4C of the C Block Storage Area, north of Newton Falls Road, in the northwestern portion of RVAAP. The C Block Storage Area 31 contains parallel roads of above ground cement igloos that formerly stored munitions. In the 1940s and 1950s, this area was used to mine Homewood Sandstone. The sandstone was quarried for the purpose of road and construction base material. The AOC was used as a disposal area for annealing process waste for a short duration during the 1950s. Liquid waste, including annealing process liquids and spent pickle liquor containing lead, mercury, chromium, and sulfuric acid from brass finishing operations, were dumped on the ground surface in the bottom of the abandoned unlined borrow pit. Potential C Block Quarry chemicals are residues from the storage of materials at the AOC, such as TAL metals, and SVOCs, explosives, and ACM. The quarry bottom within C Block has a maximum depth of 25 ft below the surrounding grade. The AOC is currently heavily forested with brush and trees of at least 1 ft in diameter. Construction debris assumed to be the result of dumping is present at the AOC.	Final Characterization of 14 AOCs, report 2007. RI/FS for Soil, Sediment, and Surface Water, report in 2011.	Draft RI/FS for Soil, Sed, and SW 2011	Final 2008 PBA Supplemental Investigation (approval not found, but comment response completed)	Draft RI/FS (2011): "Based on the soil screening analyses and fate and transport modeling, all SRCs found in the surface soil and subsurface soil samples and evaluated through the stepwise fate and transport screening evaluation here are eliminated from further consideration as CMCOCs for posing future impacts to groundwater. Comparison of modeling results to 2009 observed groundwater concentrations provides confirmation of modeling results."
RVAPP-21	Depot Sewage Treatment Plant	Site status under review.	No assessment documents are available for this AOC.	Not applicable.	Not applicable.	Not applicable.
RVAAP-24	Waste Oil Tank	Site status under review.	No assessment documents are available for this AOC.	Not applicable.	Not applicable.	Not applicable.

Appendix C
Status Summary for Compliance Restoration Sites
RI Work Plan for Facility-Wide Groundwater, RVAAP-66
January 2016

Site ID	Name	Description	Assessment History	Status/Latest Deliverable	Latest OEPA Approval?	Groundwater Related Report Conclusions
RVAAP-38	NACA Test Area	RVAAP-38 (NACA Test Area), an approximately 69-acre site, was previously used as an aircraft test area by NACA from 1947 to 1953. Surplus military aircraft crashed into constructed barriers, using a fixed rail attached to the aircraft landing gear, in an attempt to develop crash- worthy fuel tanks and/or high flashpoint aviation fuel. Burial of some demolished aircraft occurred at the site after the tests. Open Demolition Area 1, RVAAP-03, is surrounded by RVAAP-38. Fires and live ammunition were prohibited at the site after 1960 when it became a training area.	In the late-1990s, soil analyses detected low levels of metals and organics and sediment analyses detected nitrocellulose. As such, it was determined that additional study was needed of the area, and a I/Phase 1 RI, for the site was completed in 2002.Twelve groundwater monitoring wells were installed and sampled in 2004. Analytical results indicated metals and low levels of VOCs. Phase I RI, report in 2004. Final Characterization of 14 AOCs, report in 2007. Phase II RI for Soil, Sediment and Surface Water, report in 2012.	Draft Phase II RI/FS Soil, Sed, and SW (no approval documentation found). Most recent GW relevant doc was 2007 14 Site characterization (no approval found).	2001 Phase 1 approval sheet was not found, but comment sheet indicates that all comments were addressed.	*Draft* Phase II RI (2012): Based on the soil screening analysis, sediment screening analysis, leachate modeling, and transport modeling, all SRCs found in the surface soil, subsurface soil, and sediment samples and evaluated through the stepwise fate and transport screening evaluation here are eliminated from further consideration as CMCOCs. Comparison of modeling results to 2009 groundwater sampling data collected within NACA Test Area confirms modeling results. Observed maximum concentrations of all final CMCOPCs were less than those predicted by the models for groundwater beneath the sources.• Explosives, Pesticides, PCBs and VOCs were below the Region 9 tap water PRG values. • One propellant (Nitrocellulose) was detected at two sample locations. • Six SVOCs exceeded the Region 9 tap water PRGs at two sample locations. • Inorganics exceeded RVAAP background and/or Region 9 tap water PRGs at all groundwater sample locations.
RVAAP-50	Atlas Scrap Yard	In the 1940s, RVAAP-50 (Atlas Scrap Yard) contained a complex of buildings including barracks type housing that supported the principal construction and engineering company staff and included barracks type housing. After WWII, a majority of the Atlas building complex was demolished leaving the remaining portion of structures to support the installation roads and grounds maintenance staff and equipment as well as a large contingent of railroad maintenance personnel. The post WWII structures stood until after the Vietnam War at which point all remaining buildings were demolished and the site became a storage/stockpile yard for various types of bulk materials used in the day-to-day installation operations such as gravel, railroad ballast, sand, culvert pipe, railroad ties, and telephone poles. In the mid to late-1980s, the southeastern portion of the old Atlas area became a staging area for salvaged ammunition boxes from the demilitarization of defunct Vietnam War era munitions.	Final Characterization of 14 AOCs, report in 2007. RI for Soil, Sediment and Surface Water, report in 2014.	Draft RI for Soil, Sed, SW 2014 (approval not found)	2009 PBA SI and SAP Addendum (approval not found, but comment response completed in 2009, does not contain relevant GW info)	Draft RI (2014): "The predominant SRCs in surface and subsurface soil at Atlas Scrap Yard were PAHs, which were observed in all surface soil samples analyzed across the entire AOC. Inorganic chemicals were also observed in soil at concentrations above their respective background concentrations throughout the 1 AOC. Detections of explosives, propellants, VOCs, pesticides, and PCBs were limited in frequency. . . All SRCs were eliminated as posing future impacts to groundwater, and no further action (NFA) is necessary for surface soil, subsurface soil, and sediment to protect groundwater."



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed) * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 175 350 525 700 Feet

1 " = 350 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-02 AND RVAAP-002-R-01
(ERIE BURNING GROUNDS AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-1

FINAL

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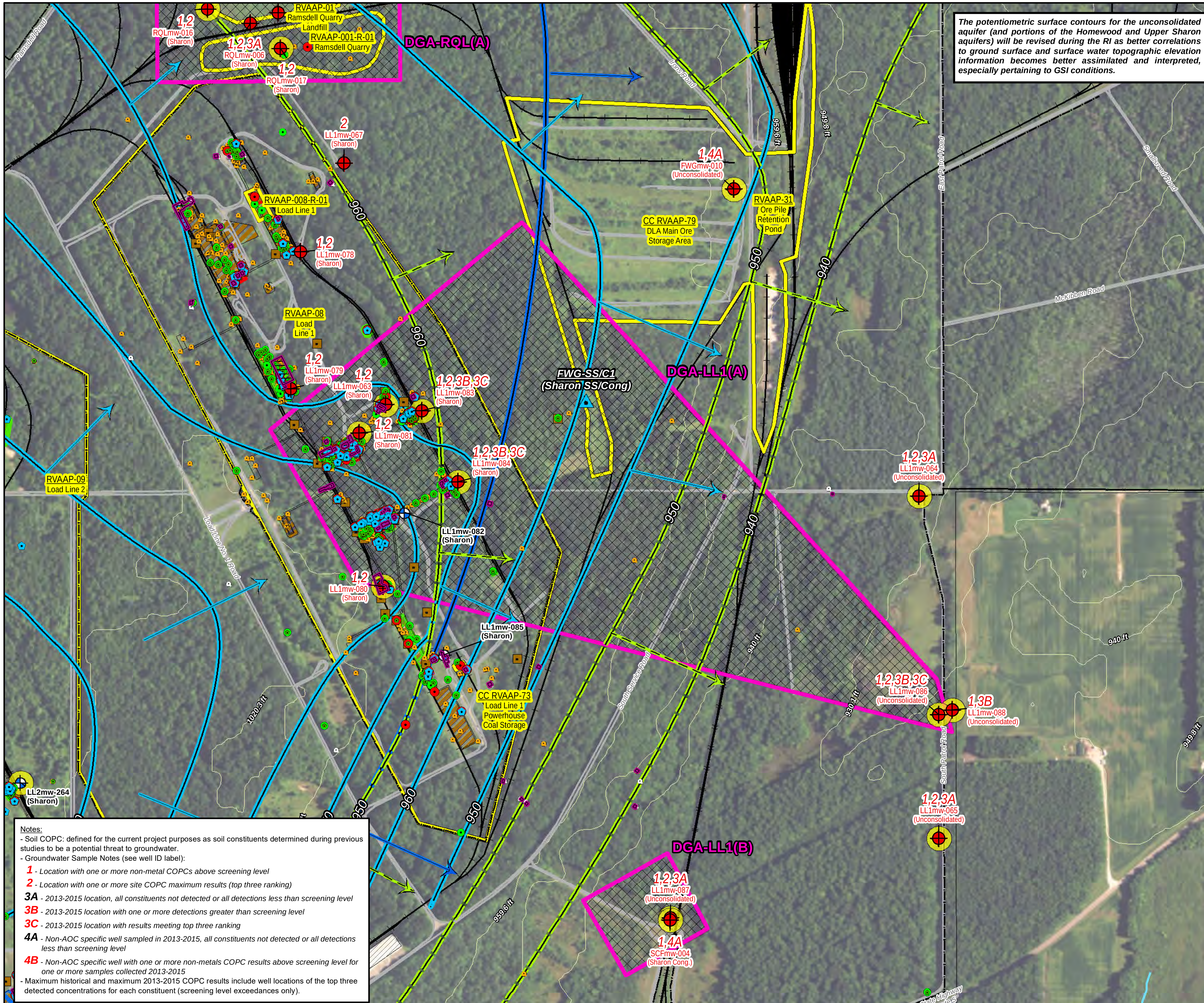

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

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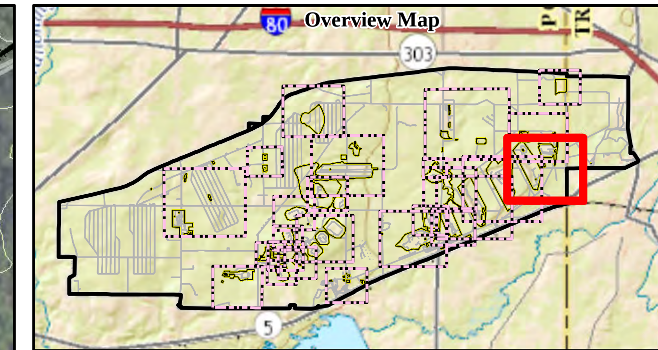


- Proposed Sharon Sandstone / Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 330 660 990 1,320 Feet

1 " = 650 ft
NAD83 UTM Zone 17N

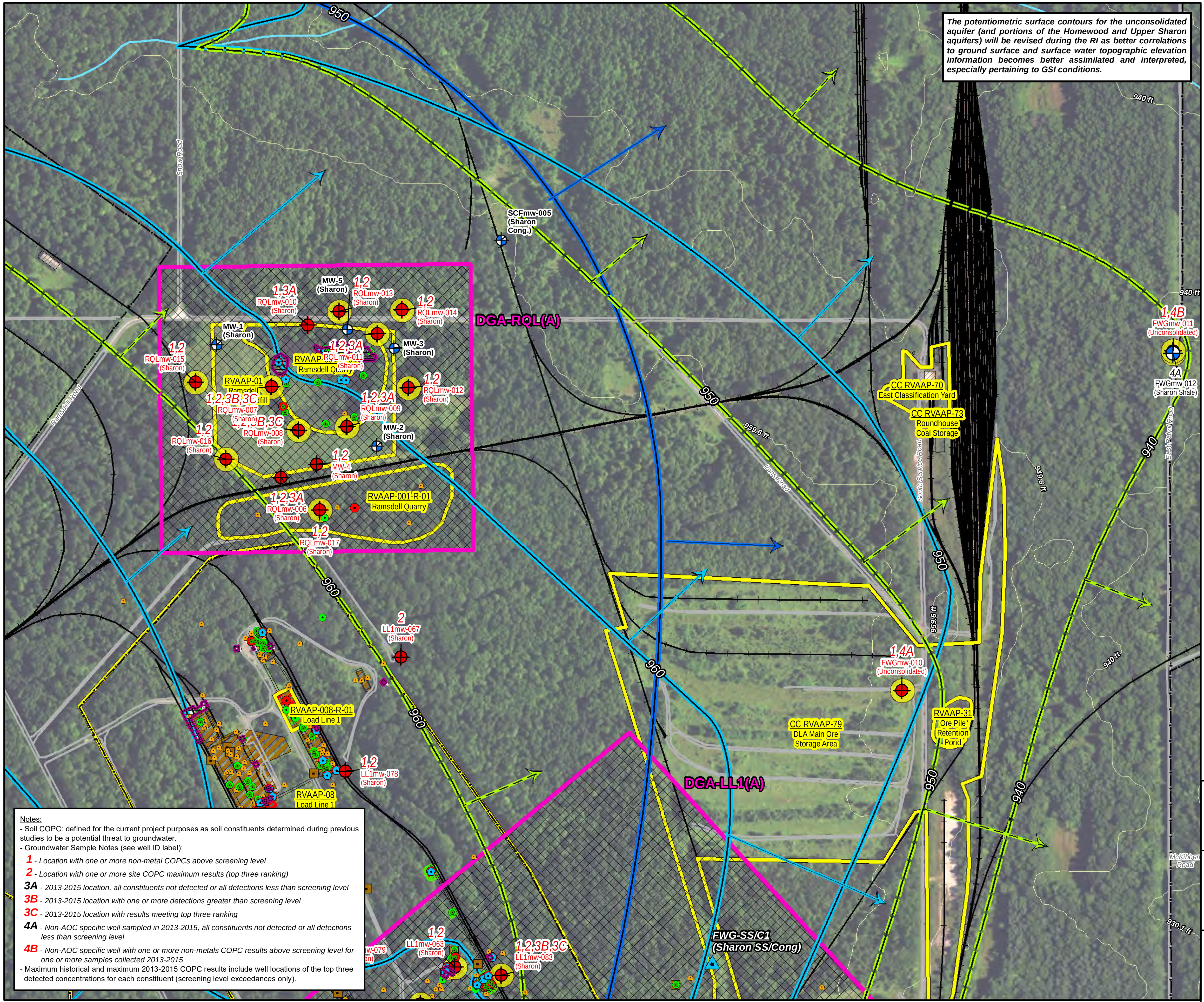
TEC-Weston Joint Venture

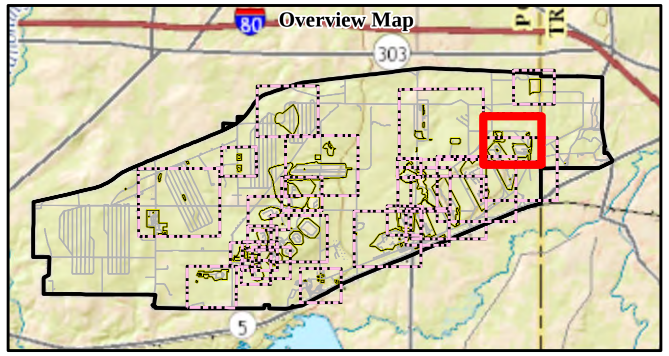
RVAAP-08 WITH RVAAP-31 AND CC RVAAP-79 (LOAD LINE 1 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-2

FINAL





- Proposed Sharon Sandstone / Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed) * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 250 500 750 1,000 Feet

1 " = 500 ft

NAD83 UTM Zone 17N

Notes:

- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Cardno TEC WESTON SOLUTIONS

TEC-Weston Joint Venture

RVAAP-01 AND RVAAP-001-R-01 (RAMSDELL QUARRY AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-3

FINAL

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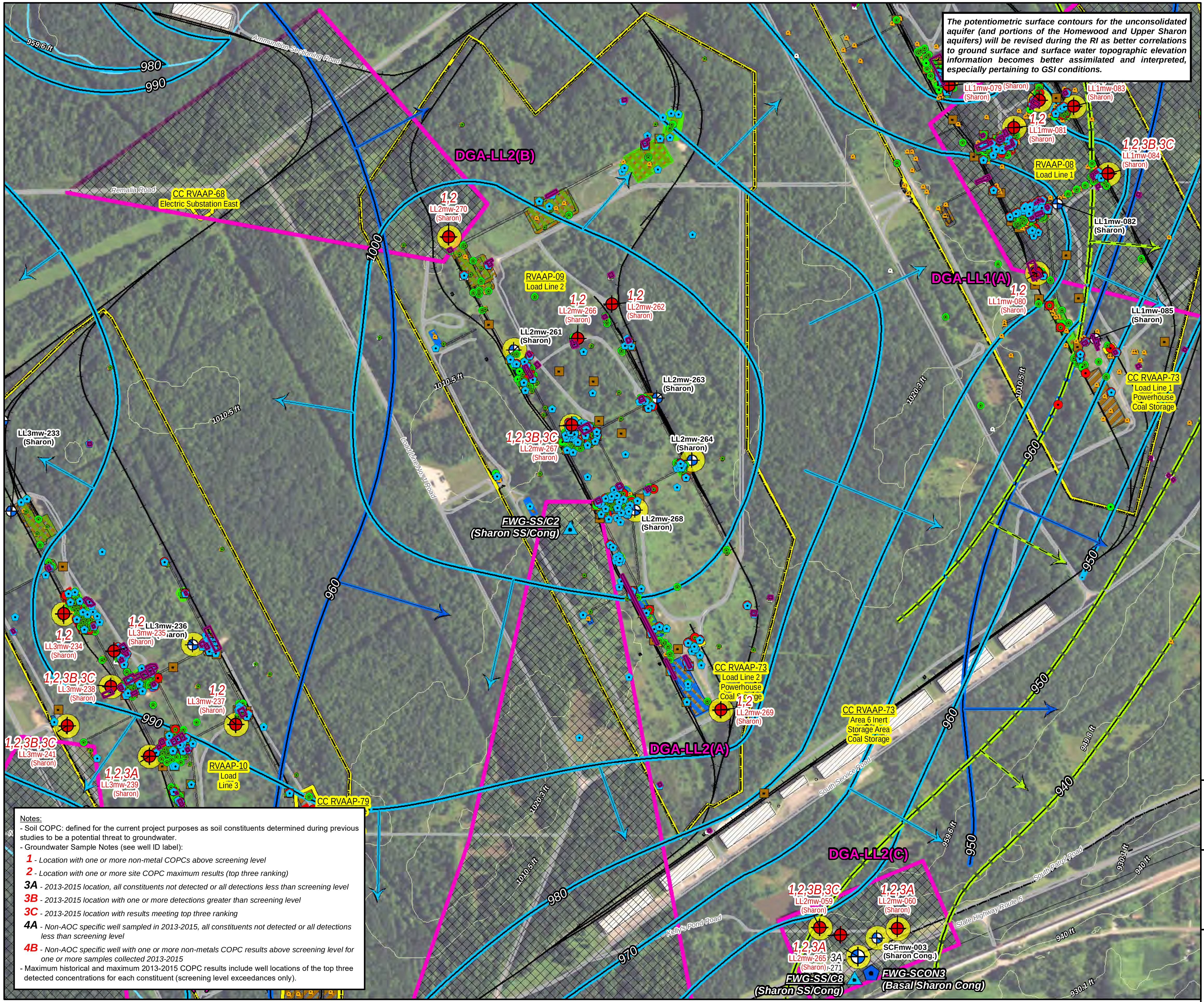

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

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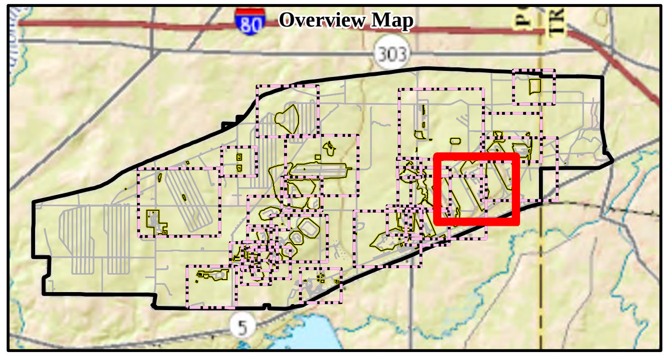


- Proposed Sharon Sandstone / Conglomerate Well Location
- Proposed Basal Sharon Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

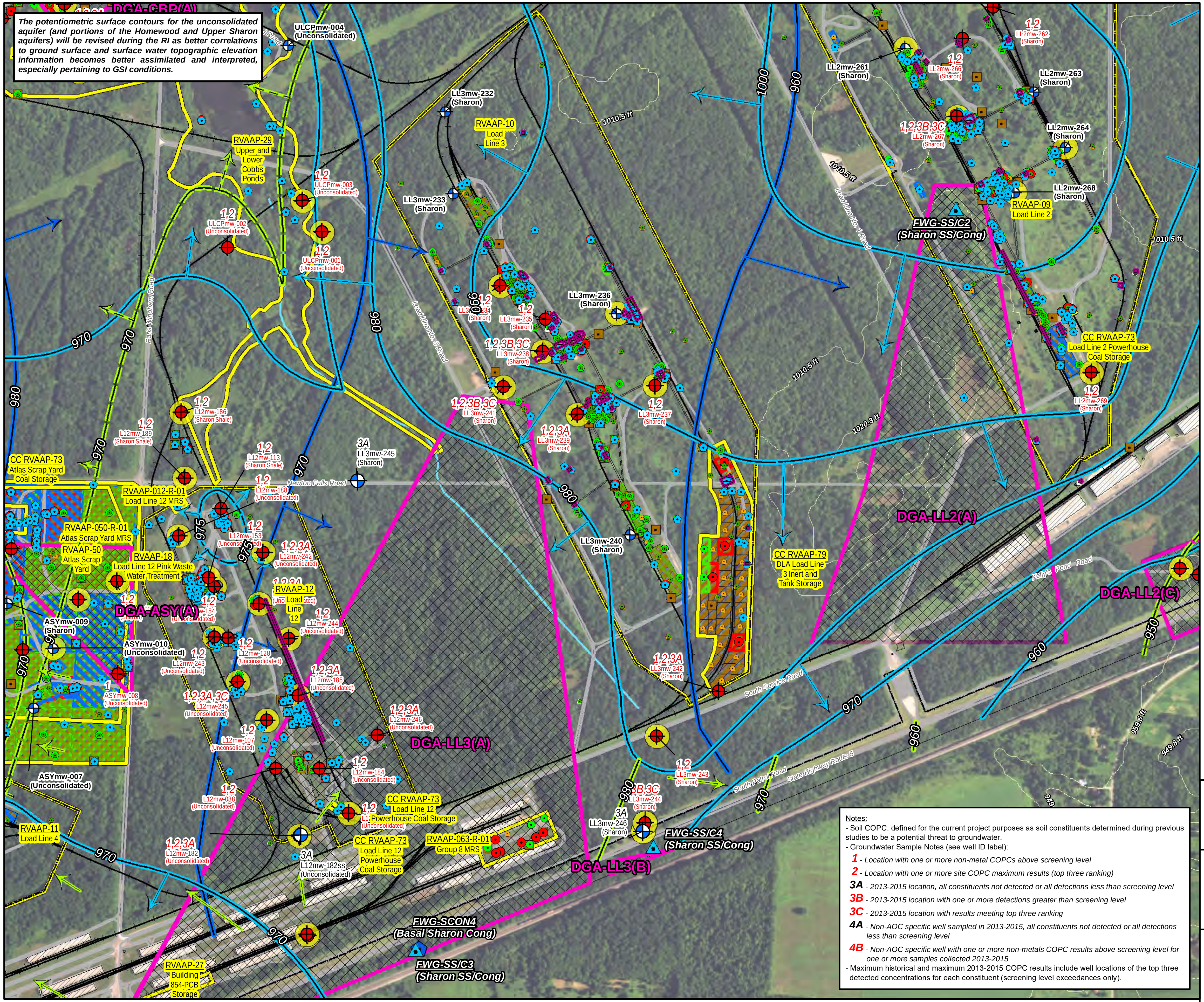
N
0 340 680 1,020 1,360 Feet
1 " = 675 ft
NAD83 UTM Zone 17N

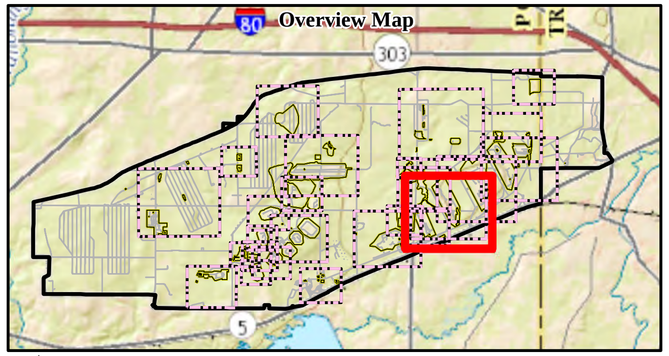
TEC-Weston Joint Venture

RVAAP-09 WITH CC RVAAP-68
(LOAD LINE 2 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-4

FINAL





- Proposed Sharon Sandstone / Conglomerate Well Location
- Proposed Basal Sharon Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 380 760 1,140 1,520 Feet

1 " = 750 ft
NAD83 UTM Zone 17N

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-10 WITH CC RVAAP-79 (LOAD LINE 3 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-5

FINAL

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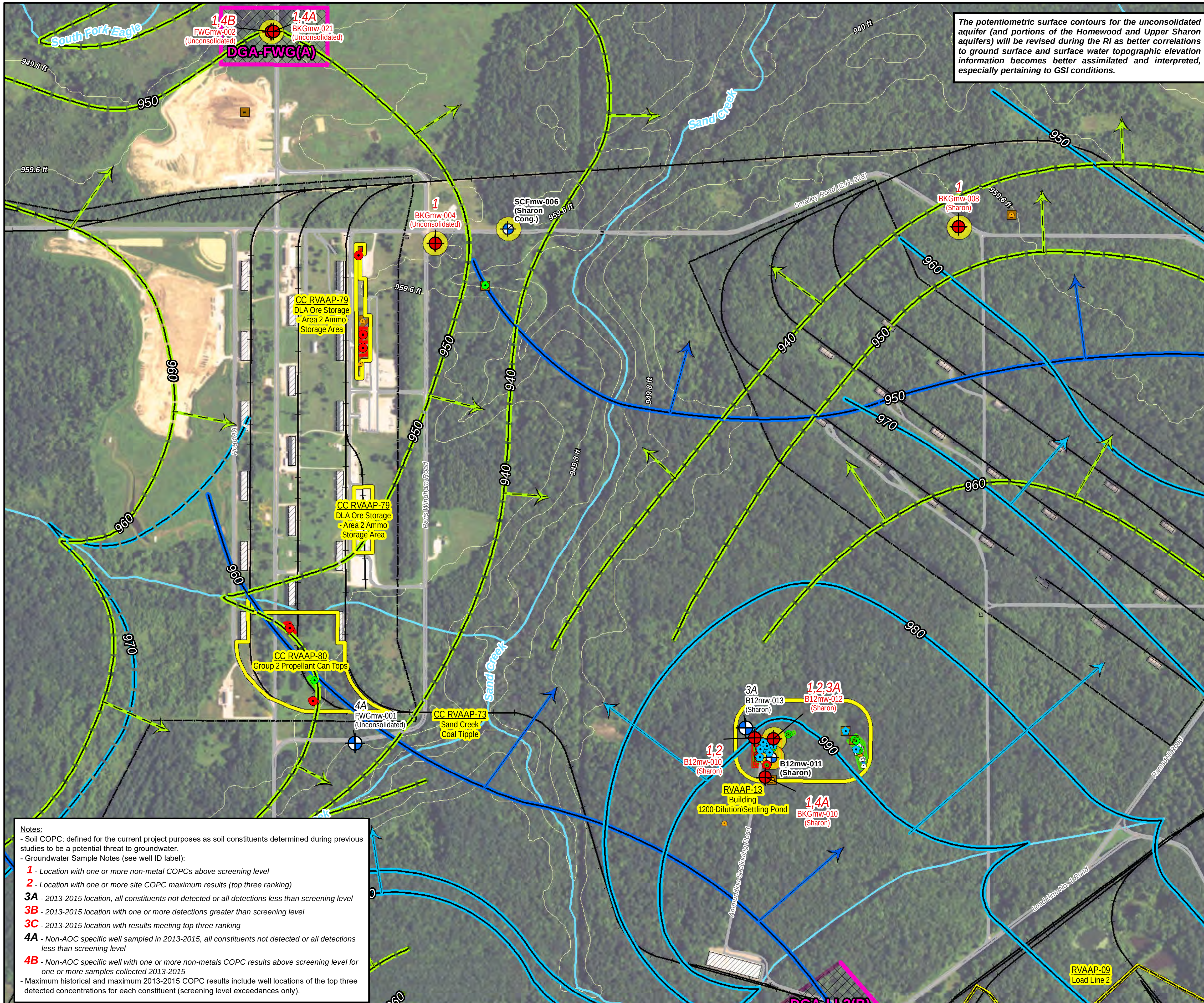

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):

1 - Location with one or more non-metal COPCs above screening level
2 - Location with one or more site COPC maximum results (top three ranking)
3A - 2013-2015 location, all constituents not detected or all detections less than screening level
3B - 2013-2015 location with one or more detections greater than screening level
3C - 2013-2015 location with results meeting top three ranking
4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015

- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

N

0 380 760 1,140 1,520 Feet

1 " = 750 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-13 WITH RVAAP-51, CC RVAAP-79, AND CC RVAAP-80 - (BUILDING 1200 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-6

FINAL

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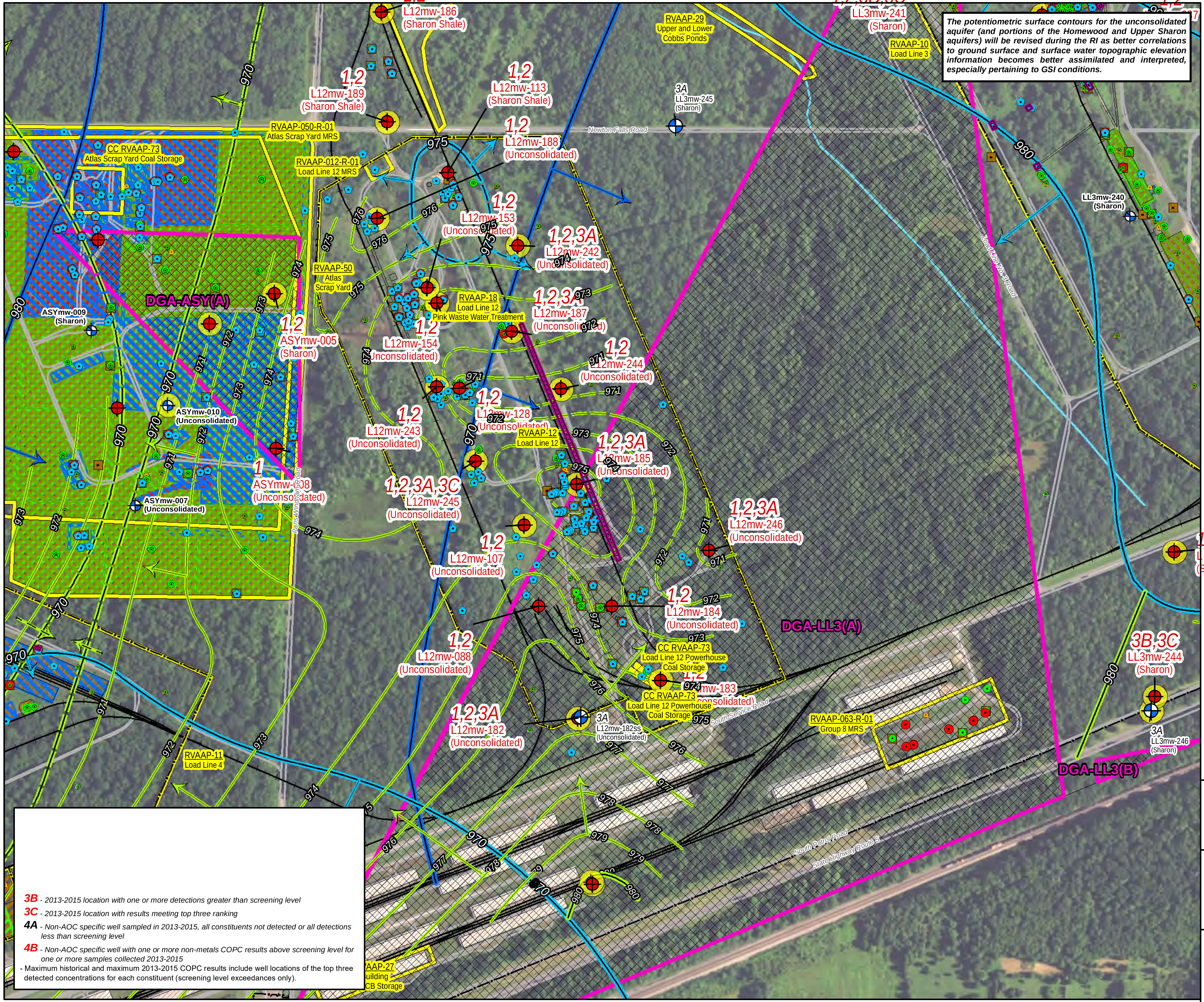

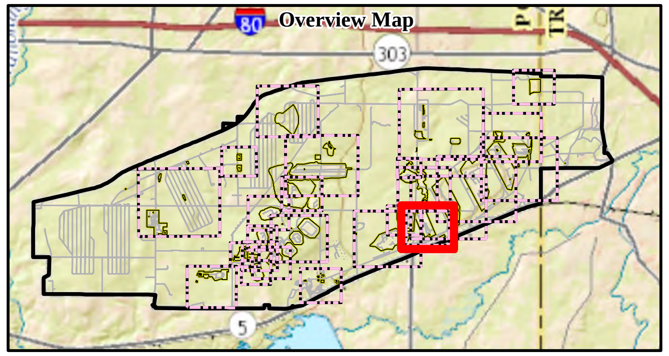

Soil Sample Location with Groundwater COPC Detected Greater than the Mean

Soil Sample Location with Detected Groundwater COPC

Soil Sample with Soil COPC Detected Greater than the Mean

Soil Sample with Soil COPC Detected

ISM Location with Groundwater COPCs Detected Greater than the Mean

ISM Location with detected Groundwater COPC

ISM Location with Soil COPC Detected Greater than the Mean

ISM Location with detected Soil COPC

Data Gap Areas

Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)

Soil, Subsurface Stations (white = metals only analyzed)

Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown

Groundwater Station

Potentiometric Surface Contour: Unconsolidated (July 2015)

Potentiometric Surface Contour: Upper Sharon (July 2015)

Potentiometric Surface Contour: Sharon Conglomerate (July 2015)

Excavation Areas

AOCs

Buildings

Streams

N

0 230 460 690 920 Feet

1 " = 450 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS

TEC-Weston Joint Venture

RVAAP-12 WITH RVAAP-063-R-01 (LOAD LINE 12 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-7

FINAL

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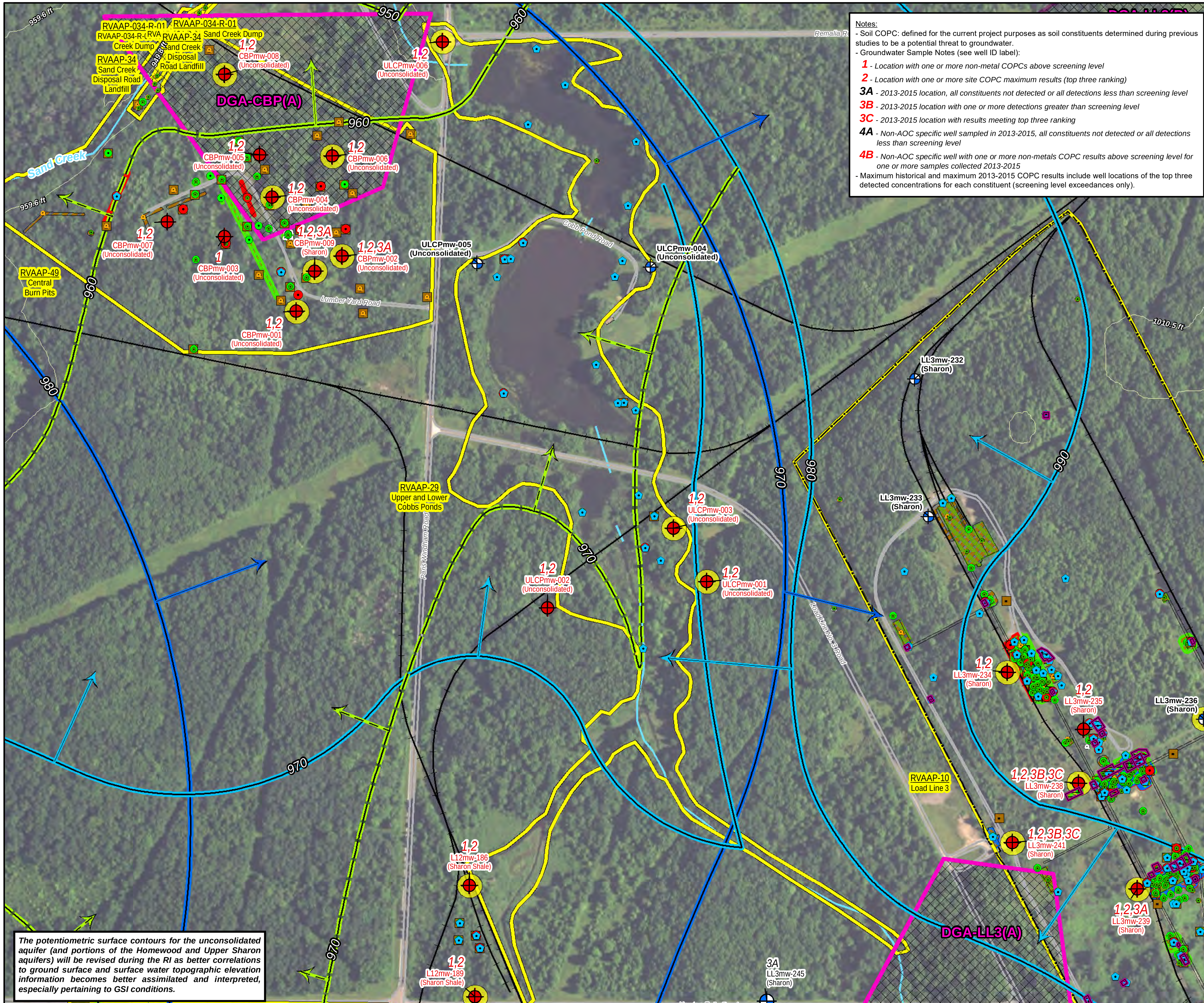

Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

N

0 225 450 675 900 Feet
1 " = 450 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-29
(UPPER AND LOWER COBBS PONDS)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-8

FINAL

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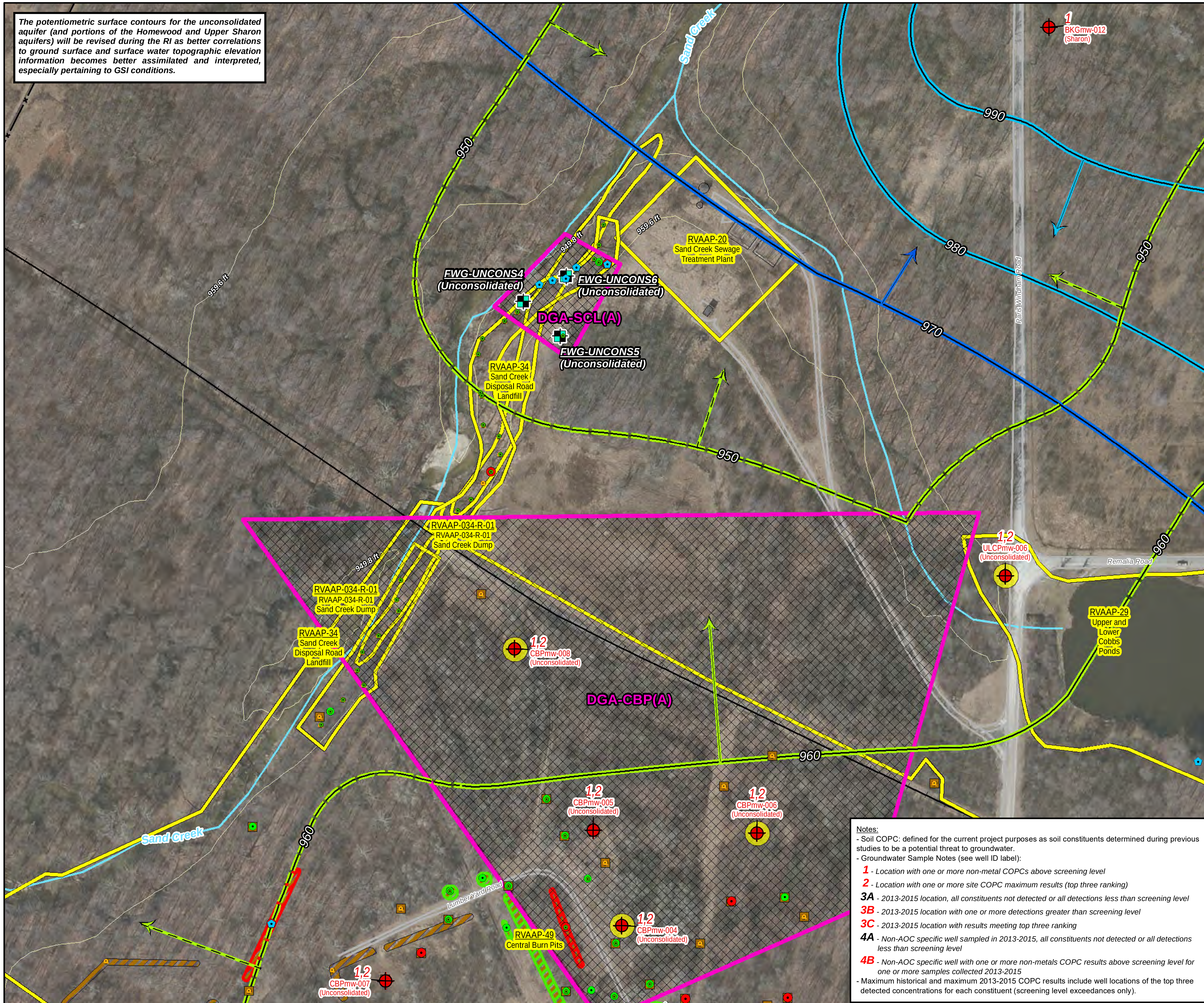
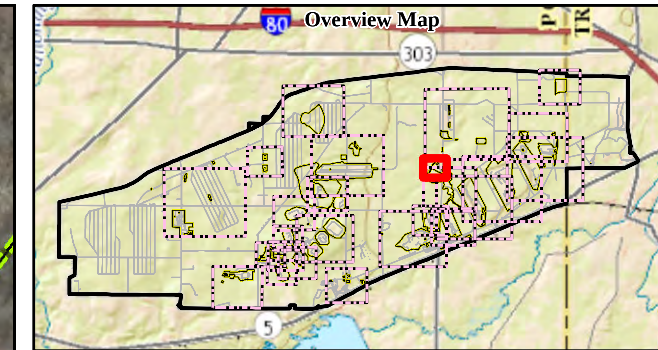
The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.





- Proposed Unconsolidated Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 100 200 300 400 Feet

1 " = 200 ft

NAD83 UTM Zone 17N

Notes:

- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):

1 - *Location with one or more non-metal COPCs above screening level*

2 - *Location with one or more site COPC maximum results (top three ranking)*

3A - *2013-2015 location, all constituents not detected or all detections less than screening level*

3B - *2013-2015 location with one or more detections greater than screening level*

3C - *2013-2015 location with results meeting top three ranking*

4A - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*

4B - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*

- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Cardno TEC WESTON SOLUTIONS

TEC-Weston Joint Venture

RVAAP 34/RVAAP 34-R
(SAND CREEK DISPOSAL AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-9

FINAL

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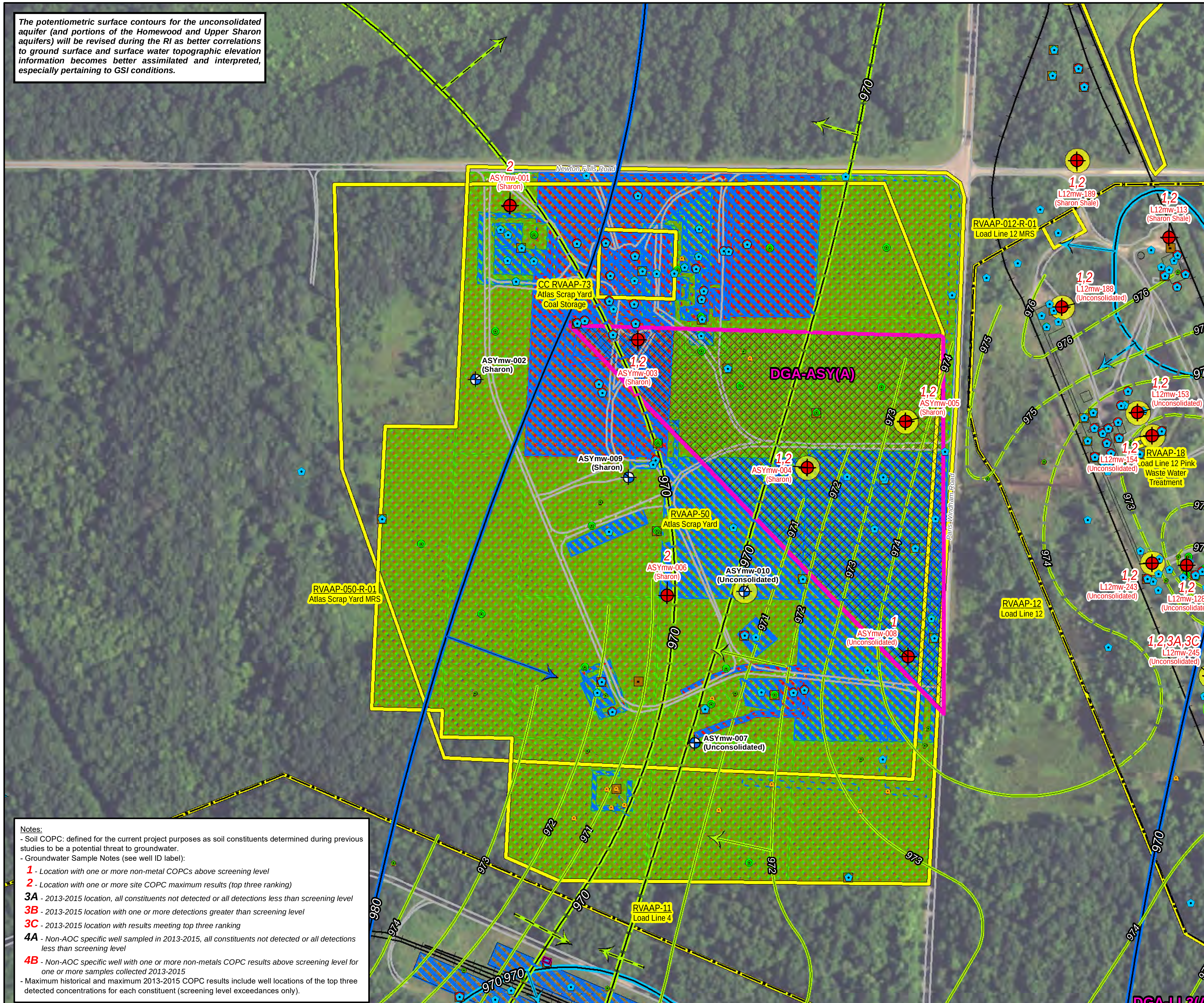
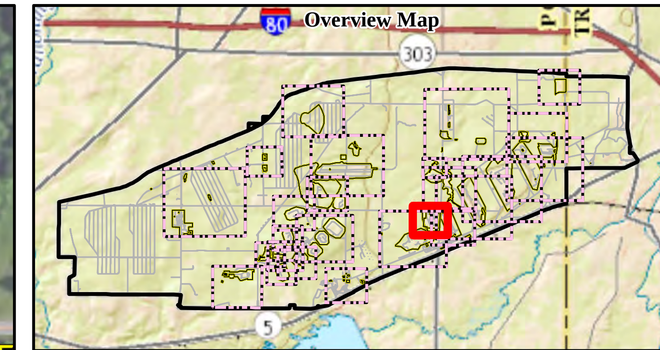


The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings

N

0 150 300 450 600 Feet

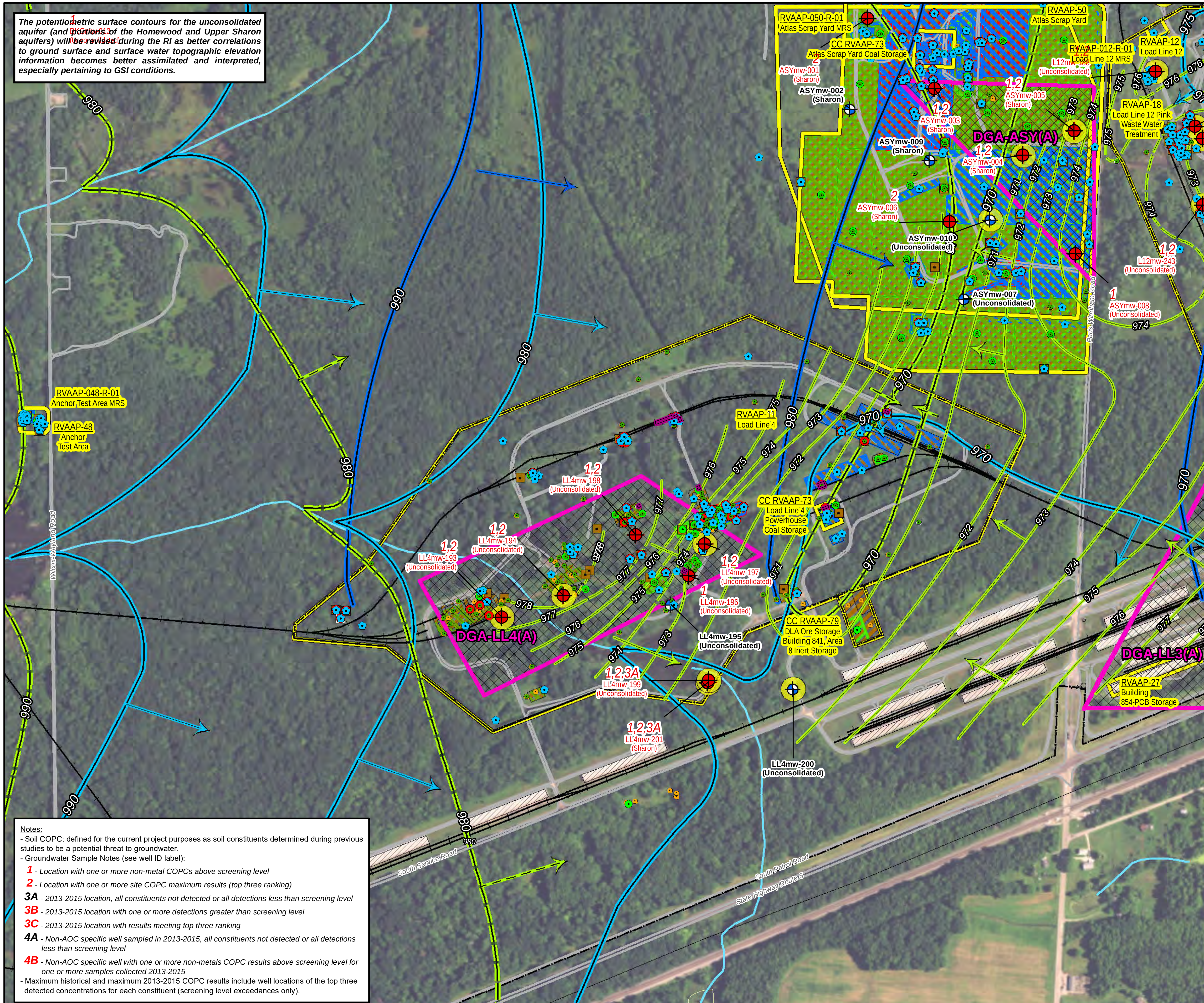
1 " = 300 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

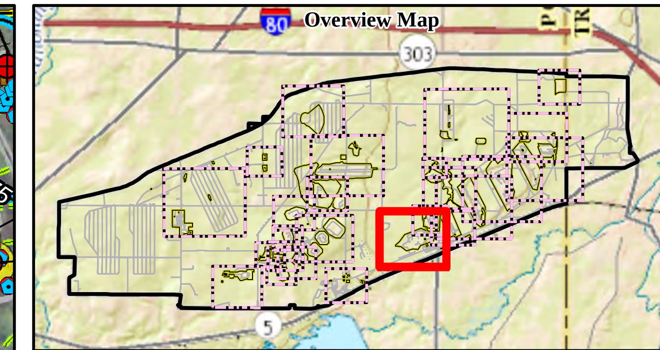
RVAAP-50 AND RVAAP-050-R-01
(ATLAS SCRAP YARD AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-10

FINAL



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 290 580 870 1,160 Feet

1 " = 575 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-11 WITH RVAAP-27, RVAAP-48, AND RVAAP-048-R-01 - (LOAD LINE 4 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-11

FINAL

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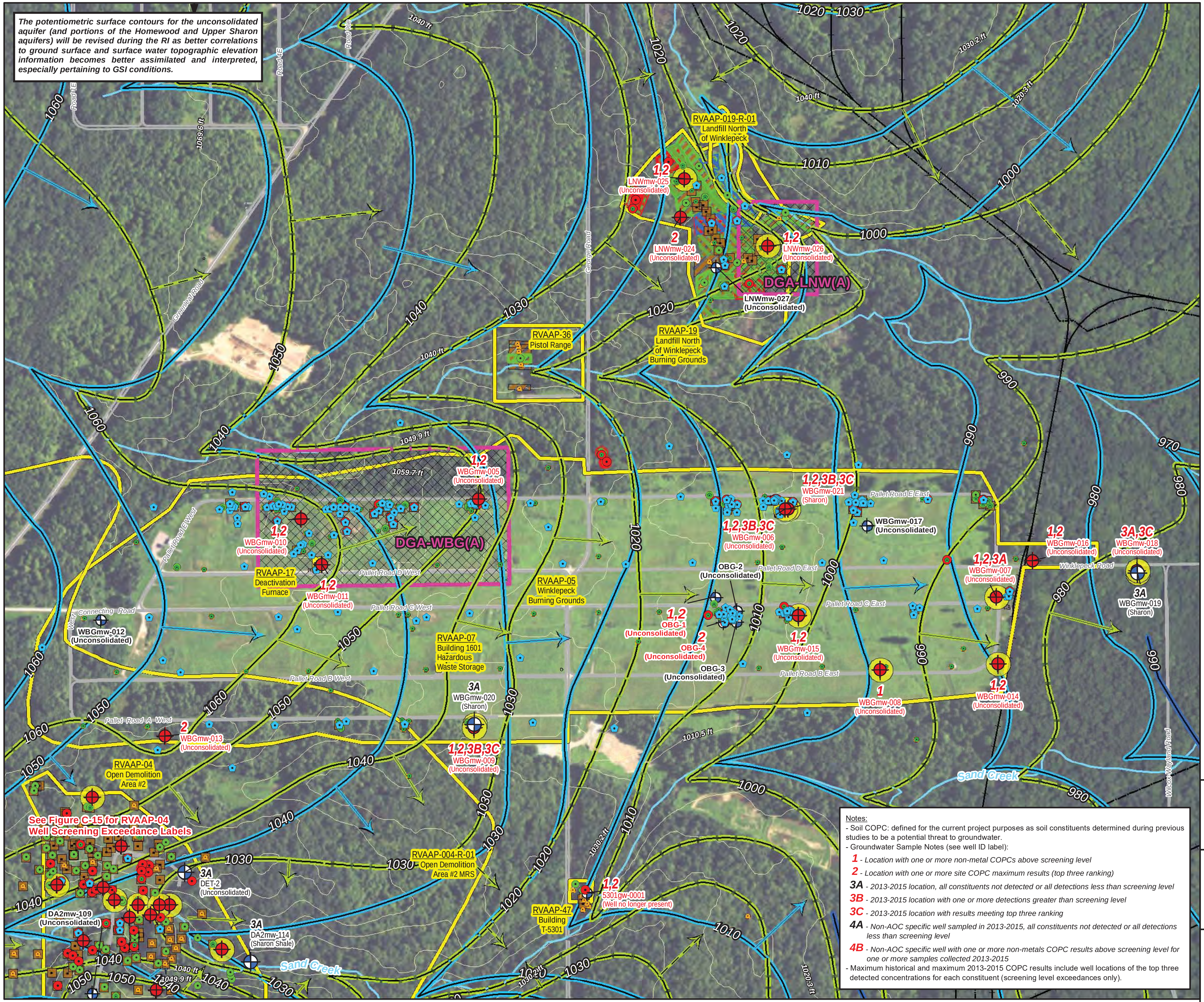

- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

Notes:

- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

N

0 310 620 930 1,240 Feet

1 " = 625 ft

NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS

TEC-Weston Joint Venture

RVAAP-05 AND RVAAP-19 (WINKLEPECK BURNING GROUNDS AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater

Former Ravenna Army Ammunition Plant

Ravenna, Ohio

Figure: C-12

FINAL

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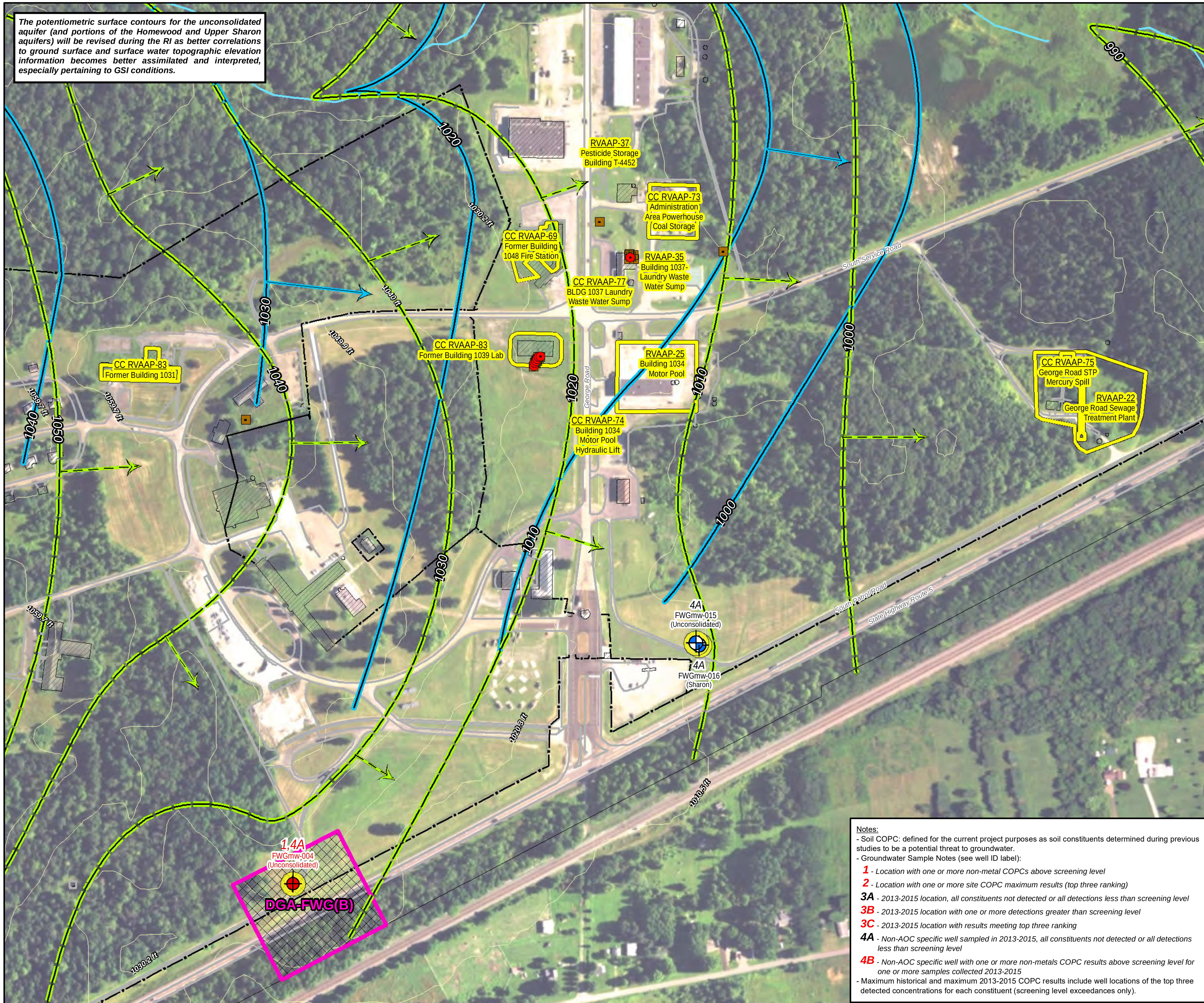
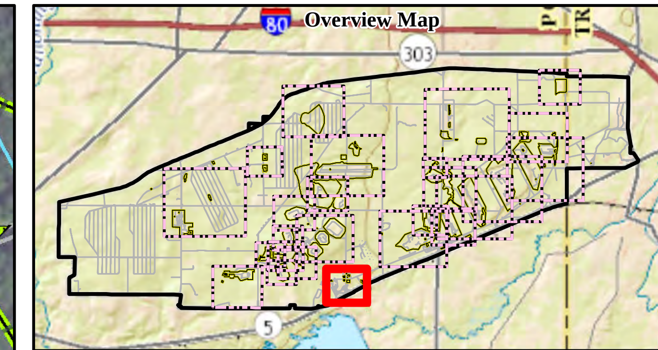
The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.





- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 175 350 525 700 Feet

1 " = 350 ft
NAD83 UTM Zone 17N

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

TEC-Weston Joint Venture

MOTOR POOL AREA

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-13

FINAL

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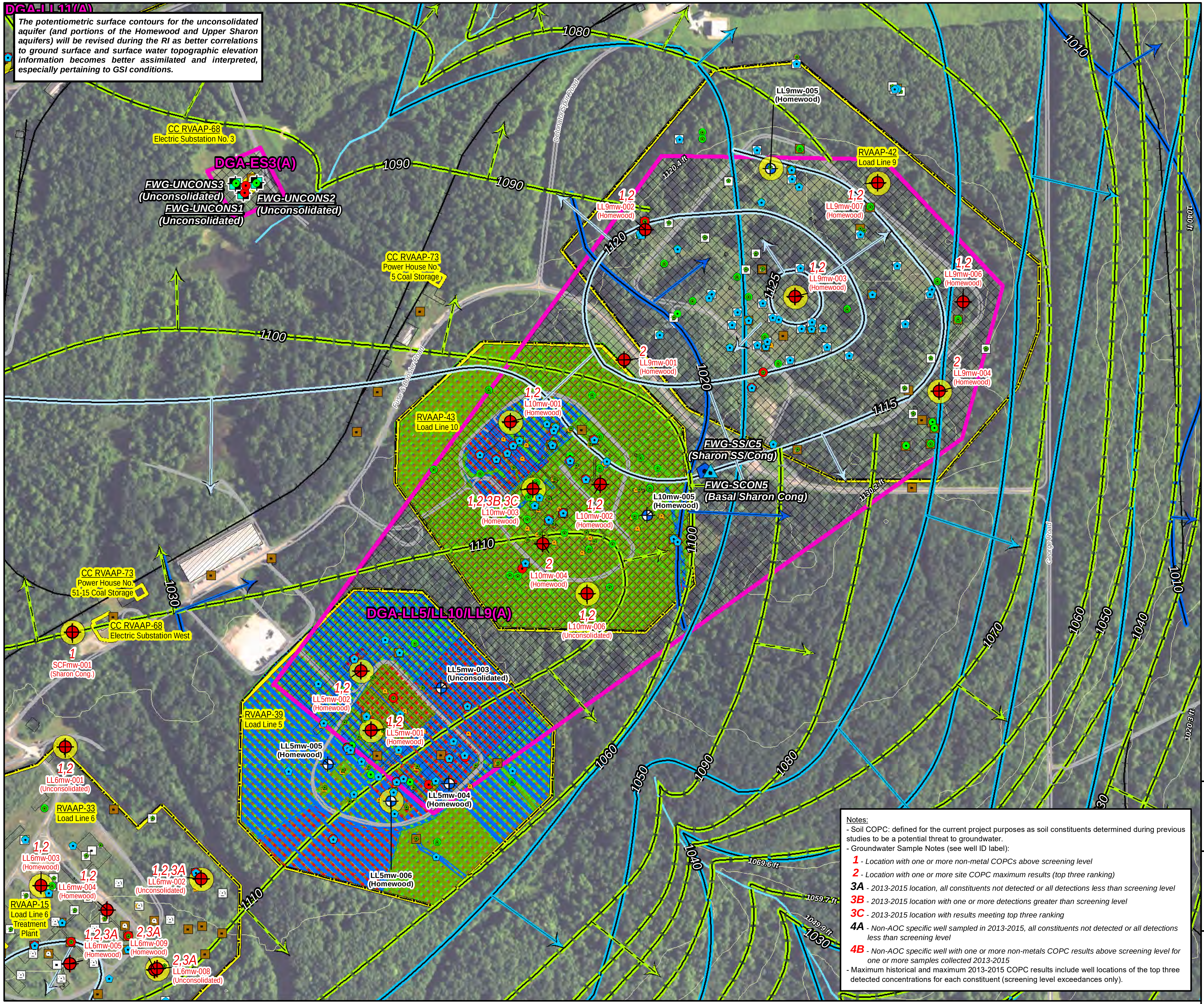

The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Proposed Sharon Sandstone / Conglomerate Well Location
Proposed Basal Sharon Conglomerate Well Location
Proposed Unconsolidated Well Location
Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Homewood and Mercer (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

Cardno TEC | WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-39, RVAAP-42, AND RVAAP-43 (LOAD LINES 5, 9, AND 10 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-14

FINAL

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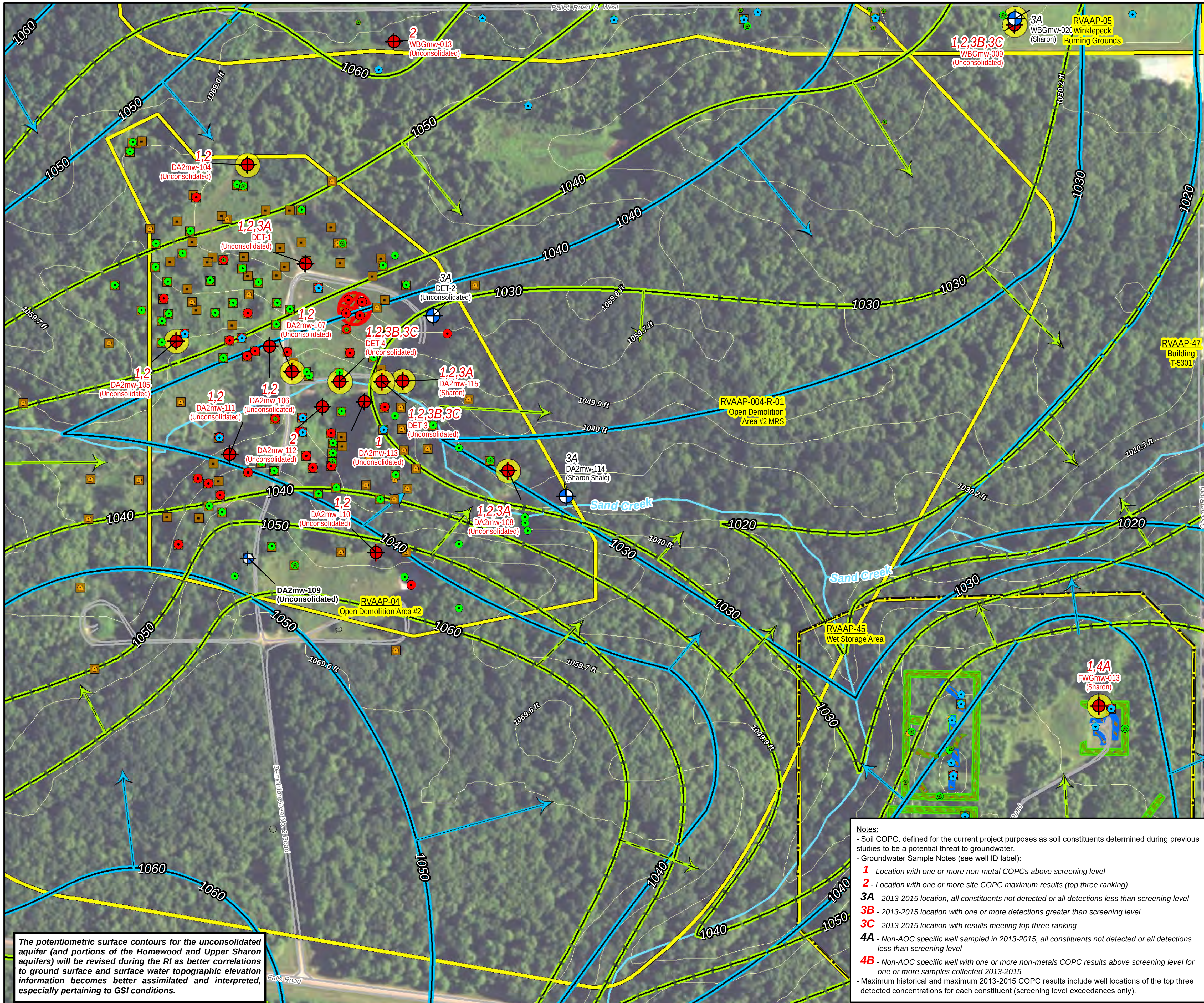
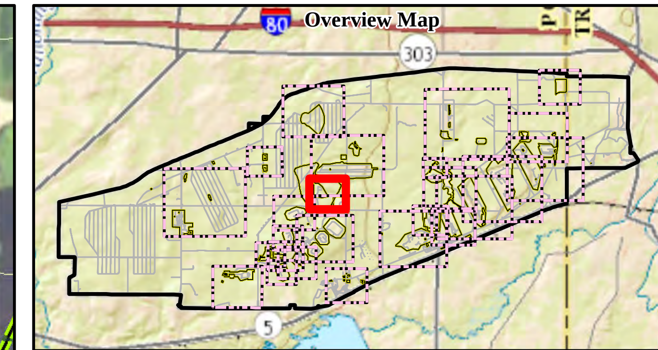


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  1 - *Location with one or more non-metal COPCs above screening level*
  2 - *Location with one or more site COPC maximum results (top three ranking)*
  3A - *2013-2015 location, all constituents not detected or all detections less than screening level*
  3B - *2013-2015 location with one or more detections greater than screening level*
  3C - *2013-2015 location with results meeting top three ranking*
  4A - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  4B - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 160 320 480 640 Feet
1 " = 315 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-04 WITH RVAAP-004-R-01, RVAAP-45, AND RVAAP-47 (OPEN DEMOLITION AREA #2)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-15

FINAL

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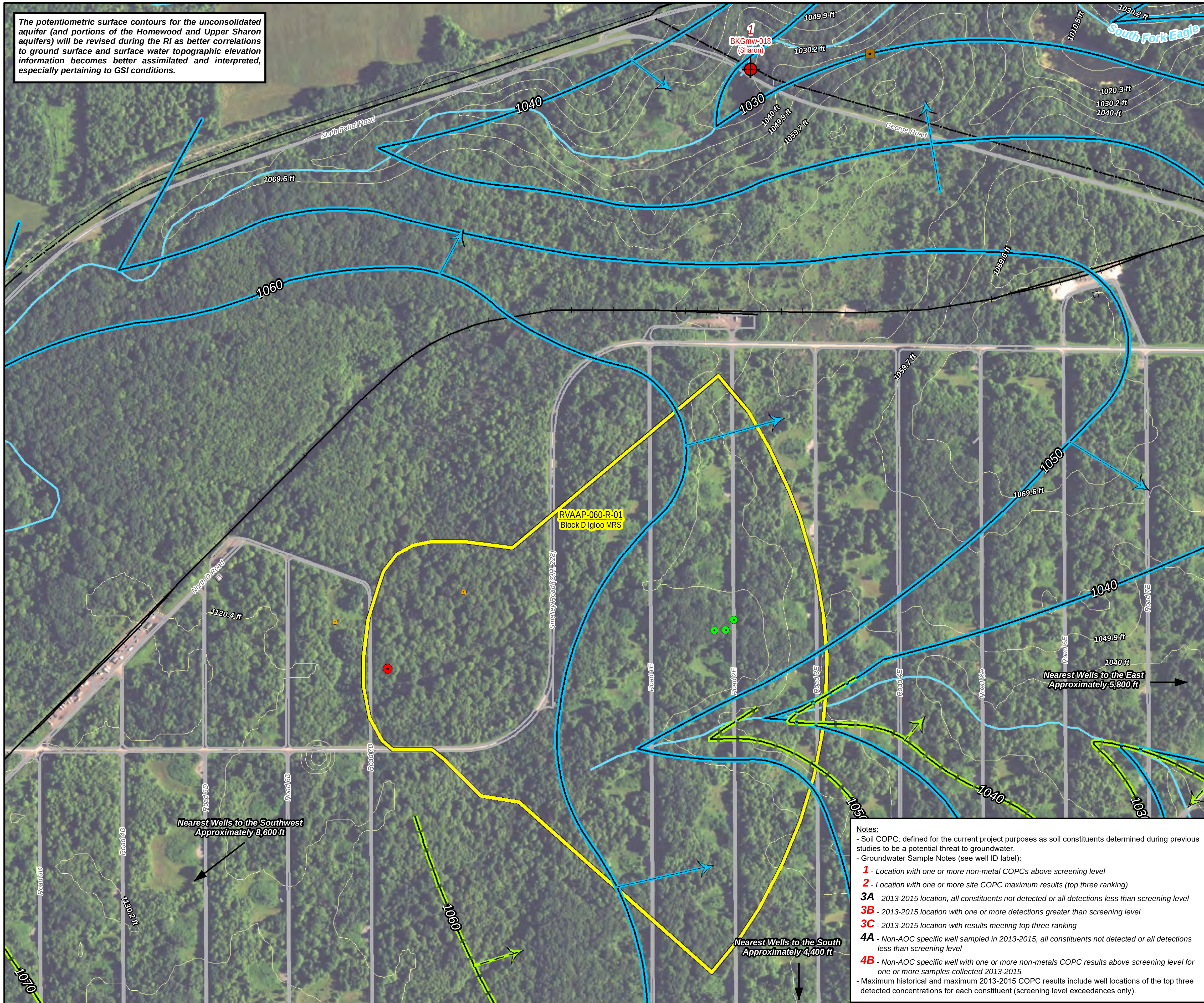
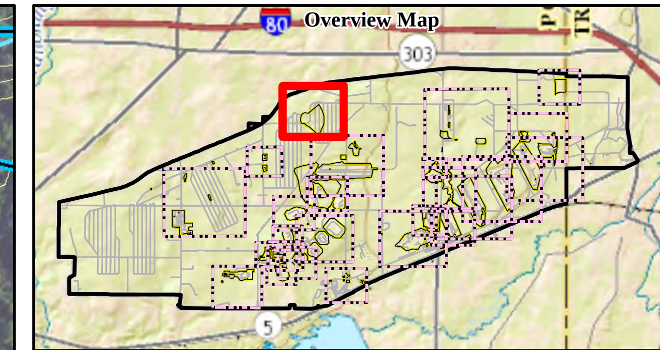


The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Groundwater Sample Locations of Concern

- *See notes on map*

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 260 520 780 1,040 Feet

1 " = 525 ft
NAD83 UTM Zone 17N

Cardno TEC | WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-060-R-01
(BLOCK D IGLOO MRS)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-16

FINAL

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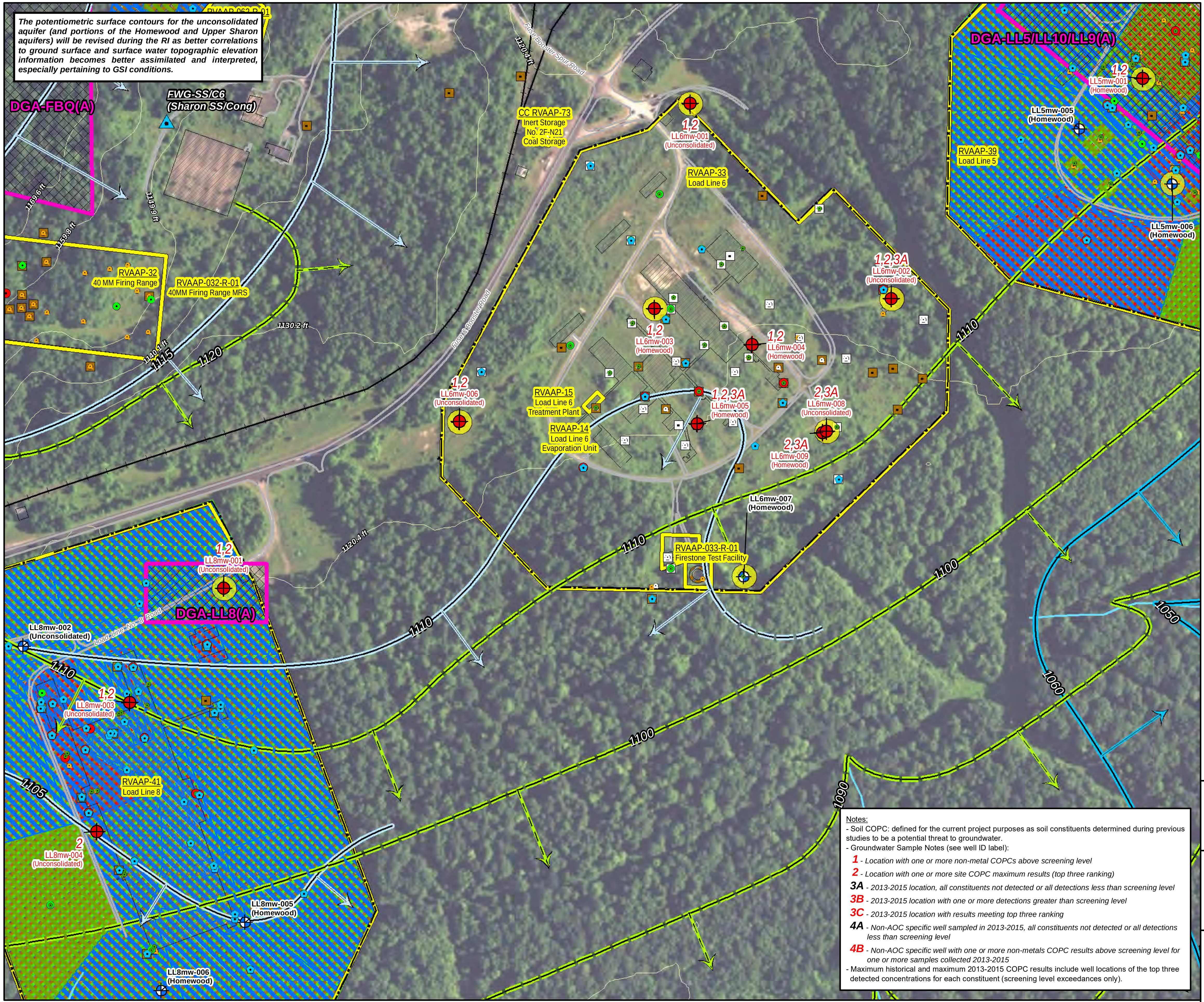

- Proposed Sharon Sandstone / Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

N

0 160 320 480 640 Feet

1 " = 325 ft

NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-33 WITH RVAAP-14, RVAAP-15, AND RVAAP-033-R-01 - (LOAD LINE 6 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-17

FINAL

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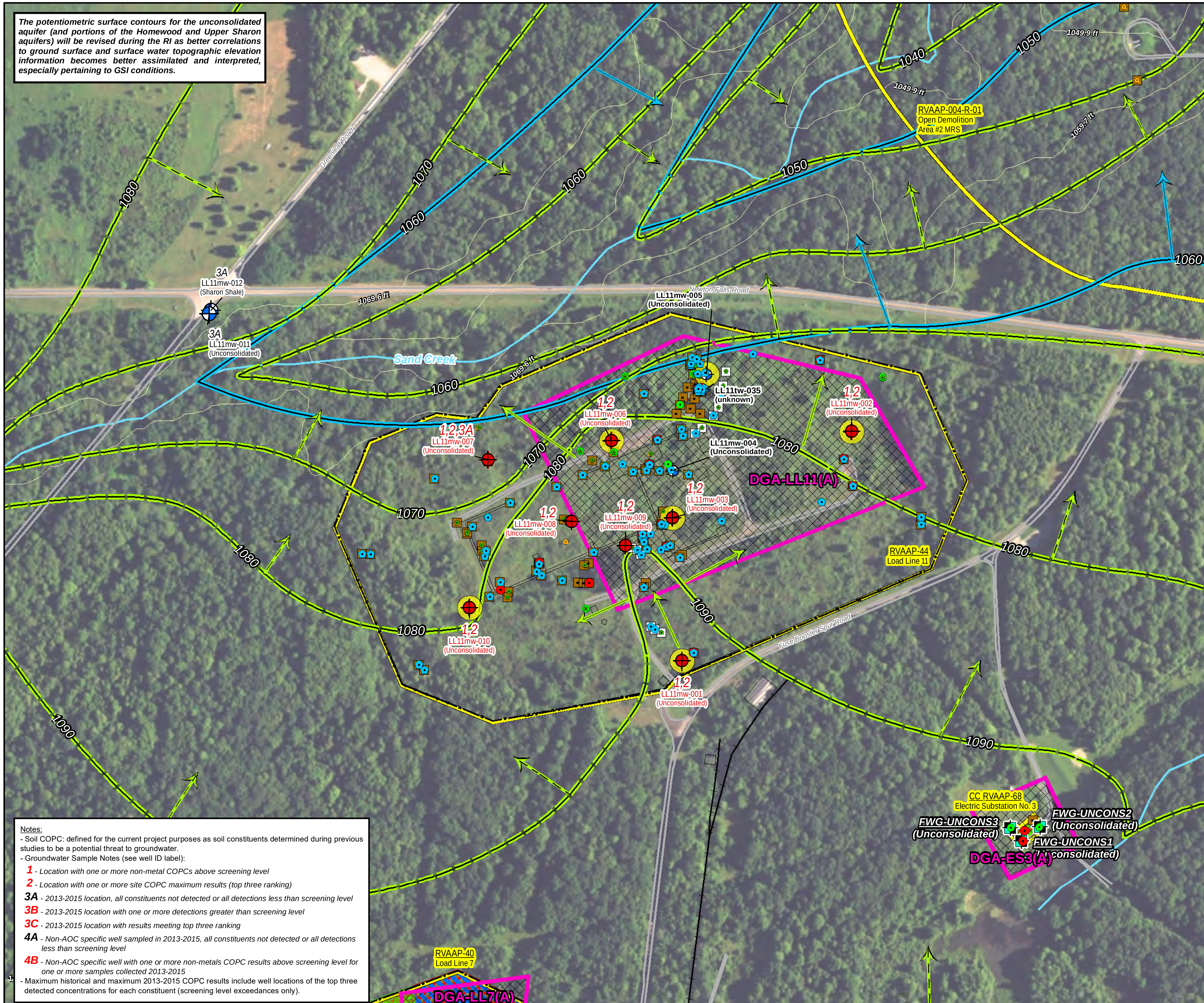
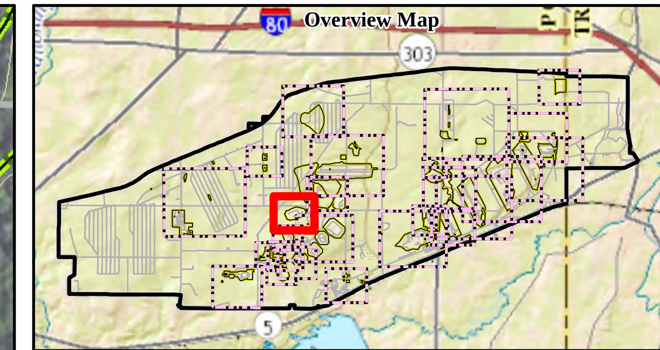
The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
1 - *Location with one or more non-metal COPCs above screening level*
2 - *Location with one or more site COPC maximum results (top three ranking)*
3A - *2013-2015 location, all constituents not detected or all detections less than screening level*
3B - *2013-2015 location with one or more detections greater than screening level*
3C - *2013-2015 location with results meeting top three ranking*
4A - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
4B - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Proposed Unconsolidated Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Temporary Well Location
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

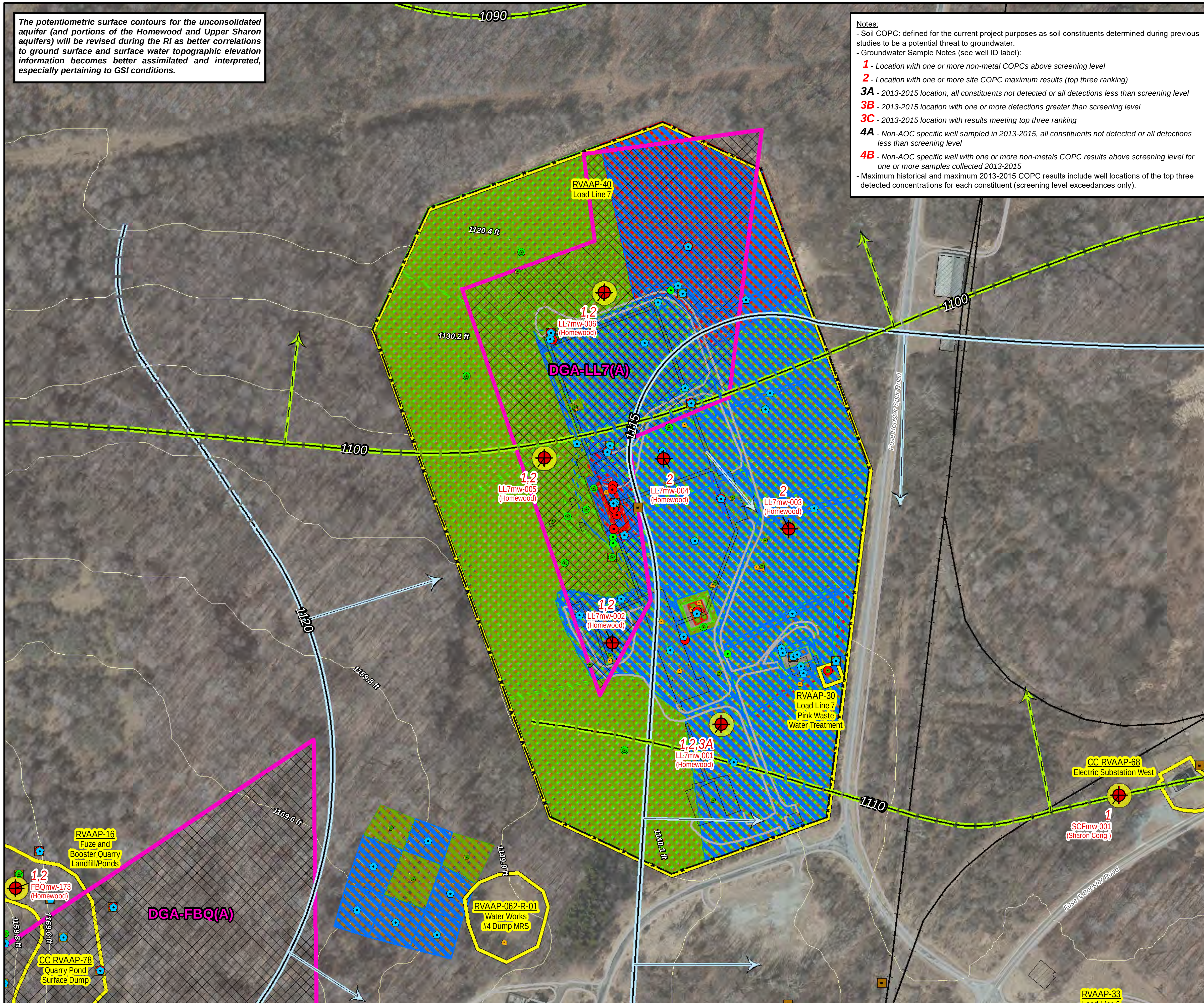
N
0 175 350 525 700 Feet
1 " = 350 ft
NAD83 UTM Zone 17N

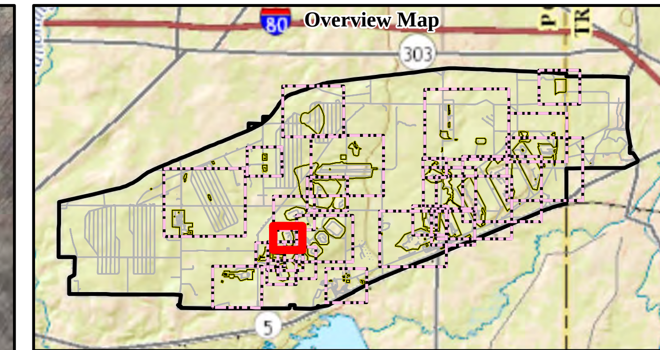
TEC-Weston Joint Venture

RVAAP-44
(LOAD LINE 11 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-18

FINAL





- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Elevation Contour Line (0.5m from USDA)

N

0 125 250 375 500 Feet

1 " = 250 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-40 WITH RVAAP-30 & RVAAP-062-R-01 (LOAD LINE 7 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-19

FINAL

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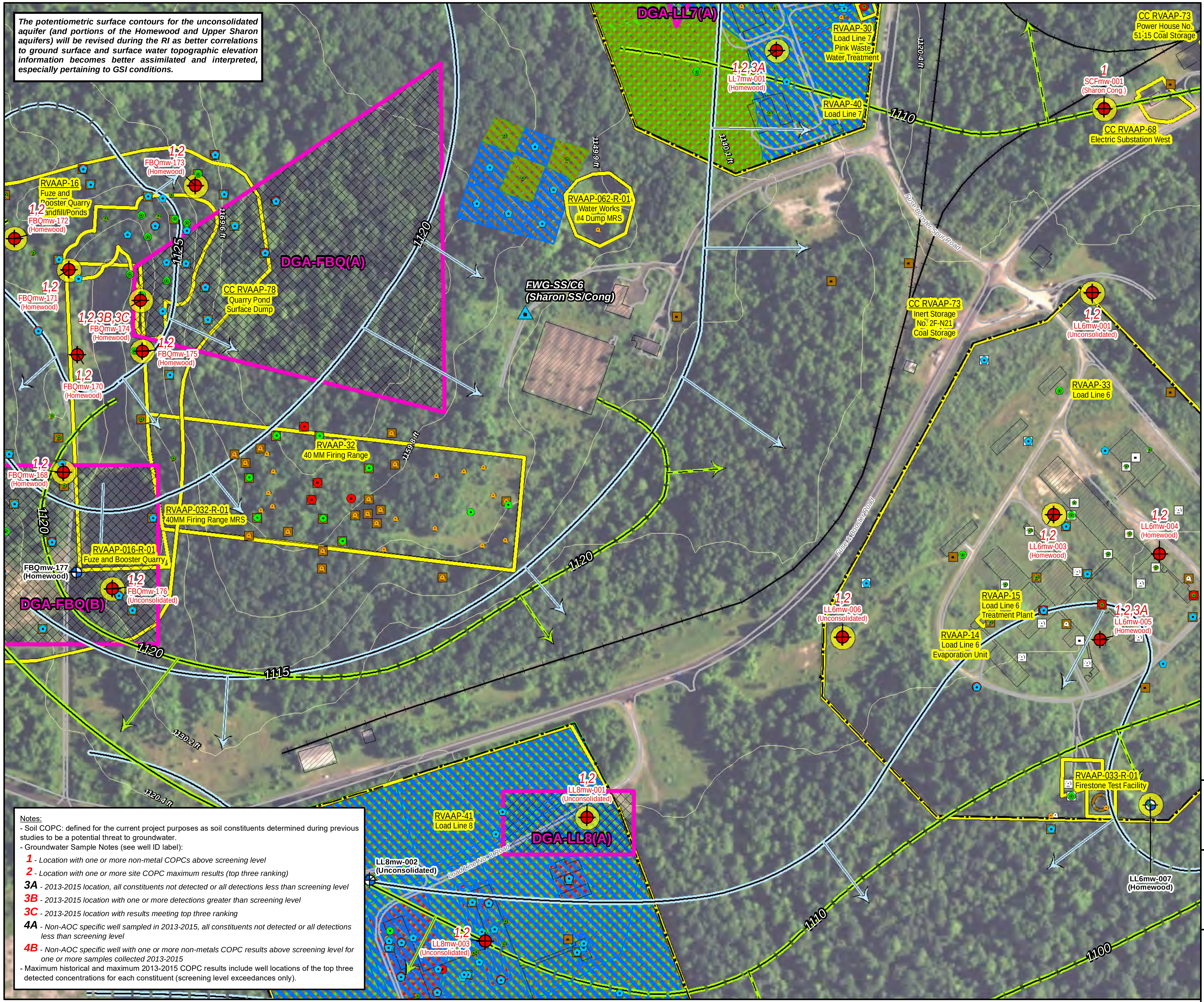
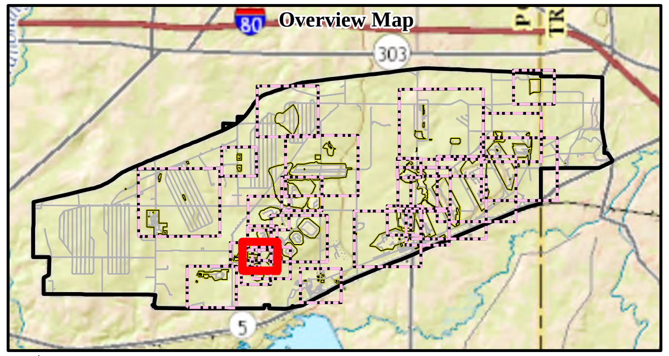


The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Proposed Sharon Sandstone / Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Elevation Contour Line (0.5m from USDA)

N

0 150 300 450 600 Feet

1 " = 300 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-32 AND RVAAP-062-R-01 (40MM FIRING RANGE AND WATER WORKS)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-20

FINAL

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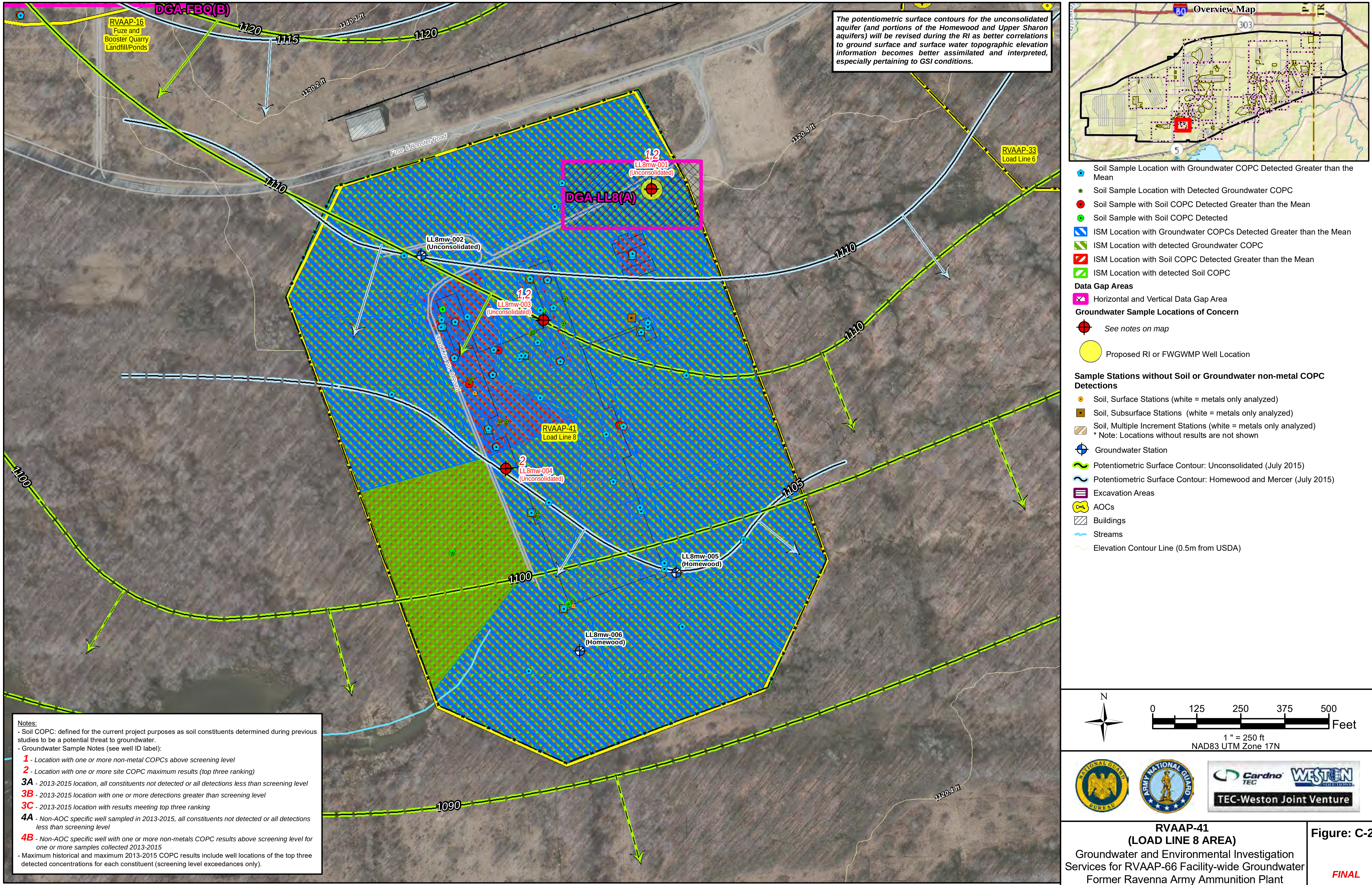

Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Homewood and Mercer (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

N

0 125 250 375 500 Feet

1 " = 250 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-41
(LOAD LINE 8 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-21

FINAL

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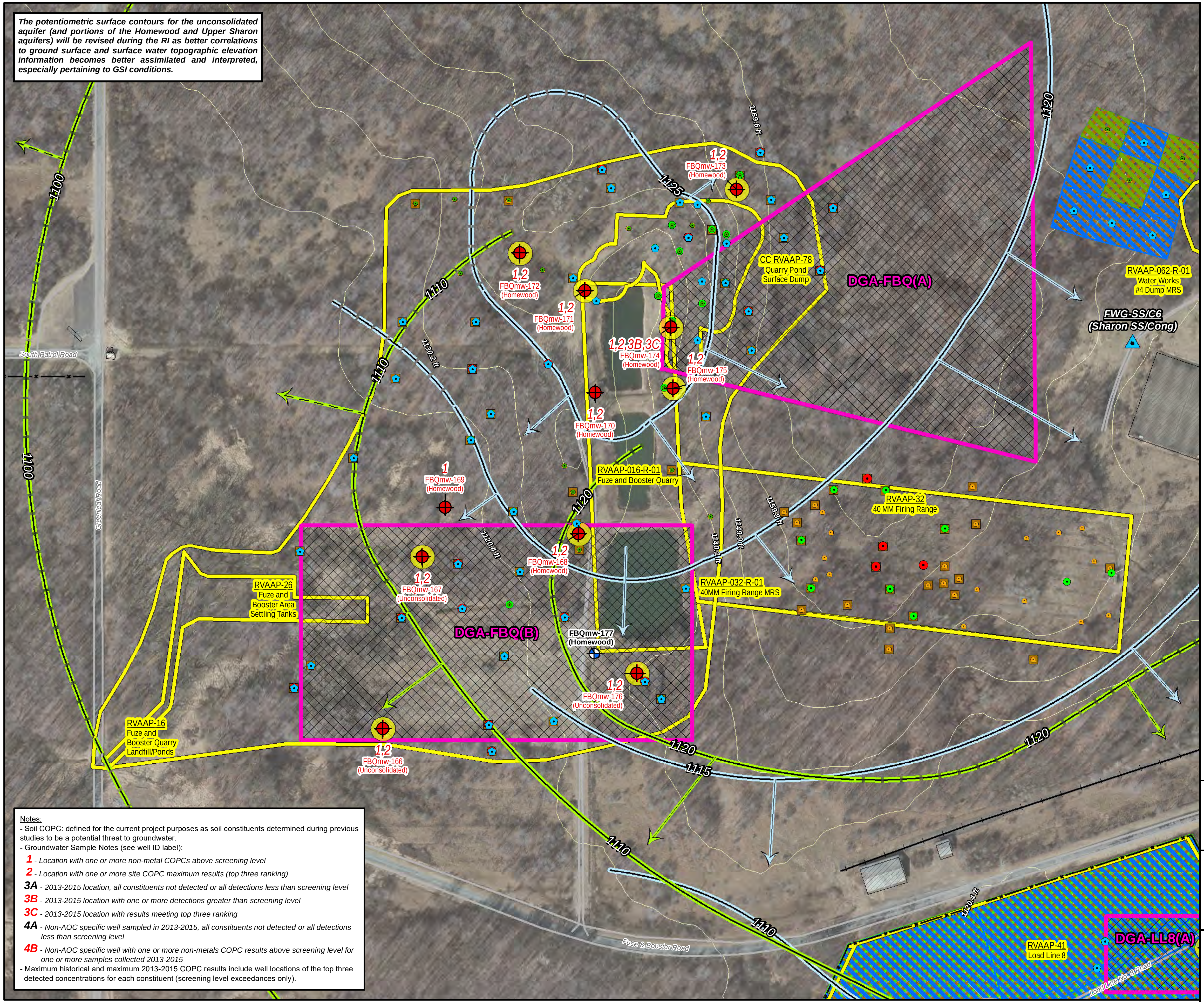

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
 1 - Location with one or more non-metal COPCs above screening level
 2 - Location with one or more site COPC maximum results (top three ranking)
 3A - 2013-2015 location, all constituents not detected or all detections less than screening level
 3B - 2013-2015 location with one or more detections greater than screening level
 3C - 2013-2015 location with results meeting top three ranking
 4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
 4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

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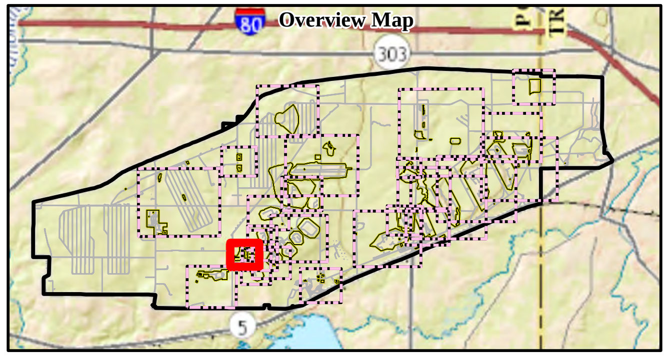


- Proposed Sharon Sandstone / Conglomerate Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
 * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Elevation Contour Line (0.5m from USDA)

N

0 125 250 375 500 Feet

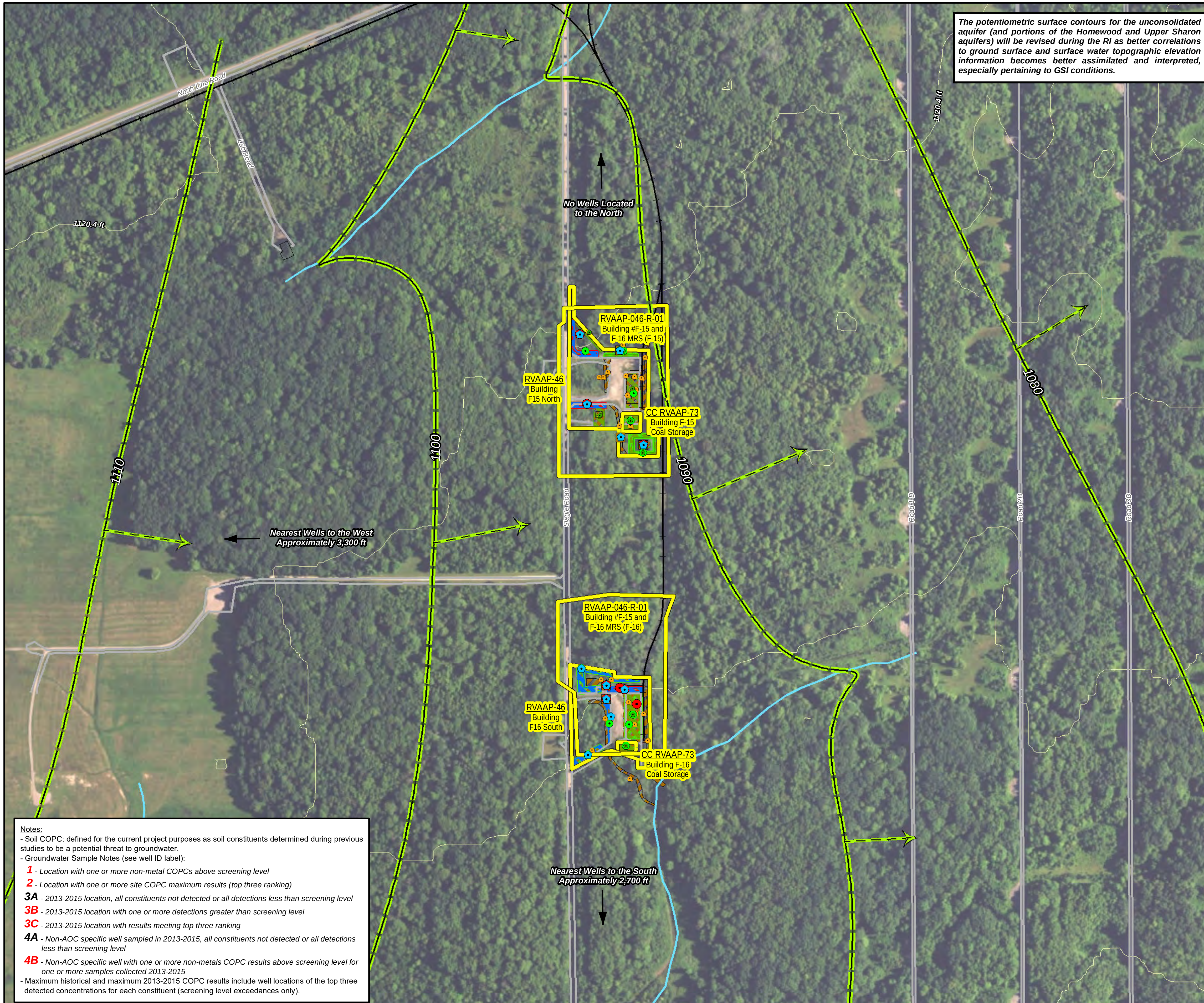
1 " = 250 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

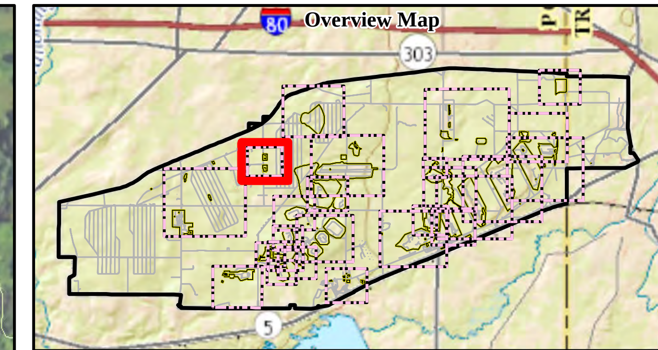
RVAAP-16 WITH RVAAP-26, RVAAP-32, AND CC-RVAAP-78 (FUZE & BOOSTER QUARRY)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-22

FINAL



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
1 - Location with one or more non-metal COPCs above screening level
2 - Location with one or more site COPC maximum results (top three ranking)
3A - 2013-2015 location, all constituents not detected or all detections less than screening level
3B - 2013-2015 location with one or more detections greater than screening level
3C - 2013-2015 location with results meeting top three ranking
4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed) * Note: Locations without results are not shown
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N
0 200 400 600 800 Feet
1 " = 400 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-46 WITH RVAAP-046-R-01 (BUILDINGS F15 AND F16 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-23

FINAL

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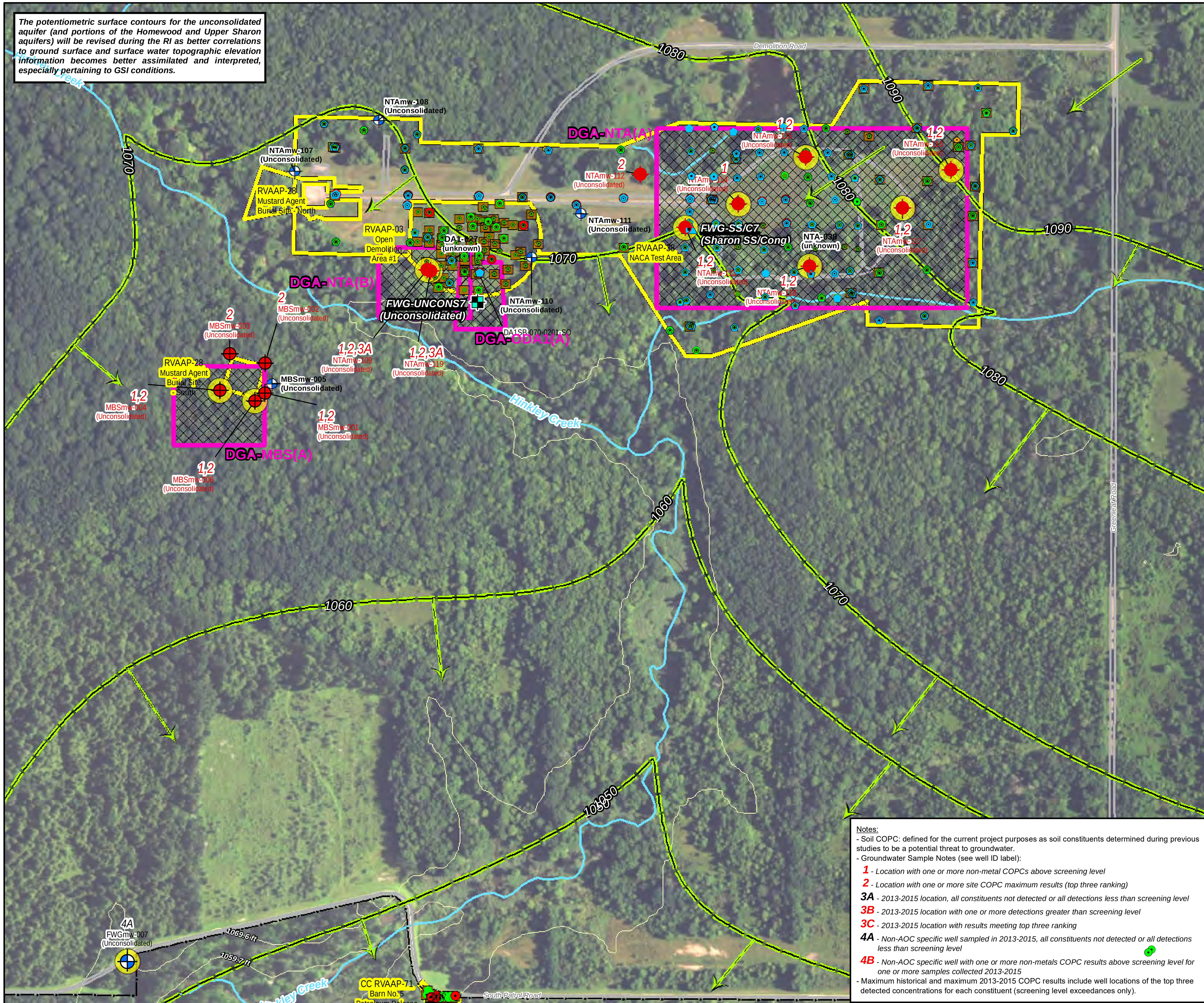

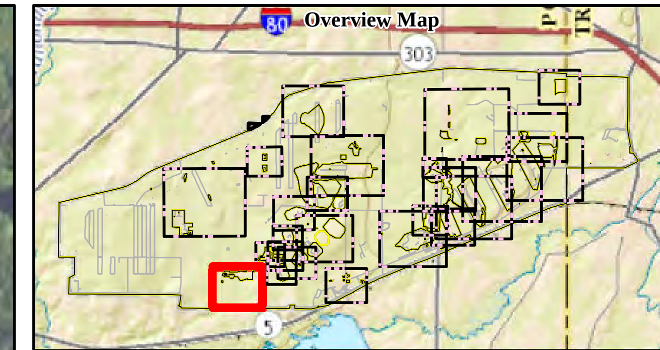

- Proposed Sharon Sandstone / Conglomerate Well Location
- Proposed Unconsolidated Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Data Gap Areas

- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Temporary Well Location
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 210 420 630 840 Feet

1 " = 425 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-28, RVAAP-38, RVAAP-03 AND CC RVAAP-71
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-24

FINAL

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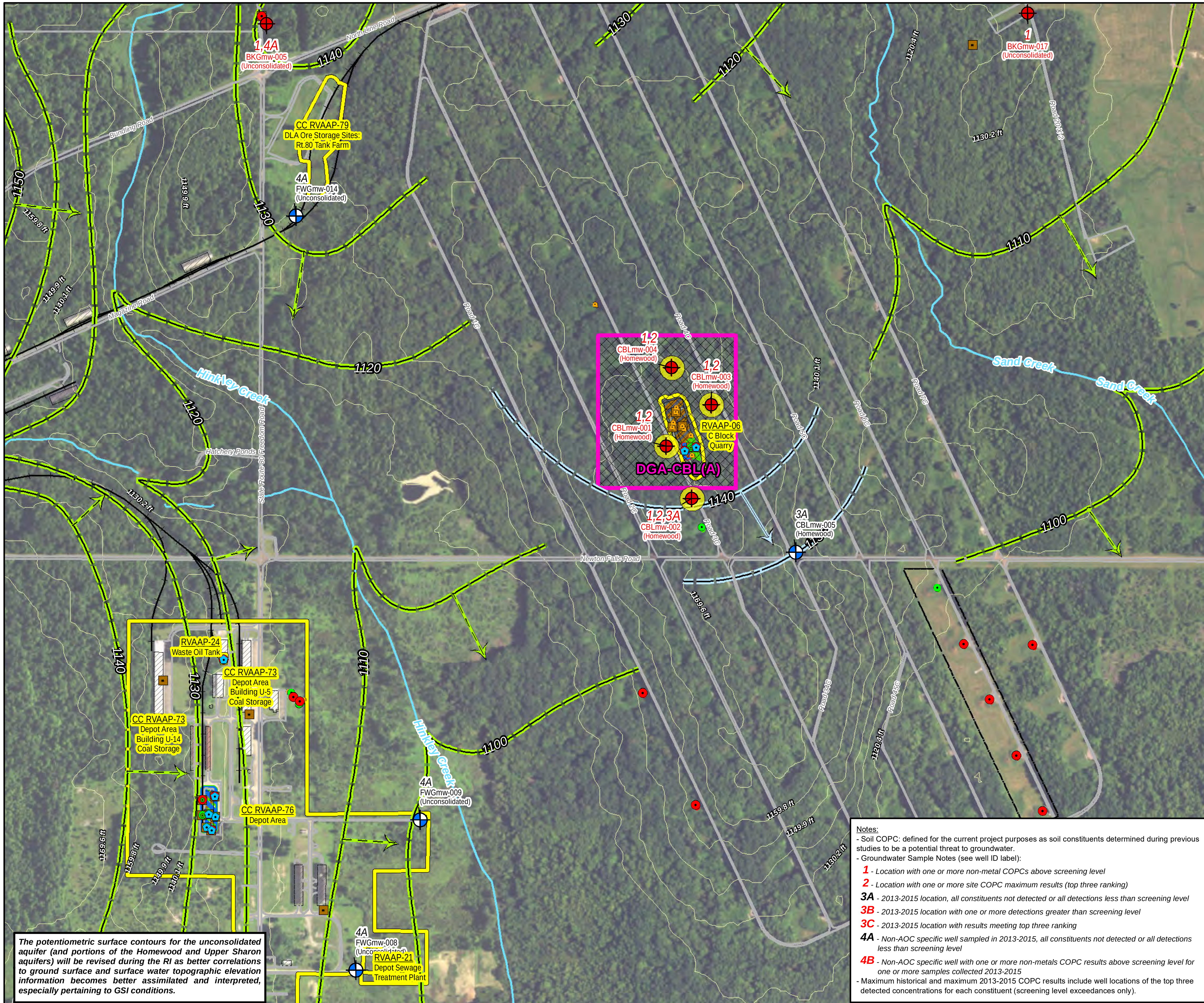
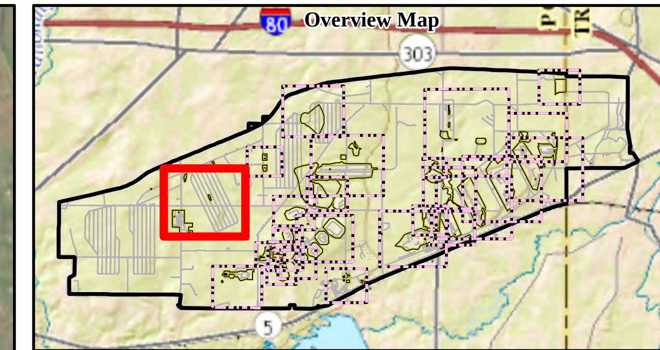


The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
1 - Location with one or more non-metal COPCs above screening level
2 - Location with one or more site COPC maximum results (top three ranking)
3A - 2013-2015 location, all constituents not detected or all detections less than screening level
3B - 2013-2015 location with one or more detections greater than screening level
3C - 2013-2015 location with results meeting top three ranking
4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Horizontal and Vertical Data Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N
0 350 700 1,050 1,400 Feet
1 " = 700 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-06 WITH RVAAP-24, CC RVAAP-76 & CC RVAAP-79 - (C BLOCK QUARRY AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-25

FINAL

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Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	2,4-Dinitrotoluene	Yes	178	8	0.00005	0.001	0.00024	4	1	0.000033	0.00035	7/22/2015	5/28/1999	9/20/2001	2/14/1999	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	2,6-Dinitrotoluene	Yes	178	4	0.00005	0.001	0.000048	178	4	0.000066	0.00027	7/22/2015	4/27/2009	7/22/2015	4/27/2009	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	2-Nitrotoluene	Yes	178	5	0.000099	0.001	0.00031	84	1	0.000089	0.00032	7/22/2015	4/6/2011	10/12/2011	4/6/2011	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	Nitrobenzene	Yes	178	12	0.00005	0.001	0.00014	60	7	0.000044	0.00062	7/22/2015	7/23/2012	7/23/2012	7/23/2012	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	Nitroglycerin	Yes	168	4	0.0005	0.017	0.0002	168	4	0.00067	0.0028	7/22/2015	8/19/2013	7/22/2015	8/19/2013	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Miscellaneous	Cyanide	Yes	168	9	0.005	0.01	0.00015	169	9	0.0034	0.01	7/22/2015	7/22/2015	7/22/2015	7/22/2015	
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**alpha-BHC**	**No**	**156**	**4**	**0.0000095**	**0.00024**	**0.0000071**	**156**	**4**	**0.0000083**	**0.000023**	**7/22/2015**	**10/14/2010**	**7/22/2015**	**10/14/2010**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**156**	**20**	**0.0000095**	**0.00024**	**0.000025**	**123**	**5**	**0.0000083**	**0.000075**	**7/22/2015**	**7/24/2014**	**7/22/2015**	**7/23/2012**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**156**	**1**	**0.0000095**	**0.00024**	**0.0000014**	**156**	**1**	**0.0000088**	**0.0000088**	**7/22/2015**	**10/9/2008**	**7/22/2015**	**10/9/2008**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Pest/PCBs	PCB-1248	Yes	157	4	0.00019	0.002	0.0000078	157	4	0.0001	0.00026	7/22/2015	10/9/2008	7/22/2015	10/9/2008	
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**Toxaphene**	**No**	**156**	**1**	**0.00048**	**0.01**	**0.000015**	**156**	**1**	**0.00064**	**0.00064**	**7/22/2015**	**10/9/2007**	**7/22/2015**	**10/9/2007**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	178	67	0.00048	0.013	0.0056	97	8	0.00022	0.084	7/22/2015	8/19/2013	10/12/2011	4/27/2009	Potential lab contaminant
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Dibenz(a,h)anthracene	Yes	178	1	0.000095	0.013	0.0000034	178	1	0.00014	0.00014	7/22/2015	10/12/2011	7/22/2015	10/12/2011	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	178	1	0.000095	0.013	0.000034	178	1	0.00014	0.00014	7/22/2015	10/12/2011	7/22/2015	10/12/2011	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Naphthalene	Yes	178	1	0.000095	0.013	0.00017	145	1	0.00024	0.00024	7/22/2015	10/14/2010	10/12/2011	10/14/2010	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	VOCs	1,1,2,2-Tetrachloroethane	Yes	178	1	0.00025	0.005	0.000076	178	1	0.00084	0.00084	7/22/2015	7/27/1998	7/22/2015	7/27/1998	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	VOCs	Benzene	Yes	178	1	0.00025	0.005	0.00045	153	1	0.00052	0.00052	7/22/2015	7/25/1998	7/22/2015	7/25/1998	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-0
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date	Most Recent Result (mg/L)
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Explosives	Nitrobenzene	10	1	0.0002	0.00014	7	1	0.0003	10/19/98	< 0.0001 U	08/19/13	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Explosives	Nitroglycerin	10	2	0.0025	0.0002	10	2	0.0028	07/25/98	< 0.00051 U	08/19/13	0.00051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Pesticides and PCBs	beta-BHC	7	2	0.00005	0.000025	6	1	0.000063	10/11/11	0.000013 JB	08/19/13	0.000013
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Volatile Organics	Benzene	10	1	0.005	0.00045	9	1	0.00052	07/25/98	< 0.00025 U	08/19/13	0.00025
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Explosives	2,6-Dinitrotoluene	30	1	0.001	0.000048	30	1	0.00008	04/27/09	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Explosives	Nitrobenzene	30	2	0.001	0.00014	8	1	0.00062	10/20/98	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Miscellaneous	Cyanide	29	8	0.01	0.00015	30	8	0.01	07/22/15	0.01 J	07/22/15	0.01
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Miscellaneous	Total Phosphorus as P	2	1	0.1	0.00004	2	1	0.1	09/20/01	< 0.1 U	09/20/01	0.1
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Semi-Volatile Organics	Dibenz(a,h)anthracene	30	1	0.01	0.0000034	30	1	0.00014	10/12/11	< 0.000098 U	07/22/15	0.000098
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	30	1	0.01	0.000034	30	1	0.00014	10/12/11	< 0.000098 U	07/22/15	0.000098
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	2,4-Dinitrotoluene	27	4	0.00029	0.00024	2	1	0.00035	02/14/99	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	2,6-Dinitrotoluene	27	1	0.00013	0.000048	27	1	0.00027	04/16/07	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	Nitrobenzene	27	4	0.00073	0.00014	6	3	0.00058	10/20/98	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	Nitroglycerin	24	2	0.0025	0.0002	24	2	0.002	07/22/98	< 0.00052 U	07/22/15	0.00052
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Pesticides and PCBs	alpha-BHC	24	3	0.00015	0.0000071	24	3	0.000023	10/14/09	< 0.000051 UJ	07/22/15	0.000051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Pesticides and PCBs	beta-BHC	24	7	0.00015	0.000025	17	3	0.000075	07/23/12	< 0.000051 UJ	07/22/15	0.000051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Pesticides and PCBs	Toxaphene	24	1	0.01	0.000015	24	1	0.00064	10/09/07	< 0.002 UJ	07/22/15	0.002
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	27	8	0.01	0.0056	14	1	0.0075	04/27/09	< 0.0053 U	07/22/15	0.0053
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Explosives	2,6-Dinitrotoluene	36	1	0.00013	0.000048	36	1	0.000071	04/10/08	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Explosives	Nitrobenzene	36	2	0.0002	0.00014	7	2	0.00041	10/20/98	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Pesticides and PCBs	beta-BHC	32	4	0.00005	0.000025	21	1	0.00005	07/24/14	< 0.000048 UJ	07/22/15	0.000048
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Pesticides and PCBs	Heptachlor	32	1	0.00005	0.0000014	32	1	0.0000088	10/09/08	< 0.000048 UJ	07/22/15	0.000048
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	36	12	0.011	0.0056	15	1	0.047	04/27/09	< 0.0048 U	07/22/15	0.0048
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	3	0.01	0.0056	6	1	0.011	05/27/99	0.00063	08/19/13	0.00063
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Inorganics	Beryllium	20	6	0.005	0.0025	1	1	0.014	02/13/99	< 0.001 U	08/19/13	0.001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	4	0.01	0.0056	9	2	0.084	05/27/99	0.00022 B	08/19/13	0.00022
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Semi-Volatile Organics	Naphthalene	11	1	0.013	0.00017	10	1	0.00024	10/14/10	< 0.000095 U	08/19/13	0.000095
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Volatile Organics	1,1,2,2-Tetrachloroethane	11	1	0.005	0.000076	11	1	0.00084	07/27/98	< 0.00025 U	08/19/13	0.00025
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	Pesticides and PCBs	PCB-1248	13	1	0.002	0.0000078	13	1	0.00014	10/09/08	< 0.0005 UJ	10/11/11	0.0005
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	13	6	0.013	0.0056	8	1	0.022	05/20/04	0.001 JB	10/11/11	0.001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-013	Pesticides and PCBs	alpha-BHC	8	1	0.00006	0.0000071	8	1	0.0000083	01/19/09	0.0000083 J	01/19/09	0.0000083
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-014	Explosives	2-Nitrotoluene	9	1	0.00056	0.00031	7	1	0.00032	04/06/11	< 0.00052 U	10/11/11	0.00052
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-014	Pesticides and PCBs	PCB-1248	9	1	0.0015	0.0000078	9	1	0.0001	10/09/08	< 0.00051 UJ	10/11/11	0.00051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-015	Pesticides and PCBs	PCB-1248	8	1	0.0015	0.0000078	8	1	0.00016	10/09/08	< 0.00052 U	10/12/11	0.00052
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Explosives	2,6-Dinitrotoluene	9	1	0.00016	0.000048	9	1	0.000066	10/09/08	< 0.0001 U	10/11/11	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Miscellaneous	Cyanide	8	1	0.01	0.00015	8	1	0.0067	10/09/08	< 0.01 U	04/06/11	0.01
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.013	0.0056	5	1	0.015	05/21/04	0.0012 JB	10/11/11	0.0012
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-017	Inorganics	Beryllium	9	5	0.001	0.0025	1	1	0.0027	05/19/04	< 0.001 U	10/11/11	0.001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-017	Pesticides and PCBs	PCB-1248	9	1	0.0015	0.0000078	9	1	0.00026	10/09/08	< 0.00054 U	10/11/11	0.00054
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-017	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	4	0.013	0.0056	6	1	0.0095	05/19/04	< 0.0099 U	10/11/11	0.0099

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-011**	**1,1,2,2-Tetrachloroethane**	**7.60E-05**	**0.00084**	**07/27/98**	**11.1**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-008**	**2,4-Dinitrotoluene**	**0.00024**	**0.00035**	**02/14/99**	**1.5**	**=**	**1**	**mg/L**	**8**	**339**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	2,4-Dinitrotoluene	0.00024	0.00022	02/13/99	0.9	=	2	mg/L	8	339	1	No	Well has had 4 consecutive ND results since last detection.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	2,4-Dinitrotoluene	0.00024	0.00016	02/14/99	0.7	=	3	mg/L	8	339	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-008**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00027**	**04/16/07**	**5.6**		**1**	**mg/L**	**5**	**339**	**5**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	MW-4	2,6-Dinitrotoluene	4.80E-05	8.50E-05	07/13/98	1.8	J	2	mg/L	5	339	5	No	Well has been abandoned.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	2,6-Dinitrotoluene	4.80E-05	8.00E-05	04/27/09	1.7	J	3	mg/L	5	339	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-014**	**2-Nitrotoluene**	**0.00031**	**0.00032**	**04/06/11**	**1.0**	**J**	**1**	**mg/L**	**5**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	2-Nitrotoluene	0.00031	0.00016	09/19/98	0.5	J	2	mg/L	5	184	1	Yes	To be sampled under the FWGWMP.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	2-Nitrotoluene	0.00031	0.00011	04/16/07	0.4	J	3	mg/L	5	184	1	No	Well has had 16 consecutive ND results since last detection.
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-011**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.084**	**05/27/99**	**15.0**	**=**	**1**	**mg/L**	**67**	**184**	**7**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Bis(2-ethylhexyl)phthalate	0.0056	0.047	04/27/09	8.4		2	mg/L	67	184	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	Bis(2-ethylhexyl)phthalate	0.0056	0.022	05/20/04	3.9	=	3	mg/L	67	184	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-006**	**Benzene**	**0.00045**	**0.00052**	**07/25/98**	**1.2**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**No**	**Well has had 9 consecutive ND results since last detection.**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Cyanide**	**0.00015**	**0.01**	**07/22/15**	**66.7**	**J**	**1**	**mg/L**	**10**	**175**	**9**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Cyanide	0.00015	0.0067	10/09/08	44.7	J	2	mg/L	10	175	9	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00014**	**10/12/11**	**41.2**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00014**	**10/12/11**	**4.1**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-011**	**Naphthalene**	**0.00017**	**0.00024**	**10/14/10**	**1.4**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Nitrobenzene**	**0.00014**	**0.00062**	**10/20/98**	**4.4**	**J**	**1**	**mg/L**	**12**	**339**	**7**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Nitrobenzene	0.00014	0.00058	10/20/98	4.1	J	2	mg/L	12	339	7	Yes	To be sampled under the FWGWMP.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Nitrobenzene	0.00014	0.00041	10/20/98	2.9	J	3	mg/L	12	339	7	No	Well has had 23 consecutive ND results since last detection.
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-006**	**Nitroglycerin**	**0.0002**	**0.0028**	**07/25/98**	**14.0**	**J**	**1**	**mg/L**	**4**	**174**	**4**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Nitroglycerin	0.0002	0.002	07/22/98	10.0	J	2	mg/L	4	174	4	Yes	To be sampled under the FWGWMP.
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-017**	**PCB-1248**	**0.0000078**	**0.00026**	**10/09/08**	**33.3**	**J**	**1**	**mg/L**	**4**	**157**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-015	PCB-1248	0.0000078	0.00016	10/09/08	20.5	J	2	mg/L	4	157	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	PCB-1248	0.0000078	0.00014	10/09/08	17.9	J	3	mg/L	4	157	4	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Cyanide	0.00015	0.01	07/22/15	66.7	J	1	mg/L	5	24	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Nitroglycerin	0.0002	0.00067	08/19/13	3.4		1	mg/L	1	25	1	Yes	To be sampled under the FWGWMP.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-02 Erie Burning Grounds	Unconsolidated	Explosives	Nitrobenzene	Yes	49	7	0.000094	0.00016	0.00014	9	1	0.000057	0.00015	1/20/2011	1/22/2009	12/1/2003	11/20/2003	
RVAAP-02 Erie Burning Grounds	Unconsolidated	Miscellaneous	Cyanide	Yes	49	1	0.01	0.01	0.00015	49	1	0.0051	0.0051	1/20/2011	4/16/2008	1/20/2011	4/16/2008	
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**49**	**4**	**0.00003**	**0.00008**	**0.000025**	**46**	**1**	**0.000018**	**0.000026**	**1/20/2011**	**1/20/2009**	**1/20/2011**	**4/15/2008**	**Pesticide from historical agricultural use**
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**52**	**28**	**0.00076**	**0.013**	**0.0056**	**24**	**1**	**0.00081**	**0.013**	**1/21/2013**	**1/21/2013**	**1/20/2011**	**10/13/2008**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-0
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-123	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.013	0.0056	4	1	0.013	11/25/03	< 0.01 U	01/20/11
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-125	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0051	04/16/08	< 0.01 U	01/20/09
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-126	Explosives	Nitrobenzene	7	2	0.00016	0.00014	2	1	0.00015	11/20/03	< 0.000096 U	01/20/11
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-127	Pesticides and PCBs	beta-BHC	9	3	0.00005	0.000025	7	1	0.000026	04/15/08	0.000025 JB	01/20/09

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**EBGmw-125**	**Cyanide**	**0.00015**	**0.0051**	**04/16/08**	**34.0**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**EBGmw-126**	**Nitrobenzene**	**0.00014**	**0.00015**	**11/20/03**	**1.1**	**J**	**1**	**mg/L**	**7**	**99**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-123	Nitrobenzene	0.00014	9.00E-05	04/16/08	0.6	J	2	mg/L	7	99	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-128	Nitrobenzene	0.00014	7.00E-05	10/13/08	0.5	J	3	mg/L	7	99	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-04 Open Demolition Area #2	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**16**	**5**	**0.00048**	**0.0053**	**0.0056**	**1**	**1**	**0.00056**	**0.0092**	**7/23/2015**	**8/20/2013**	**7/26/2012**	**7/26/2012**	**Lab contaminant**
RVAAP-04 Open Demolition Area #2	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	126	10	0.00005	0.00015	0.000048	126	10	0.00005	0.000082	7/23/2015	10/14/2011	7/23/2015	10/14/2011	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Explosives	Nitroglycerin	Yes	112	1	0.0005	0.00099	0.0002	112	1	0.00034	0.00034	7/23/2015	10/14/2011	7/23/2015	10/14/2011	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Explosives	RDX	Yes	126	21	0.00005	0.00015	0.0007	12	12	0.00016	0.0061	7/23/2015	7/23/2015	7/23/2015	7/23/2015	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Miscellaneous	Cyanide	Yes	117	2	0.005	0.01	0.00015	117	2	0.0025	0.009	7/23/2015	4/17/2007	7/23/2015	4/17/2007	
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**115**	**1**	**0.0000095**	**0.000053**	**0.0000071**	**110**	**1**	**0.000011**	**0.000011**	**7/23/2015**	**10/13/2008**	**7/23/2015**	**10/13/2008**	**Pesticide from historical agricultural use**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**115**	**10**	**0.0000095**	**0.000053**	**0.000025**	**89**	**1**	**0.0000094**	**0.000028**	**7/23/2015**	**8/20/2013**	**7/23/2015**	**10/14/2008**	**Pesticide from historical agricultural use**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**115**	**1**	**0.0000095**	**0.000053**	**0.0000014**	**115**	**1**	**0.0000081**	**0.0000081**	**7/23/2015**	**1/26/2009**	**7/23/2015**	**1/26/2009**	**Pesticide from historical agricultural use**
RVAAP-04 Open Demolition Area #2	Unconsolidated	Pest/PCBs	PCB-1242	Yes	124	1	0.00038	0.001	0.0000078	124	1	0.00057	0.00057	7/23/2015	4/11/2008	7/23/2015	4/11/2008	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Pest/PCBs	PCB-1254	Yes	124	1	0.00019	0.001	0.0000078	124	1	0.00016	0.00016	7/23/2015	7/13/2006	7/23/2015	7/13/2006	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	2,6-Dinitrotoluene	Yes	102	1	0.00076	0.0054	0.000048	102	1	0.0046	0.0046	2/1/2012	4/17/2007	2/1/2012	4/17/2007	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Benz(a)anthracene	Yes	116	1	0.000095	0.0002	0.000012	116	1	0.00015	0.00015	7/23/2015	8/20/2013	7/23/2015	8/20/2013	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Benzo(a)pyrene	Yes	116	1	0.000095	0.0002	0.0000034	116	1	0.00012	0.00012	7/23/2015	8/20/2013	7/23/2015	8/20/2013	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Benzo(b)fluoranthene	Yes	116	1	0.000095	0.0002	0.000034	116	1	0.00012	0.00012	7/23/2015	8/20/2013	7/23/2015	8/20/2013	
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**125**	**49**	**0.00048**	**0.011**	**0.0056**	**59**	**2**	**0.00035**	**0.018**	**7/23/2015**	**8/20/2013**	**10/14/2011**	**10/13/2008**	**Lab contaminant**
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Naphthalene	Yes	116	1	0.000095	0.0002	0.00017	98	1	0.00028	0.00028	7/23/2015	10/15/2010	10/11/2011	10/15/2010	

Notes

Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-04 Open Demolition Area #2	Sharon	DA2mw-115	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	16	5	0.0053	0.0056	1	1	0.0092	07/26/12	< 0.0052 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-104	Explosives	2,6-Dinitrotoluene	6	2	0.00011	0.000048	6	2	0.000082	10/14/11	0.000082 J	10/14/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-104	Pesticides and PCBs	PCB-1242	6	1	0.0005	0.0000078	6	1	0.00057	04/11/08	< 0.00048 UJ	10/14/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-105	Explosives	2,6-Dinitrotoluene	5	3	0.00011	0.000048	5	3	0.000074	10/13/08	0.00006 J	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-106	Pesticides and PCBs	Heptachlor	6	1	0.00003	0.0000014	6	1	0.0000081	01/26/09	< 0.00003 UJ	01/21/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-107	Miscellaneous	Cyanide	14	1	0.01	0.00015	14	1	0.0025	03/09/06	< 0.01 UJ	01/21/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-107	Pesticides and PCBs	PCB-1254	15	1	0.001	0.0000078	15	1	0.00016	07/13/06	< 0.00048 UJ	10/12/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-108	Explosives	2,6-Dinitrotoluene	10	2	0.0001	0.000048	10	2	0.000065	10/13/08	< 0.0001 U	01/24/13
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-108	Explosives	Nitroglycerin	10	1	0.00066	0.0002	10	1	0.00034	10/14/11	< 0.0005 U	01/24/13
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-108	Pesticides and PCBs	alpha-BHC	5	1	0.00003	0.0000071	5	1	0.000011	10/13/08	< 0.00003 UJ	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-110	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.01	0.0056	4	1	0.018	10/13/08	< 0.01 U	01/21/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-111	Explosives	2,6-Dinitrotoluene	6	1	0.00011	0.000048	6	1	0.00005	01/26/09	0.00005 J	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-113	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000068	04/11/08	0.000054 J	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-1	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	2	0.00051	0.0056	4	1	0.008	05/17/01	0.0034 B	08/20/13
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Miscellaneous	Cyanide	22	1	0.01	0.00015	22	1	0.009	04/17/07	< 0.01 UJ	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	2,6-Dinitrotoluene	14	1	0.005	0.000048	14	1	0.0046	04/17/07	< 0.00076 U	02/01/12
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Benz(a)anthracene	22	1	0.0002	0.000012	22	1	0.00015	08/20/13	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Benzo(a)pyrene	22	1	0.0002	0.0000034	22	1	0.00012	08/20/13	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Benzo(b)fluoranthene	22	1	0.0002	0.000034	22	1	0.00012	08/20/13	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Naphthalene	22	1	0.0002	0.00017	14	1	0.00028	10/15/10	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-4	Explosives	RDX	22	18	0.00015	0.0007	12	12	0.0061	01/23/13	0.0025	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-4	Pesticides and PCBs	beta-BHC	21	2	0.000053	0.000025	13	1	0.000028	10/14/08	< 0.000051 U	07/23/15

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0046**	**04/17/07**	**95.8**	**J**	**1**	**mg/L**	**11**	**228**	**11**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-104	2,6-Dinitrotoluene	4.80E-05	8.20E-05	10/14/11	1.7	J	2	mg/L	11	228	11	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-105	2,6-Dinitrotoluene	4.80E-05	7.40E-05	10/13/08	1.5	J	3	mg/L	11	228	11	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Benz(a)anthracene**	**1.20E-05**	**0.00015**	**08/20/13**	**12.5**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Benzo(a)pyrene**	**3.40E-06**	**0.00012**	**08/20/13**	**35.3**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.00012**	**08/20/13**	**3.5**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Cyanide**	**0.00015**	**0.009**	**04/17/07**	**60.0**	**JB**	**1**	**mg/L**	**2**	**117**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-107	Cyanide	0.00015	0.0025	03/09/06	16.7	J	2	mg/L	2	117	1	Yes	**8 consecutive ND results since last detection.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Naphthalene**	**0.00017**	**0.00028**	**10/15/10**	**1.6**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DA2mw-108**	**Nitroglycerin**	**0.0002**	**0.00034**	**10/14/11**	**1.7**	**J**	**1**	**mg/L**	**1**	**112**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DA2mw-104**	**PCB-1242**	**0.0000078**	**0.00057**	**04/11/08**	**73.1**	**J**	**1**	**mg/L**	**1**	**124**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DA2mw-107**	**PCB-1254**	**0.0000078**	**0.00016**	**07/13/06**	**20.5**	**J**	**1**	**mg/L**	**1**	**124**	**1**	**Yes**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-4**	**RDX**	**0.0007**	**0.0061**	**01/23/13**	**8.7**		**1**	**mg/L**	**21**	**126**	**12**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-111	RDX	0.0007	0.00048	09/11/02	0.7	J	2	mg/L	21	126	12	No	Well has had 4 consecutive ND results since last detection.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-110	RDX	0.0007	0.00031	09/11/02	0.4	J	3	mg/L	21	126	12	No	Well has had 5 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Benz(a)anthracene	0.000012	0.00015	08/20/13	12.5		1	mg/L	1	14	1	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Benzo(a)pyrene	0.0000034	0.00012	08/20/13	35.3		1	mg/L	1	14	1	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Benzo(b)fluoranthene	0.000034	0.00012	08/20/13	3.5		1	mg/L	1	14	1	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-4	RDX	0.0007	0.0061	01/23/13	8.7		1	mg/L	6	15	6	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-05 Winklepeck Burning Grounds	Sharon	Miscellaneous	Cyanide	Yes	16	1	0.005	0.01	0.00015	16	1	0.0042	0.0042	7/23/2014	7/23/2014	7/23/2014	7/23/2014	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	2,4-Dinitrotoluene	Yes	137	14	0.00005	0.0005	0.00024	17	2	0.000033	0.00095	7/22/2015	1/26/2009	10/10/2007	11/3/2000	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	137	6	0.00005	0.0005	0.000048	137	6	0.000051	0.00025	7/22/2015	10/10/2008	7/22/2015	10/10/2008	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	2-Nitrotoluene	Yes	137	11	0.000099	0.0025	0.00031	90	4	0.000091	0.0026	7/22/2015	4/16/2008	1/19/2011	4/16/2008	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	3-Nitrotoluene	Yes	137	2	0.000099	0.0025	0.00017	110	1	0.000076	0.00031	7/22/2015	11/1/2000	2/1/2012	11/1/2000	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	RDX	Yes	138	59	0.00005	0.005	0.0007	49	48	0.000099	0.074	7/22/2015	7/22/2015	7/22/2015	7/22/2015	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Miscellaneous	Cyanide	Yes	123	10	0.01	0.01	0.00015	123	10	0.0013	0.019	8/21/2013	10/10/2008	8/21/2013	10/10/2008	
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**113**	**1**	**0.0000095**	**0.00015**	**0.0000014**	**113**	**1**	**0.0000063**	**0.0000063**	**8/21/2013**	**3/9/2006**	**8/21/2013**	**3/9/2006**	**Pesticide from historical agricultural use**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**113**	**2**	**0.0000095**	**0.00015**	**0.0000014**	**113**	**2**	**0.0000076**	**0.000056**	**8/21/2013**	**3/8/2006**	**8/21/2013**	**3/8/2006**	**Pesticide from historical agricultural use**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**Lindane**	**No**	**113**	**9**	**0.0000095**	**0.00015**	**0.000041**	**21**	**3**	**0.000013**	**0.000057**	**8/21/2013**	**10/4/2006**	**1/19/2011**	**10/4/2006**	**Pesticide from historical agricultural use**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	SVOCs	2,6-Dinitrotoluene	Yes	112	1	0.00076	0.01	0.000048	112	1	0.00066	0.00066	2/1/2012	1/23/2007	2/1/2012	1/23/2007	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	136	48	0.00048	0.012	0.0056	66	5	0.00031	0.049	7/22/2015	8/21/2013	1/19/2011	1/26/2009	Potential lab contaminant
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**VOCs**	**Chloroform**	**No**	**129**	**5**	**0.00025**	**0.005**	**0.00022**	**129**	**5**	**0.00064**	**0.0017**	**8/21/2013**	**11/2/2000**	**8/21/2013**	**11/2/2000**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-05 Winklepeck Burning Grounds	Sharon	WBGmw-021	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.0042	07/23/14	0.0042 J	07/23/14
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.0062	04/16/08	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	10	4	0.01	0.0056	7	1	0.0058	07/09/08	< 0.01 U	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	Volatile Organics	Chloroform	10	1	0.005	0.00022	10	1	0.0017	05/20/98	< 0.001 U	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Explosives	2,4-Dinitrotoluene	23	1	0.0005	0.00024	13	1	0.00095	11/03/00	< 0.0001 U	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Explosives	2,6-Dinitrotoluene	23	1	0.0005	0.000048	23	1	0.00025	11/03/00	< 0.0001 U	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Explosives	RDX	24	24	0.005	0.0007	24	24	0.074	04/15/05	0.01	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Miscellaneous	Cyanide	17	4	0.01	0.00015	17	4	0.009	04/18/07	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Pesticides and PCBs	Lindane	15	8	0.00006	0.000041	5	3	0.000057	10/04/06	< 0.00006 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	7	0.01	0.0056	10	1	0.0098	05/02/06	< 0.0048 U	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Miscellaneous	Cyanide	19	2	0.01	0.00015	19	2	0.0095	10/10/07	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Pesticides and PCBs	Heptachlor	15	1	0.00005	0.0000014	15	1	0.0000063	03/09/06	< 0.00003 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Semi-Volatile Organics	2,6-Dinitrotoluene	16	1	0.01	0.000048	16	1	0.00066	01/23/07	< 0.00076 U	02/01/12
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	18	4	0.012	0.0056	9	1	0.049	11/03/00	0.00093 J	01/24/13
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-008	Volatile Organics	Chloroform	6	1	0.005	0.00022	6	1	0.00064	05/20/98	< 0.001 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Explosives	RDX	24	24	0.0005	0.0007	24	24	0.013	07/15/05	0.0028	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Miscellaneous	Cyanide	17	2	0.01	0.00015	17	2	0.019	05/20/98	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Pesticides and PCBs	Heptachlor epoxide	15	1	0.00015	0.0000014	15	1	0.0000076	03/08/06	< 0.00003 U	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Volatile Organics	Chloroform	20	1	0.005	0.00022	20	1	0.0011	05/20/98	< 0.00025 U	01/24/13
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Explosives	2,4-Dinitrotoluene	8	2	0.00013	0.00024	1	1	0.00028	11/02/00	< 0.000099 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Explosives	2,6-Dinitrotoluene	8	1	0.00028	0.000048	8	1	0.000051	07/09/08	< 0.000099 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Pesticides and PCBs	Heptachlor epoxide	8	1	0.00005	0.0000014	8	1	0.000056	11/02/00	< 0.00003 UJ	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	6	0.01	0.0056	3	1	0.0062	01/26/09	0.0062 JB	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Volatile Organics	Chloroform	8	2	0.005	0.00022	8	2	0.0015	11/02/00	< 0.001 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-011	Explosives	2,6-Dinitrotoluene	6	3	0.00013	0.000048	6	3	0.0001	11/02/00	< 0.000099 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-011	Explosives	2-Nitrotoluene	6	2	0.0005	0.00031	5	1	0.00033	11/02/00	< 0.0005 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	Explosives	2,6-Dinitrotoluene	5	1	0.00013	0.000048	5	1	0.00011	11/04/00	< 0.0001 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	Explosives	2-Nitrotoluene	5	2	0.00051	0.00031	5	2	0.00049	11/04/00	< 0.00051 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0089	10/10/08	< 0.01 UJ	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-015	Explosives	2-Nitrotoluene	5	1	0.00052	0.00031	5	1	0.0026	11/01/00	< 0.0005 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-015	Explosives	3-Nitrotoluene	5	1	0.00052	0.00017	5	1	0.00031	11/01/00	< 0.0005 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-016	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	3	0.01	0.0056	3	1	0.01	07/09/08	0.0011 JB	01/26/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-05 Winklepeck Burning Grounds	**Sharon**	**WBGmw-021**	**Cyanide**	**0.00015**	**0.0042**	**07/23/14**	**28.0**	**J**	**1**	**mg/L**	**1**	**16**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-006**	**2,4-Dinitrotoluene**	**0.00024**	**0.00095**	**11/03/00**	**4.0**	**=**	**1**	**mg/L**	**19**	**265**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	OBG-1	2,4-Dinitrotoluene	0.00024	0.00044	11/05/00	1.8	=	2	mg/L	19	265	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	2,4-Dinitrotoluene	0.00024	0.00028	11/02/00	1.2	=	3	mg/L	19	265	3	No	Well has had 4 consecutive ND results since last detection.
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-007**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00066**	**01/23/07**	**13.8**	**J**	**1**	**mg/L**	**8**	**265**	**8**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	2,6-Dinitrotoluene	4.80E-05	0.00025	11/03/00	5.2	=	2	mg/L	8	265	8	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	OBG-1	2,6-Dinitrotoluene	4.80E-05	0.00012	11/05/00	2.5	J	3	mg/L	8	265	8	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-015**	**2-Nitrotoluene**	**0.00031**	**0.0026**	**11/01/00**	**8.4**	**=**	**1**	**mg/L**	**12**	**145**	**4**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	2-Nitrotoluene	0.00031	0.00049	11/04/00	1.6	=	2	mg/L	12	145	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-011	2-Nitrotoluene	0.00031	0.00033	11/02/00	1.1	=	3	mg/L	12	145	4	No	Well has had 4 consecutive ND results since last detection.
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-015**	**3-Nitrotoluene**	**0.00017**	**0.00031**	**11/01/00**	**1.8**	**=**	**1**	**mg/L**	**3**	**145**	**1**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	OBG-4	3-Nitrotoluene	0.00017	0.00015	11/05/00	0.9	J	2	mg/L	3	145	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	3-Nitrotoluene	0.00017	7.60E-05	05/20/98	0.4	J	3	mg/L	3	145	1	No	Well has had 6 consecutive ND results since last detection.
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-007**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**4.90E-02**	**11/03/00**	**8.8**	**=**	**1**	**mg/L**	**48**	**144**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-016	Bis(2-ethylhexyl)phthalate	0.0056	1.00E-02	07/09/08	1.8	J	2	mg/L	48	144	4	No	The need for characterization of DEHP will be based on confirmation of the constituent at WBGmw-007.
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Bis(2-ethylhexyl)phthalate	0.0056	9.80E-03	05/02/06	1.8	J	3	mg/L	48	144	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-009**	**Cyanide**	**0.00015**	**0.019**	**05/20/98**	**126.7**	**=**	**1**	**mg/L**	**10**	**135**	**10**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Cyanide	0.00015	0.0095	10/10/07	63.3	J	2	mg/L	10	135	10	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Cyanide	0.00015	0.009	04/18/07	60.0	J	3	mg/L	10	135	10	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-006**	**RDX**	**0.0007**	**0.074**	**04/15/05**	**105.7**	**J**	**1**	**mg/L**	**59**	**146**	**48**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	RDX	0.0007	0.013	07/15/05	18.6	=	2	mg/L	59	146	48	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-013	RDX	0.0007	0.00066	09/03/02	0.9	=	3	mg/L	59	146	48	No	Well has had 4 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-05 Winklepeck Burning Grounds	**Sharon**	**WBGmw-021**	**Cyanide**	**0.00015**	**0.0042**	**07/23/14**	**28.0**	**J**	**1**	**mg/L**	**1**	**10**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-006**	**RDX**	**0.0007**	**0.041**	**03/11/15**	**58.6**		**1**	**mg/L**	**16**	**17**	**12**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	RDX	0.0007	0.0056	07/23/14	8.0		2	mg/L	16	17	12	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-018	RDX	0.0007	0.00036	08/21/13	0.5		3	mg/L	16	17	12	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-06 C Block Quarry	Homewood	Miscellaneous	Cyanide	Yes	22	1	0.01	0.01	0.00015	22	1	0.007	0.007	1/24/2013	10/10/2008	1/24/2013	10/10/2008	
RVAAP-06 C Block Quarry	Homewood	Pest/PCBs	PCB-1248	Yes	30	1	0.00019	0.0016	0.0000078	30	1	0.00011	0.00011	1/24/2013	10/9/2008	1/24/2013	10/9/2008	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Benz(a)anthracene	Yes	30	1	0.000095	0.00024	0.000012	30	1	0.00016	0.00016	1/24/2013	1/20/2005	1/24/2013	1/20/2005	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Benzo(a)pyrene	Yes	30	1	0.000095	0.00041	0.0000034	30	1	0.00017	0.00017	1/24/2013	1/20/2005	1/24/2013	1/20/2005	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Benzo(b)fluoranthene	Yes	30	1	0.000095	0.00041	0.000034	30	1	0.00013	0.00013	1/24/2013	1/20/2005	1/24/2013	1/20/2005	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	30	18	0.00076	0.077	0.0056	12	2	0.00082	0.4	1/24/2013	1/24/2013	4/7/2011	1/12/2005	Potential lab contaminant
RVAAP-06 C Block Quarry	Homewood	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	30	1	0.000095	0.00041	0.000034	30	1	0.00014	0.00014	1/24/2013	1/20/2005	1/24/2013	1/20/2005	

Notes

Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present abov

COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime can

DL - laboratory method detection limit

J - data qualifier indicating estimated results

mg/L - milligrams per liter

Monitored Zone - well-specific screened interval aquifer formation

SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.007	10/10/08	< 0.01 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Benz(a)anthracene	6	1	0.0002	0.000012	6	1	0.00016	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Benzo(a)pyrene	6	1	0.0004	0.0000034	6	1	0.00017	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Benzo(b)fluoranthene	6	1	0.0004	0.000034	6	1	0.00013	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	6	1	0.0004	0.000034	6	1	0.00014	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	6	0.077	0.0056	3	1	0.4	01/12/05	0.0011 B	01/23/13
RVAAP-06 C Block Quarry	Homewood	CBLmw-003	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	5	0.015	0.0056	2	1	0.031	01/12/05	0.0023 JB	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-004	Pesticides and PCBs	PCB-1248	6	1	0.0016	0.0000078	6	1	0.00011	10/09/08	< 0.0005 UJ	04/07/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-002**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**0.4**	**01/12/05**	**71.4**	**=**	**1**	**mg/L**	**18**	**30**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	Homewood	CBLmw-003	Bis(2-ethylhexyl)phthalate	5.60E-03	0.031	01/12/05	5.5	=	2	mg/L	18	30	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Bis(2-ethylhexyl)phthalate	5.60E-03	0.0037	07/11/08	0.7	J	3	mg/L	18	30	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Benz(a)anthracene**	**1.20E-05**	**0.00016**	**01/20/05**	**13.3**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Benzo(a)pyrene**	**3.40E-06**	**0.00017**	**01/20/05**	**50.0**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.00013**	**01/20/05**	**3.8**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Cyanide**	**0.00015**	**0.007**	**10/10/08**	**46.7**	**J**	**1**	**mg/L**	**1**	**22**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00014**	**01/20/05**	**4.1**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-004**	**PCB-1248**	**7.80E-06**	**0.00011**	**10/09/08**	**14.1**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-08 Load Line 1	Sharon	Explosives	1,3-Dinitrobenzene	Yes	129	47	0.000096	0.003	0.0002	50	33	0.000019	0.00133	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2,4,6-Trinitrotoluene	Yes	129	64	0.000096	0.003	0.00098	51	43	0.00005	0.016	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2,4-Dinitrotoluene	Yes	129	65	0.000096	0.0013	0.00024	52	46	0.000052	0.0079	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2,6-Dinitrotoluene	Yes	129	49	0.000096	0.0089	0.000048	129	49	0.000054	0.0038	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2-Amino-4,6-Dinitrotoluene	Yes	114	76	0.000096	0.002	0.0039	45	45	0.0001	0.029	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	3-Nitrotoluene	Yes	129	4	0.0001	0.01	0.00017	117	1	0.00012	0.0004	7/20/2015	1/21/2014	8/2/2011	1/17/2011	
RVAAP-08 Load Line 1	Sharon	Explosives	4-Amino-2,6-Dinitrotoluene	Yes	114	77	0.000096	0.002	0.0039	50	50	0.00019	0.036	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	Nitroglycerin	Yes	97	2	0.0005	0.06	0.0002	97	2	0.0042	0.027	7/20/2015	10/4/2000	7/20/2015	10/4/2000	
RVAAP-08 Load Line 1	Sharon	Explosives	RDX	Yes	129	66	0.00005	0.02	0.0007	44	34	0.000085	0.088	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Miscellaneous	Cyanide	Yes	104	8	0.002	0.01	0.00015	104	8	0.0016	0.019	4/5/2011	1/17/2011	4/5/2011	1/17/2011	
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**4,4'-DDE**	**No**	**120**	**1**	**0.000019**	**0.00096**	**0.000046**	**55**	**1**	**0.013**	**0.013**	**7/20/2015**	**10/3/2000**	**7/20/2015**	**10/3/2000**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Aldrin**	**No**	**120**	**1**	**0.000019**	**0.00096**	**0.00000092**	**120**	**1**	**0.000011**	**0.000011**	**7/20/2015**	**5/2/2006**	**7/20/2015**	**5/2/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**alpha-BHC**	**No**	**120**	**3**	**0.000019**	**0.00096**	**0.0000071**	**120**	**3**	**0.000011**	**0.00018**	**7/20/2015**	**8/1/2011**	**7/20/2015**	**8/1/2011**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**120**	**27**	**0.000019**	**0.00096**	**0.000025**	**111**	**19**	**0.0000088**	**0.00026**	**7/20/2015**	**8/21/2013**	**7/20/2015**	**8/21/2013**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Dieldrin**	**No**	**120**	**1**	**0.000019**	**0.00096**	**0.0000017**	**120**	**1**	**0.000029**	**0.000029**	**7/20/2015**	**5/2/2006**	**7/20/2015**	**5/2/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**120**	**4**	**0.000019**	**0.00096**	**0.0000014**	**120**	**4**	**0.000011**	**0.000044**	**7/20/2015**	**3/10/2015**	**7/20/2015**	**3/10/2015**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**120**	**9**	**0.000019**	**0.00096**	**0.0000014**	**120**	**9**	**0.000066**	**0.0061**	**7/20/2015**	**7/11/2006**	**7/20/2015**	**7/11/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Toxaphene**	**No**	**120**	**1**	**0.00076**	**0.04**	**0.000015**	**120**	**1**	**0.00034**	**0.00034**	**7/20/2015**	**3/6/2006**	**7/20/2015**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	Sharon	SVOCs	2,4-Dinitrotoluene	Yes	107	24	0.0048	0.01	0.00024	107	24	0.00034	0.0036	8/2/2011	8/1/2011	8/2/2011	8/1/2011	
RVAAP-08 Load Line 1	Sharon	SVOCs	2,6-Dinitrotoluene	Yes	107	9	0.0048	0.01	0.000048	107	9	0.00064	0.0024	8/2/2011	10/8/2007	8/2/2011	10/8/2007	
RVAAP-08 Load Line 1	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**120**	**43**	**0.00048**	**0.012**	**0.0056**	**53**	**2**	**0.00082**	**0.021**	**7/20/2015**	**3/10/2015**	**8/2/2011**	**10/11/2010**	**Lab contaminant**
RVAAP-08 Load Line 1	**Sharon**	**VOCs**	**Chloroform**	**No**	**110**	**2**	**0.001**	**0.005**	**0.00022**	**110**	**2**	**0.0011**	**0.0012**	**8/2/2011**	**9/2/1999**	**8/2/2011**	**9/2/1999**	**Lab contaminant**
RVAAP-08 Load Line 1	Unconsolidated	Explosives	Nitroglycerin	Yes	57	1	0.00049	0.0025	0.0002	57	1	0.00033	0.00033	7/23/2015	7/24/2014	7/23/2015	7/24/2014	
RVAAP-08 Load Line 1	Unconsolidated	Miscellaneous	Cyanide	Yes	31	1	0.002	0.01	0.00015	31	1	0.011	0.011	10/21/2014	7/7/2008	10/21/2014	7/7/2008	
RVAAP-08 Load Line 1	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**52**	**1**	**0.0000095**	**0.00015**	**0.0000071**	**52**	**1**	**0.000028**	**0.000028**	**7/21/2015**	**10/21/2014**	**7/21/2015**	**10/21/2014**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**52**	**2**	**0.0000095**	**0.00015**	**0.000025**	**26**	**1**	**0.0000095**	**0.000027**	**7/21/2015**	**1/21/2013**	**7/21/2015**	**7/23/2012**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**52**	**1**	**0.0000095**	**0.00015**	**0.0000014**	**52**	**1**	**0.000029**	**0.000029**	**7/21/2015**	**3/10/2015**	**7/21/2015**	**3/10/2015**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**58**	**21**	**0.00048**	**0.01**	**0.0056**	**12**	**3**	**0.0005**	**0.0086**	**7/23/2015**	**3/9/2015**	**8/1/2011**	**7/14/2010**	**Lab contaminant**

Notes

Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer r
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	2,4,6-Trinitrotoluene	6	3	0.003	0.00098	2	1	0.00099	07/07/08	0.00059	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	2,4-Dinitrotoluene	6	5	0.00014	0.00024	1	1	0.00027	07/07/08	0.00021	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	2,6-Dinitrotoluene	6	5	0.00014	0.000048	6	5	0.00064	08/02/11	0.00064	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	4-Amino-2,6-Dinitrotoluene	5	5	0.00014	0.0039	2	2	0.0064	07/07/08	0.0063	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0029	08/12/96	< 0.01 U	10/08/08
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Pesticides and PCBs	alpha-BHC	6	1	0.00006	0.0000071	6	1	0.000012	10/09/08	< 0.00003 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Pesticides and PCBs	beta-BHC	6	3	0.00006	0.000025	4	1	0.000069	10/09/08	< 0.00003 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-078	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0016	05/02/06	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Sharon	LL1mw-078	Pesticides and PCBs	Heptachlor epoxide	15	2	0.00005	0.0000014	15	2	0.00023	07/11/06	< 0.00003 UJ	07/14/10
RVAAP-08 Load Line 1	Sharon	LL1mw-079	Explosives	2,6-Dinitrotoluene	8	2	0.00013	0.000048	8	2	0.000057	01/28/08	< 0.000099 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-079	Explosives	RDX	8	8	0.0005	0.0007	4	4	0.0022	07/07/08	0.0006	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-079	Volatile Organics	Chloroform	8	2	0.005	0.00022	8	2	0.0012	09/02/99	< 0.001 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	1,3-Dinitrobenzene	17	7	0.002	0.0002	7	5	0.00095	10/04/00	0.00041	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2,4,6-Trinitrotoluene	17	15	0.002	0.00098	3	3	0.0036	10/04/00	0.00056	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2,4-Dinitrotoluene	17	9	0.0013	0.00024	7	6	0.0009	10/04/00	0.00027	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2,6-Dinitrotoluene	17	7	0.0037	0.000048	17	7	0.00089	07/14/10	0.00043	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2-Amino-4,6-Dinitrotoluene	16	16	0.002	0.0039	8	8	0.01	10/04/00	0.0054 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	4-Amino-2,6-Dinitrotoluene	16	16	0.002	0.0039	11	11	0.011	10/04/05	0.0086 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	Nitroglycerin	7	1	0.025	0.0002	7	1	0.027	10/04/00	< 0.00065 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	RDX	17	17	0.005	0.0007	17	17	0.088	07/14/10	0.081 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Inorganics	Beryllium	20	3	0.01	0.0025	11	2	0.0048	10/19/09	< 0.001 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Pesticides and PCBs	beta-BHC	16	10	0.0005	0.000025	15	9	0.000063	08/01/11	0.000063 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Pesticides and PCBs	Heptachlor epoxide	16	4	0.0005	0.0000014	16	4	0.0028	10/04/05	< 0.000029 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Semi-Volatile Organics	2,4-Dinitrotoluene	16	1	0.01	0.00024	16	1	0.00034	08/01/11	0.00034 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Explosives	Nitroglycerin	9	1	0.0025	0.0002	9	1	0.0042	10/03/00	< 0.00065 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Explosives	RDX	9	8	0.00102	0.0007	6	5	0.0028	10/03/00	0.0016 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Miscellaneous	Cyanide	7	1	0.01	0.00015	7	1	0.0051	09/02/99	< 0.01 U	04/05/11
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	1,3-Dinitrobenzene	23	15	0.001	0.0002	19	12	0.0013	09/01/99	0.00024 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2,4,6-Trinitrotoluene	23	23	0.001	0.00098	23	23	0.011	09/01/99	0.0034 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2,4-Dinitrotoluene	23	23	0.001	0.00024	23	23	0.0052	10/08/07	0.0027 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2,6-Dinitrotoluene	23	22	0.0089	0.000048	23	22	0.0038	09/01/99	0.0016 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2-Amino-4,6-Dinitrotoluene	22	22	0.001	0.0039	22	22	0.029	10/03/00	0.011 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	4-Amino-2,6-Dinitrotoluene	22	22	0.001	0.0039	22	22	0.036	07/14/10	0.024 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	RDX	23	13	0.0025	0.0007	1	1	0.0012	10/03/00	< 0.000051 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Miscellaneous	Cyanide	17	2	0.01	0.00015	17	2	0.0033	10/04/05	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	4,4'-DDE	22	1	0.00096	0.000046	15	1	0.013	10/03/00	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Aldrin	22	1	0.00096	0.00000092	22	1	0.000011	05/02/06	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	alpha-BHC	22	1	0.00096	0.0000071	22	1	0.000011	04/16/07	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	beta-BHC	22	6	0.00096	0.000025	21	6	0.00017	04/16/07	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Dieldrin	22	1	0.00096	0.0000017	22	1	0.000029	05/02/06	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Heptachlor	22	1	0.00096	0.0000014	22	1	0.000044	03/10/15	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Heptachlor epoxide	22	2	0.00096	0.0000014	22	2	0.0061	10/04/05	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Toxaphene	22	1	0.04	0.000015	22	1	0.00034	03/06/06	< 0.0019 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Semi-Volatile Organics	2,4-Dinitrotoluene	17	16	0.01	0.00024	17	16	0.0036	10/08/07	0.0016 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Semi-Volatile Organics	2,6-Dinitrotoluene	17	9	0.01	0.000048	17	9	0.0024	10/04/05	< 0.0049 UJ	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	1,3-Dinitrobenzene	16	16	0.00104	0.0002	16	16	0.00133	08/02/07	0.00026 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2,4,6-Trinitrotoluene	16	16	0.00104	0.00098	16	16	0.016	10/02/00	0.0058 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2,4-Dinitrotoluene	16	16	0.00104	0.00024	16	16	0.0079	09/04/99	0.0011 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2,6-Dinitrotoluene	16	13	0.0064	0.000048	16	13	0.0013	01/17/11	0.00062 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2-Amino-4,6-Dinitrotoluene	15	15	0.00104	0.0039	15	15	0.02	10/02/00	0.0075 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	3-Nitrotoluene	16	2	0.00104	0.00017	11	1	0.0004	01/17/11	< 0.0001 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	4-Amino-2,6-Dinitrotoluene	15	15	0.00104	0.0039	15	15	0.036	08/21/13	0.024 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	RDX	16	12	0.0015	0.0007	9	7	0.00242	08/02/07	0.0013 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.0067	01/17/11	< 0.01 UJ	04/05/11
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Pesticides and PCBs	alpha-BHC	15	1	0.00095	0.0000071	15	1	0.00018	08/01/11	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Pesticides and PCBs	beta-BHC	15	3	0.00095	0.000025	15	3	0.00026	07/14/10	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Pesticides and PCBs	Heptachlor	15	3	0.00095	0.0000014	15	3	0.000043	03/10/15	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Semi-Volatile Organics	2,4-Dinitrotoluene	10	7	0.01	0.00024	10	7	0.003	10/02/00	0.00075 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	15	10	0.01	0.0056	2	1	0.0061	10/11/10	< 0.0049 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Miscellaneous	Cyanide	9	2	0.01	0.00015	9	2	0.019	04/07/08	< 0.01 U	07/08/10
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Pesticides and PCBs	Heptachlor epoxide	9	1	0.00005	0.0000014	9	1	0.00022	09/19/01	< 0.000029 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.01	0.0056	5	1	0.021	04/07/08	0.00092 J	08/02/11
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-004	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.013	10/12/10	< 0.01 U	04/05/11
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	4	2	0.00078	0.0056	1	1	0.04	10/15/12	< 0.00078 U	01/21/13
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-064	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.011	07/07/08	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-065	Inorganics	Beryllium	23	2	0.004	0.0025	3	1	0.004	10/19/09	< 0.001 U	07/23/15

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-065	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	19	8	0.01	0.0056	9	3	0.0086	07/14/10	< 0.0048 U	07/23/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Explosives	Nitroglycerin	9	1	0.00053	0.0002	9	1	0.00033	07/24/14	< 0.00051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Pesticides and PCBs	beta-BHC	9	2	0.000051	0.000025	3	1	0.000027	07/23/12	< 0.000051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Pesticides and PCBs	Heptachlor	9	1	0.000051	0.0000014	9	1	0.000029	03/10/15	< 0.000051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-087	Inorganics	Beryllium	9	2	0.001	0.0025	1	1	0.0056	07/23/12	< 0.001 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-088	Pesticides and PCBs	alpha-BHC	6	1	0.000053	0.0000071	6	1	0.000028	10/21/14	< 0.000051 U	07/21/15

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**1,3-Dinitrobenzene**	**0.0002**	**0.00133**	**08/02/07**	**6.7**		**1**	**mg/L**	**47**	**129**	**33**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	1,3-Dinitrobenzene	0.0002	0.0013	09/01/99	6.5	=	2	mg/L	47	129	33	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	1,3-Dinitrobenzene	0.0002	0.00095	10/04/00	4.8	J	3	mg/L	47	129	33	Yes	No Mann-Kendall Trend Stable to Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.016**	**10/02/00**	**16.3**	**=**	**1**	**mg/L**	**64**	**129**	**43**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,4,6-Trinitrotoluene	0.00098	0.011	09/01/99	11.2	=	2	mg/L	64	129	43	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2,4,6-Trinitrotoluene	0.00098	0.0036	10/04/00	3.7	=	3	mg/L	64	129	43	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4-Dinitrotoluene**	**0.00024**	**0.0079**	**09/04/99**	**32.9**	**=**	**1**	**mg/L**	**89**	**236**	**70**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,4-Dinitrotoluene	0.00024	0.0052	10/08/07	21.7	J	2	mg/L	89	236	70	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2,4-Dinitrotoluene	0.00024	0.0009	10/04/00	3.8	J	3	mg/L	89	236	70	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Stable (flat) Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0038**	**09/01/99**	**79.2**	**=**	**1**	**mg/L**	**58**	**236**	**58**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,6-Dinitrotoluene	4.80E-05	0.0013	08/01/11	27.1		2	mg/L	58	236	58	Yes	No M-K Trend (decreasing OLS Regression Line and stable Theil-Sen Trend Line); reviewing potential hydrogeology influences on contaminant concentrations
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,6-Dinitrotoluene	4.80E-05	0.0013	01/17/11	27.1	J	2	mg/L	58	236	58	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2,6-Dinitrotoluene	4.80E-05	0.00089	07/14/10	18.5		3	mg/L	58	236	58	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.029**	**10/03/00**	**7.4**	**=**	**1**	**mg/L**	**76**	**114**	**45**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2-Amino-4,6-Dinitrotoluene	0.0039	0.02	03/06/06	5.1	=	2	mg/L	76	114	45	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2-Amino-4,6-Dinitrotoluene	0.0039	0.02	10/02/00	5.1	=	2	mg/L	76	114	45	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2-Amino-4,6-Dinitrotoluene	0.0039	0.01	10/04/00	2.6	=	3	mg/L	76	114	45	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**3-Nitrotoluene**	**0.00017**	**0.0004**	**01/17/11**	**2.4**	**J**	**1**	**mg/L**	**4**	**129**	**1**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-067	3-Nitrotoluene	0.00017	0.00016	10/04/00	0.9	J	2	mg/L	4	129	1	No	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 5 consecutive ND results since last detection.
RVAAP-08 Load Line 1	Sharon	LL1mw-081	3-Nitrotoluene	0.00017	0.00014	09/02/99	0.8	J	3	mg/L	4	129	1	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.036**	**07/14/10**	**9.2**	**J**	**1**	**mg/L**	**77**	**114**	**50**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.036**	**08/21/13**	**9.2**		**1**	**mg/L**	**77**	**114**	**50**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-080	4-Amino-2,6-Dinitrotoluene	0.0039	0.011	10/04/05	2.8	=	2	mg/L	77	114	50	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-063	4-Amino-2,6-Dinitrotoluene	0.0039	0.0064	07/07/08	1.6		3	mg/L	77	114	50	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL2mw-060**	**Cyanide**	**0.00015**	**0.019**	**04/07/08**	**126.7**		**1**	**mg/L**	**8**	**104**	**8**	**No**	**Insufficient data for statistical evaluation, 2 detections out of 9 samples** **Well has had 6 consecutive ND results since last detection.**
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Cyanide	0.00015	0.0067	01/17/11	44.7	J	2	mg/L	8	104	8	Yes	Insufficient data for statistical evaluation, 1 detection out of 6 samples
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Cyanide	0.00015	0.0051	09/02/99	34.0	J	3	mg/L	8	104	8	Yes	Insufficient data for statistical evaluation, 1 detection out of 6 samples
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-080**	**Nitroglycerin**	**0.0002**	**0.027**	**10/04/00**	**135.0**	**=**	**1**	**mg/L**	**2**	**97**	**2**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Nitroglycerin	0.0002	0.0042	10/03/00	21.0	=	2	mg/L	2	97	2	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-080**	**RDX**	**0.0007**	**0.088**	**07/14/10**	**125.7**	**J**	**1**	**mg/L**	**66**	**129**	**34**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	Sharon	LL1mw-081	RDX	0.0007	0.0028	10/03/00	4.0	=	2	mg/L	66	129	34	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-084	RDX	0.0007	0.00242	08/02/07	3.5		3	mg/L	66	129	34	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Unconsolidated**	**LL1mw-064**	**Cyanide**	**0.00015**	**0.011**	**07/07/08**	**73.3**		**1**	**mg/L**	**1**	**31**	**1**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 8 samples**
RVAAP-08 Load Line 1	**Unconsolidated**	**LL1mw-086**	**Nitroglycerin**	**0.0002**	**0.00033**	**07/24/14**	**1.7**	**J**	**1**	**mg/L**	**1**	**57**	**1**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**1,3-Dinitrobenzene**	**0.0002**	**0.00048**	**03/10/15**	**2.4**	**J**	**1**	**mg/L**	**10**	**10**	**9**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	1,3-Dinitrobenzene	0.0002	0.00028	08/21/13	1.4	J	2	mg/L	10	10	9	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.012**	**08/21/13**	**12.2**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.012**	**01/21/14**	**12.2**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.012**	**03/10/15**	**12.2**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,4,6-Trinitrotoluene	0.00098	0.0048	03/10/15	4.9	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2,4-Dinitrotoluene**	**0.00024**	**0.0033**	**03/10/15**	**13.8**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,4-Dinitrotoluene	0.00024	0.0016	07/21/14	6.7	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,4-Dinitrotoluene	0.00024	0.0016	03/10/15	6.7	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2,6-Dinitrotoluene**	**0.000048**	**0.0022**	**03/10/15**	**45.8**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,6-Dinitrotoluene	0.000048	0.001	07/21/14	20.8	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.014**	**08/21/13**	**3.6**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2-Amino-4,6-Dinitrotoluene	0.0039	0.013	03/10/15	3.3	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2-Amino-4,6-Dinitrotoluene	0.0039	0.013	08/21/13	3.3	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.036**	**08/21/13**	**9.2**		**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	Sharon	LL1mw-083	4-Amino-2,6-Dinitrotoluene	0.0039	0.028	08/21/13	7.2		2	mg/L	10	10	10	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**RDX**	**0.0007**	**0.0021**	**08/21/13**	**3.0**	**J**	**1**	**mg/L**	**6**	**10**	**5**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	RDX	0.0007	0.0003	01/21/14	0.4	J	2	mg/L	6	10	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Unconsolidated**	**LL1mw-086**	**Nitroglycerin**	**0.0002**	**0.00033**	**07/24/14**	**1.7**	**J**	**1**	**mg/L**	**1**	**29**	**1**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-09 Load Line 2	Sharon	Explosives	2,4-Dinitrotoluene	Yes	142	36	0.00005	0.00106	0.00024	29	22	0.00004	0.00086	7/23/2015	7/23/2015	3/24/2015	3/24/2015	
RVAAP-09 Load Line 2	Sharon	Explosives	2,6-Dinitrotoluene	Yes	142	2	0.00005	0.00106	0.000048	142	2	0.000059	0.000092	7/23/2015	4/7/2008	7/23/2015	4/7/2008	
RVAAP-09 Load Line 2	Sharon	Explosives	RDX	Yes	142	19	0.00005	0.02	0.0007	21	12	0.000042	0.0017	7/23/2015	7/23/2015	7/23/2015	7/23/2015	
RVAAP-09 Load Line 2	Sharon	Miscellaneous	Cyanide	Yes	108	7	0.002	0.01	0.00015	108	7	0.0058	0.027	10/22/2014	1/18/2011	10/22/2014	1/18/2011	
RVAAP-09 Load Line 2	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**122**	**11**	**0.0000095**	**0.0003**	**0.000025**	**104**	**2**	**0.000007**	**0.000029**	**10/22/2014**	**7/12/2010**	**10/22/2014**	**7/9/2010**	**Pesticide from historical agricultural use**
RVAAP-09 Load Line 2	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**122**	**2**	**0.0000095**	**0.0003**	**0.0000014**	**122**	**2**	**0.0000065**	**0.00002**	**10/22/2014**	**3/6/2006**	**10/22/2014**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-09 Load Line 2	**Sharon**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**122**	**6**	**0.0000095**	**0.0003**	**0.0000014**	**122**	**6**	**0.000097**	**0.00046**	**10/22/2014**	**3/6/2006**	**10/22/2014**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-09 Load Line 2	Sharon	Pest/PCBs	PCB-1242	Yes	122	2	0.00038	0.001	0.0000078	122	2	0.00072	0.00085	10/22/2014	9/20/2001	10/22/2014	9/20/2001	
RVAAP-09 Load Line 2	Sharon	SVOCs	2,4-Dinitrotoluene	Yes	113	3	0.00077	0.01	0.00024	113	3	0.00063	0.00064	1/30/2012	10/8/2007	1/30/2012	10/8/2007	
RVAAP-09 Load Line 2	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**141**	**47**	**0.00048**	**0.01**	**0.0056**	**59**	**6**	**0.00062**	**0.021**	**7/23/2015**	**8/21/2013**	**1/30/2012**	**7/9/2010**	**Lab contaminant**
RVAAP-09 Load Line 2	Sharon	SVOCs	Pentachlorophenol	Yes	123	2	0.00095	0.025	0.00004	123	2	0.0013	0.0047	10/22/2014	4/7/2008	10/22/2014	4/7/2008	
RVAAP-09 Load Line 2	Sharon	VOCs	Benzene	Yes	128	9	0.00025	0.005	0.00045	104	1	0.00022	0.00049	10/22/2014	10/6/2008	8/2/2011	9/11/2001	

Notes

Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present

COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetim

DL - laboratory method detection limit

J - data qualifier indicating estimated results

mg/L - milligrams per liter

Monitored Zone - well-specific screened interval aquifer formation

SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Explosives	2,4-Dinitrotoluene	25	22	0.00024	0.00024	16	16	0.00086	10/08/07	< 0.0001 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0058	07/08/10	0.0058 J	07/08/10
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	Heptachlor	19	1	0.00005	0.0000014	19	1	0.00002	04/12/05	< 0.00001 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	Heptachlor epoxide	19	4	0.000052	0.0000014	19	4	0.00046	10/04/05	< 0.000052 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	PCB-1242	19	1	0.001	0.0000078	19	1	0.00085	09/20/01	< 0.00041 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Semi-Volatile Organics	2,4-Dinitrotoluene	16	3	0.01	0.00024	16	3	0.00064	10/08/07	< 0.00078 U	01/30/12
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	6	0.01	0.0056	9	1	0.0071	05/02/06	< 0.005 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Miscellaneous	Cyanide	9	2	0.01	0.00015	9	2	0.019	04/07/08	< 0.01 U	07/08/10
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Pesticides and PCBs	Heptachlor epoxide	9	1	0.00005	0.0000014	9	1	0.00022	09/19/01	< 0.000029 U	08/02/11
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	5	0.01	0.0056	5	1	0.021	04/07/08	< 0.0048 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-262	Pesticides and PCBs	Heptachlor	16	1	0.0000532	0.0000014	16	1	0.0000065	03/06/06	< 0.00003 U	07/09/10
RVAAP-09 Load Line 2	Sharon	LL2mw-262	Pesticides and PCBs	Heptachlor epoxide	16	1	0.0000532	0.0000014	16	1	0.00012	03/06/06	< 0.00003 U	07/09/10
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Explosives	2,6-Dinitrotoluene	19	2	0.00013	0.000048	19	2	0.000092	04/07/08	< 0.0001 U	07/23/14
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Pesticides and PCBs	PCB-1242	16	1	0.00058	0.0000078	16	1	0.00072	09/19/01	< 0.00038 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	20	10	0.01	0.0056	8	2	0.017	10/06/08	< 0.005 U	07/23/14
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0064	01/18/11	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Pesticides and PCBs	beta-BHC	7	1	0.0000556	0.000025	7	1	0.000029	07/09/10	< 0.00003 UJ	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	2	0.01	0.0056	4	1	0.0058	07/09/10	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Volatile Organics	Benzene	7	1	0.005	0.00045	7	1	0.00049	09/11/01	< 0.001 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Explosives	2,4-Dinitrotoluene	14	12	0.00104	0.00024	7	6	0.00036	01/18/11	0.0002 B	07/23/15
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Explosives	RDX	14	12	0.00104	0.0007	13	12	0.0017	01/18/11	0.0013	07/23/15
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Inorganics	Beryllium	16	2	0.01	0.0025	4	2	0.0037	10/12/10	< 0.001 U	07/23/15
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Miscellaneous	Cyanide	8	2	0.01	0.00015	8	2	0.027	10/12/10	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-269	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0084	01/18/11	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-270	Pesticides and PCBs	beta-BHC	6	1	0.00005	0.000025	6	1	0.000029	04/07/08	< 0.00003 U	07/15/10
RVAAP-09 Load Line 2	Sharon	LL2mw-270	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.01	0.0056	4	1	0.014	01/28/08	< 0.01 U	07/15/10
RVAAP-09 Load Line 2	Sharon	LL2mw-270	Semi-Volatile Organics	Pentachlorophenol	6	2	0.01	0.00004	6	2	0.0047	04/07/08	< 0.005 U	07/15/10

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-059**	**2,4-Dinitrotoluene**	**0.00024**	**0.00086**	**10/08/07**	**3.6**		**1**	**mg/L**	**39**	**255**	**25**	**Yes**	**No Mann-Kendall Trend Increasing to Stable OLS Regression Line Increasing to Stable Theil-Sen Trend Line**
RVAAP-09 Load Line 2	Sharon	LL2mw-267	2,4-Dinitrotoluene	0.00024	0.00036	01/18/11	1.5		2	mg/L	39	255	25	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-059	2,4-Dinitrotoluene	0.00024	0.00022	07/11/06	0.9	=	3	mg/L	39	255	25	Yes	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Increasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-060	2,4-Dinitrotoluene	0.00024	0.00022	10/01/00	0.9	=	3	mg/L	39	255	25	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 16 consecutive ND results since last detection.
RVAAP-09 Load Line 2	Sharon	LL2mw-267	2,4-Dinitrotoluene	0.00024	0.00022	07/09/10	0.9		3	mg/L	39	255	25	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-265**	**2,6-Dinitrotoluene**	**4.80E-05**	**9.20E-05**	**04/07/08**	**1.9**	**J**	**1**	**mg/L**	**2**	**255**	**2**	**No**	**No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 10 consecutive ND results since last detection.**
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-266**	**Benzene**	**0.00045**	**0.00049**	**09/11/01**	**1.1**	**J**	**1**	**mg/L**	**9**	**128**	**1**	**No**	**Insufficient data for statistical evaluation, 1 detection out of 6 samples. Well has had 5 consecutive ND results since last detection.**
RVAAP-09 Load Line 2	Sharon	LL2mw-268	Benzene	0.00045	0.00044	10/06/08	1.0	JB	2	mg/L	9	128	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 5 samples
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Benzene	0.00045	0.00042	10/06/08	0.9	JB	3	mg/L	9	128	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 9 samples. Well has had 4 consecutive ND results since last detection.
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-267**	**Cyanide**	**0.00015**	**0.027**	**10/12/10**	**180.0**	**J**	**1**	**mg/L**	**7**	**108**	**7**	**Yes**	**Insufficient data for statistical evaluation, 2 detection out of 5 samples**
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Cyanide	0.00015	0.019	04/07/08	126.7		2	mg/L	7	108	7	Yes	Insufficient data for statistical evaluation, 2 detection out of 9 samples.
RVAAP-09 Load Line 2	Sharon	LL2mw-269	Cyanide	0.00015	0.0084	01/18/11	56.0	J	3	mg/L	7	108	7	No	Insufficient data for statistical evaluation, 1 detection out of 5 samples, need for sampling reviewed after free cyanide testing of LL2mw-267
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-059**	**PCB-1242**	**0.0000078**	**0.00085**	**09/20/01**	**109.0**	**=**	**1**	**mg/L**	**2**	**122**	**2**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 19 samples.**
RVAAP-09 Load Line 2	Sharon	LL2mw-265	PCB-1242	0.0000078	0.00072	09/19/01	92.3	=	2	mg/L	2	122	2	No	Insufficient data for statistical evaluation, 1 detection out of 10 samples. Well has had 9 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-270**	**Pentachlorophenol**	**4.00E-05**	**0.0047**	**04/07/08**	**117.5**	**J**	**1**	**mg/L**	**2**	**123**	**2**	**Yes**	**Insufficient data for statistical evaluation, 2 detection out of 6 samples**
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-267**	**RDX**	**0.0007**	**0.0017**	**01/18/11**	**2.4**	**J**	**1**	**mg/L**	**19**	**142**	**12**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**
RVAAP-09 Load Line 2	Sharon	LL2mw-059	RDX	0.0007	0.0002	10/01/00	0.3	J	2	mg/L	19	142	12	Yes	Decreasing Mann-Kendall Trend Stable (flat) OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-262	RDX	0.0007	0.00018	09/07/01	0.3	J	3	mg/L	19	142	12	No	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 5 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-059**	**2,4-Dinitrotoluene**	**0.00024**	**0.00052**	**01/21/14**	**2.2**		**1**	**mg/L**	**9**	**24**	**6**	**Yes**	**No Mann-Kendall Trend** **Increasing to Stable OLS Regression Line** **Increasing to Stable Theil-Sen Trend Line**
RVAAP-09 Load Line 2	Sharon	LL2mw-059	2,4-Dinitrotoluene	0.00024	0.0003	07/23/14	1.3		2	mg/L	9	24	6	Yes	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Increasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-267	2,4-Dinitrotoluene	0.00024	0.0003	08/21/13	1.3		2	mg/L	9	24	6	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-267**	**RDX**	**0.0007**	**0.0015**	**08/21/13**	**2.1**		**1**	**mg/L**	**5**	**24**	**5**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-10 Load Line 3	Sharon	Explosives	1,3,5-Trinitrobenzene	Yes	144	44	0.00005	0.0056	0.059	1	1	0.000028	0.065	7/21/2015	7/20/2015	7/14/2005	7/14/2005	
RVAAP-10 Load Line 3	Sharon	Explosives	1,3-Dinitrobenzene	Yes	144	4	0.00005	0.0056	0.0002	13	1	0.000051	0.00076	7/21/2015	8/4/2011	8/3/2011	8/3/2011	
RVAAP-10 Load Line 3	Sharon	Explosives	2,4,6-Trinitrotoluene	Yes	144	50	0.00005	0.0056	0.00098	37	35	0.000025	0.13	7/21/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	2,6-Dinitrotoluene	Yes	144	27	0.00005	0.0065	0.000048	144	27	0.000057	0.00092	7/21/2015	7/20/2015	7/21/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	2-Amino-4,6-Dinitrotoluene	Yes	144	75	0.000096	0.0056	0.0039	25	25	0.00012	0.032	7/21/2015	7/21/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	3-Nitrotoluene	Yes	144	2	0.000099	0.028	0.00017	96	1	0.00012	0.00036	7/21/2015	3/11/2015	8/4/2011	1/19/2011	
RVAAP-10 Load Line 3	Sharon	Explosives	4-Amino-2,6-Dinitrotoluene	Yes	144	82	0.00005	0.0056	0.0039	27	27	0.00006	0.059	7/21/2015	7/21/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	Nitrobenzene	Yes	144	7	0.00005	0.0056	0.00014	29	5	0.000073	0.0015	7/21/2015	3/11/2015	7/23/2014	7/23/2014	
RVAAP-10 Load Line 3	Sharon	Explosives	RDX	Yes	144	77	0.00005	0.0056	0.0007	39	36	0.00014	0.011	7/21/2015	7/21/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Miscellaneous	Cyanide	Yes	108	6	0.005	0.01	0.00015	108	6	0.0014	0.021	10/22/2014	1/18/2011	10/22/2014	1/18/2011	
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**alpha-BHC**	**No**	**142**	**3**	**0.0000095**	**0.0015**	**0.0000071**	**142**	**3**	**0.000018**	**0.000027**	**7/21/2015**	**8/3/2011**	**7/21/2015**	**8/3/2011**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**142**	**23**	**0.0000095**	**0.0015**	**0.000025**	**111**	**15**	**0.0000083**	**0.00028**	**7/21/2015**	**3/11/2015**	**7/21/2015**	**3/11/2015**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**142**	**2**	**0.0000095**	**0.0015**	**0.0000014**	**142**	**2**	**0.000038**	**0.000047**	**7/21/2015**	**3/11/2015**	**7/21/2015**	**3/11/2015**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**142**	**5**	**0.0000095**	**0.0015**	**0.0000014**	**142**	**5**	**0.000038**	**0.013**	**7/21/2015**	**10/5/2005**	**7/21/2015**	**10/5/2005**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**Toxaphene**	**No**	**142**	**1**	**0.00048**	**0.1**	**0.000015**	**142**	**1**	**0.0021**	**0.0021**	**7/21/2015**	**3/6/2006**	**7/21/2015**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	Sharon	SVOCs	2,6-Dinitrotoluene	Yes	99	1	0.00076	0.01	0.000048	99	1	0.0018	0.0018	1/31/2012	10/5/2005	1/31/2012	10/5/2005	
RVAAP-10 Load Line 3	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**145**	**59**	**0.00048**	**0.01**	**0.0056**	**47**	**6**	**0.00039**	**0.029**	**7/21/2015**	**8/20/2013**	**7/23/2014**	**8/3/2011**	**Lab contaminant**
RVAAP-10 Load Line 3	Sharon	SVOCs	Pentachlorophenol	Yes	111	1	0.00095	0.01	0.00004	111	1	0.003	0.003	10/22/2014	10/4/2005	10/22/2014	10/4/2005	
RVAAP-10 Load Line 3	**Sharon**	**VOCs**	**Chloroform**	**No**	**123**	**7**	**0.00025**	**0.005**	**0.00022**	**122**	**6**	**0.0002**	**0.0012**	**10/22/2014**	**4/7/2011**	**10/22/2014**	**4/7/2011**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present ab
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-10 Load Line 3	Sharon	LL3mw-232	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.012	04/08/08	< 0.01 U	07/08/10
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Explosives	2,6-Dinitrotoluene	13	4	0.00013	0.000048	13	4	0.00013	01/29/08	< 0.00011 UJ	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Explosives	RDX	13	11	0.0005	0.0007	1	1	0.00079	09/11/01	0.00053 J	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.021	01/29/08	< 0.01 U	07/08/10
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Pesticides and PCBs	alpha-BHC	13	2	0.000064	0.0000071	13	2	0.000027	07/08/08	0.000018 JB	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	13	7	0.01	0.0056	8	2	0.01	08/03/11	0.01 B	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-235	Pesticides and PCBs	alpha-BHC	6	1	0.00005	0.0000071	6	1	0.00002	10/08/08	< 0.000029 U	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	2,4,6-Trinitrotoluene	6	4	0.0002	0.00098	3	3	0.0034	01/29/08	0.002	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	2,6-Dinitrotoluene	6	3	0.00013	0.000048	6	3	0.000083	01/29/08	< 0.0001 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	2-Amino-4,6-Dinitrotoluene	6	5	0.0002	0.0039	3	3	0.0078	01/29/08	0.0057	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	4-Amino-2,6-Dinitrotoluene	6	5	0.0002	0.0039	4	4	0.013	01/29/08	0.01	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Pesticides and PCBs	beta-BHC	6	2	0.0003	0.000025	6	2	0.000061	01/29/08	< 0.0003 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	1,3,5-Trinitrobenzene	19	19	0.0056	0.059	1	1	0.065	07/14/05	0.024 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	1,3-Dinitrobenzene	19	1	0.0056	0.0002	10	1	0.00076	08/03/11	< 0.0001 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	2,4,6-Trinitrotoluene	19	19	0.0056	0.00098	19	19	0.13	07/14/05	0.055 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	2,6-Dinitrotoluene	19	8	0.0065	0.000048	19	8	0.00092	07/14/05	0.00038 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	2-Amino-4,6-Dinitrotoluene	19	19	0.0056	0.0039	18	18	0.032	09/18/01	0.009 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	3-Nitrotoluene	19	2	0.028	0.00017	14	1	0.00036	01/19/11	< 0.0001 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	4-Amino-2,6-Dinitrotoluene	19	19	0.0056	0.0039	19	19	0.059	01/21/14	0.025 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	Nitrobenzene	19	6	0.0056	0.00014	14	5	0.0015	10/03/06	< 0.0001 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	RDX	19	19	0.0056	0.0007	19	19	0.011	01/19/11	0.0068 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0019	05/02/06	< 0.01 UJ	01/19/11
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	beta-BHC	20	10	0.0015	0.000025	19	10	0.00028	07/14/05	< 0.000052 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	Heptachlor	20	1	0.0015	0.0000014	20	1	0.000038	03/11/15	< 0.000052 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	Heptachlor epoxide	20	2	0.0015	0.0000014	20	2	0.013	10/05/05	< 0.000052 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	Toxaphene	20	1	0.1	0.000015	20	1	0.0021	03/06/06	< 0.0021 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Semi-Volatile Organics	2,6-Dinitrotoluene	15	1	0.01	0.000048	15	1	0.0018	10/05/05	< 0.0048 U	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	20	7	0.01	0.0056	8	2	0.021	10/05/05	< 0.0049 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Explosives	RDX	6	5	0.00105	0.0007	5	4	0.0017	04/07/11	0.0017	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Pesticides and PCBs	Heptachlor epoxide	6	1	0.0000532	0.0000014	6	1	0.000075	09/18/01	< 0.00003 UJ	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	1	0.01	0.0056	5	1	0.0087	07/08/10	< 0.01 U	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Volatile Organics	Chloroform	6	6	0.005	0.00022	6	6	0.0012	09/18/01	0.00043 JB	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	2,4,6-Trinitrotoluene	14	14	0.00054	0.00098	13	13	0.012	04/08/08	0.006	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	2,6-Dinitrotoluene	14	10	0.00054	0.000048	14	10	0.0003	04/08/08	0.00014	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	2-Amino-4,6-Dinitrotoluene	14	14	0.00054	0.0039	4	4	0.0064	01/29/08	0.0026	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	4-Amino-2,6-Dinitrotoluene	14	14	0.00054	0.0039	4	4	0.0059	01/29/08	0.0027	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	RDX	14	13	0.0017	0.0007	13	12	0.0018	01/29/08	0.0013	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Pesticides and PCBs	beta-BHC	14	4	0.00011	0.000025	10	3	0.000052	07/07/08	< 0.000048 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Pesticides and PCBs	Heptachlor	14	1	0.00011	0.0000014	14	1	0.000047	03/11/15	< 0.000048 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0014	03/09/06	< 0.01 UJ	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Pesticides and PCBs	Heptachlor epoxide	18	2	0.00005	0.0000014	18	2	0.000051	04/12/05	< 0.00001 U	01/21/13
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	18	7	0.01	0.0056	7	1	0.029	01/18/11	< 0.00083 U	01/21/13
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Semi-Volatile Organics	Pentachlorophenol	15	1	0.01	0.00004	15	1	0.003	10/04/05	< 0.005 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Explosives	2,6-Dinitrotoluene	7	2	0.00013	0.000048	7	2	0.000079	01/28/08	0.000077 J	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Miscellaneous	Cyanide	7	2	0.01	0.00015	7	2	0.02	01/28/08	0.0056 J	01/18/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-001	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0072	07/10/08	< 0.01 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000073	07/10/08	< 0.000098 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	4,4'-DDD	5	1	0.00003	0.000031	1	1	0.00035	09/04/01	< 0.00003 UJ	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	Endrin	5	1	0.00003	0.00023	1	1	0.00031	09/04/01	< 0.00003 UJ	01/20/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**1,3,5-Trinitrobenzene**	**0.059**	**0.065**	**07/14/05**	**1.1**	**=**	**1**	**mg/L**	**44**	**144**	**1**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-238	1,3,5-Trinitrobenzene	0.059	0.024	07/20/15	0.4	J	2	mg/L	44	144	1	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	1,3,5-Trinitrobenzene	0.059	0.024	04/08/08	0.4		2	mg/L	44	144	1	Yes	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-237	1,3,5-Trinitrobenzene	0.059	0.00042	01/29/08	0.0	J	3	mg/L	44	144	1	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**1,3-Dinitrobenzene**	**0.0002**	**0.00076**	**08/03/11**	**3.8**	**J**	**1**	**mg/L**	**4**	**144**	**1**	**Yes**	**No Mann-Kendall Trend** **Decreasing to Stable OLS Regression Line** **Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	1,3-Dinitrobenzene	0.0002	0.00012	09/21/01	0.6	J	2	mg/L	4	144	1	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-236	1,3-Dinitrobenzene	0.0002	0.0001	08/04/11	0.5	B	3	mg/L	4	144	1	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.13**	**07/14/05**	**132.7**	**=**	**1**	**mg/L**	**50**	**144**	**35**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,4,6-Trinitrotoluene	0.00098	0.012	04/08/08	12.2		2	mg/L	50	144	35	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-237	2,4,6-Trinitrotoluene	0.00098	0.0034	01/29/08	3.5	J	3	mg/L	50	144	35	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,4,6-Trinitrotoluene	0.00098	0.0034	08/04/11	3.5		3	mg/L	50	144	35	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0018**	**10/05/05**	**37.5**	**J**	**1**	**mg/L**	**28**	**243**	**28**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-238	2,6-Dinitrotoluene	4.80E-05	0.0003	07/23/14	6.3	J	2	mg/L	28	243	28	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,6-Dinitrotoluene	4.80E-05	0.0003	04/08/08	6.3	J	2	mg/L	28	243	28	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-234	2,6-Dinitrotoluene	4.80E-05	0.00013	01/29/08	2.7	J	3	mg/L	28	243	28	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.032**	**09/18/01**	**8.2**	**=**	**1**	**mg/L**	**75**	**144**	**25**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-10 Load Line 3	Sharon	LL3mw-237	2-Amino-4,6-Dinitrotoluene	0.0039	0.0078	01/29/08	2.0	J	2	mg/L	75	144	25	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2-Amino-4,6-Dinitrotoluene	0.0039	0.0064	01/29/08	1.6		3	mg/L	75	144	25	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**3-Nitrotoluene**	**0.00017**	**0.00036**	**01/19/11**	**2.1**	**J**	**1**	**mg/L**	**2**	**144**	**1**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing to Stable OLS Regression Line Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.059**	**01/21/14**	**15.1**	**J**	**1**	**mg/L**	**82**	**144**	**27**	**Yes**	**No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-237	4-Amino-2,6-Dinitrotoluene	0.0039	0.013	01/29/08	3.3	J	2	mg/L	82	144	27	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	4-Amino-2,6-Dinitrotoluene	0.0039	0.0059	01/29/08	1.5		3	mg/L	82	144	27	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-234**	**Cyanide**	**0.00015**	**0.021**	**01/29/08**	**140.0**	**J**	**1**	**mg/L**	**6**	**108**	**6**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 6 samples**
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Cyanide	0.00015	0.02	01/28/08	133.3		2	mg/L	6	108	6	Yes	Insufficient data for statistical evaluation, 2 detection out of 6 samples
RVAAP-10 Load Line 3	Sharon	LL3mw-232	Cyanide	0.00015	0.012	04/08/08	80.0	J	3	mg/L	6	108	6	No	Insufficient data for statistical evaluation, 1 detection out of 6 samples, need for sampling reviewed after testing of LL3mw-234 and -243 for free cyanide
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**Nitrobenzene**	**0.00014**	**0.0015**	**10/03/06**	**10.7**	**=**	**1**	**mg/L**	**7**	**243**	**4**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Nitrobenzene	0.00014	7.30E-05	10/07/08	0.5	J	2	mg/L	7	243	4	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-242**	**Pentachlorophenol**	**4.00E-05**	**0.003**	**10/04/05**	**75.0**	**J**	**1**	**mg/L**	**1**	**111**	**1**	**No**	**Insufficient data for statistical evaluation, 1 detection out of 13 samples. Well has had 9 consecutive ND results since last detection.**
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**RDX**	**0.0007**	**0.011**	**01/19/11**	**15.7**	**J**	**1**	**mg/L**	**77**	**144**	**36**	**Yes**	**No Mann-Kendall Trend Stable (flat) OLS Regression Line Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	RDX	0.0007	0.0018	01/29/08	2.6	J	2	mg/L	77	144	36	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-239	RDX	0.0007	0.0017	04/07/11	2.4		3	mg/L	77	144	36	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.12**	**01/21/14**	**122.4**	**J**	**1**	**mg/L**	**11**	**35**	**11**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,4,6-Trinitrotoluene	0.00098	0.0071	01/21/13	7.2		2	mg/L	11	35	11	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,6-Dinitrotoluene**	**0.000048**	**0.00052**	**08/19/13**	**10.8**	**J**	**1**	**mg/L**	**8**	**35**	**8**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,6-Dinitrotoluene	0.000048	0.00014	07/20/15	2.9		2	mg/L	8	35	8	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.019**	**08/19/13**	**4.9**		**1**	**mg/L**	**30**	**35**	**5**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2-Amino-4,6-Dinitrotoluene	0.0039	0.003	01/21/13	0.8		2	mg/L	30	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-244	2-Amino-4,6-Dinitrotoluene	0.0039	0.00065	08/20/13	0.2		3	mg/L	30	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.059**	**01/21/14**	**15.1**	**J**	**1**	**mg/L**	**32**	**35**	**5**	**Yes**	**No Mann-Kendall Trend** **Decreasing to Stable OLS Regression Line** **Decreasing to Stable Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	4-Amino-2,6-Dinitrotoluene	0.0039	0.0029	01/21/13	0.7		2	mg/L	32	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	4-Amino-2,6-Dinitrotoluene	0.0039	0.0029	08/19/13	0.7		2	mg/L	32	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-244	4-Amino-2,6-Dinitrotoluene	0.0039	0.0007	01/22/14	0.2		3	mg/L	32	35	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**Nitrobenzene**	**0.00014**	**0.00017**	**08/19/13**	**1.2**	**J**	**1**	**mg/L**	**3**	**35**	**2**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**RDX**	**0.0007**	**0.0072**	**08/19/13**	**10.3**		**1**	**mg/L**	**32**	**35**	**10**	**Yes**	**No Mann-Kendall Trend** **Stable (flat) OLS Regression Line** **Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	RDX	0.0007	0.0013	07/20/15	1.9		2	mg/L	32	35	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-244	RDX	0.0007	0.00056	01/22/14	0.8		3	mg/L	32	35	10	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-11 Load Line 4	Sharon	SVOCs	Naphthalene	Yes	4	1	0.000095	0.000097	0.00017	1	1	0.00032	0.00032	1/23/2013	10/17/2012	10/17/2012	10/17/2012	
RVAAP-11 Load Line 4	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	70	4	0.000049	0.00102	0.000048	70	4	0.000051	0.000077	1/23/2013	7/7/2008	1/23/2013	7/7/2008	
RVAAP-11 Load Line 4	Unconsolidated	Miscellaneous	Cyanide	Yes	64	3	0.01	0.01	0.00015	64	3	0.0013	0.01	4/4/2011	4/4/2011	4/4/2011	4/4/2011	
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**70**	**4**	**0.0000095**	**0.000051**	**0.000025**	**65**	**2**	**0.00002**	**0.000043**	**1/23/2013**	**4/8/2008**	**4/4/2011**	**5/2/2006**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**Dieldrin**	**No**	**70**	**1**	**0.0000095**	**0.000051**	**0.0000017**	**70**	**1**	**0.000027**	**0.000027**	**1/23/2013**	**3/7/2006**	**1/23/2013**	**3/7/2006**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**70**	**2**	**0.0000095**	**0.000051**	**0.0000014**	**70**	**2**	**0.0000065**	**0.000013**	**1/23/2013**	**4/13/2005**	**1/23/2013**	**4/13/2005**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**70**	**2**	**0.0000095**	**0.000051**	**0.0000014**	**70**	**2**	**0.000022**	**0.000069**	**1/23/2013**	**10/5/2005**	**1/23/2013**	**10/5/2005**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**70**	**19**	**0.00076**	**0.01**	**0.0056**	**39**	**1**	**0.00082**	**0.0082**	**1/23/2013**	**1/23/2013**	**4/4/2011**	**7/8/2010**	**Lab contaminant**
RVAAP-11 Load Line 4	Unconsolidated	VOCs	Benzene	Yes	70	4	0.00025	0.005	0.00045	64	1	0.00031	0.00047	1/23/2013	10/7/2008	4/4/2011	10/7/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above S
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cance
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-11 Load Line 4	Sharon	LL4mw-201	Semi-Volatile Organics	Naphthalene	4	1	0.000097	0.00017	1	1	0.00032	10/17/12	< 0.000096 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-193	Explosives	2,6-Dinitrotoluene	6	2	0.00013	0.000048	6	2	0.000077	07/07/08	< 0.00011 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-193	Volatile Organics	Benzene	6	1	0.001	0.00045	6	1	0.00047	10/07/08	< 0.001 U	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-194	Explosives	2,6-Dinitrotoluene	5	2	0.00013	0.000048	5	2	0.00007	01/29/08	< 0.000095 U	10/07/08
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-196	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	2	0.01	0.0056	4	1	0.0082	07/08/10	0.00082 J	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-197	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0076	04/04/11	0.0076 J	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0013	03/07/06	< 0.01 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Pesticides and PCBs	Heptachlor	14	1	0.00005	0.0000014	14	1	0.0000065	04/13/05	< 0.00003 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Pesticides and PCBs	Heptachlor epoxide	14	1	0.00005	0.0000014	14	1	0.000069	10/05/05	< 0.00003 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Miscellaneous	Cyanide	18	1	0.01	0.00015	18	1	0.01	04/04/11	< 0.01 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	beta-BHC	21	3	0.00005	0.000025	17	2	0.000043	03/07/06	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Dieldrin	21	1	0.00005	0.0000017	21	1	0.000027	03/07/06	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Heptachlor	21	1	0.00005	0.0000014	21	1	0.000013	04/13/05	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Heptachlor epoxide	21	1	0.00005	0.0000014	21	1	0.000022	10/05/05	< 0.0000095 U	01/23/13

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-11 Load Line 4	**Sharon**	**LL4mw-201**	**Naphthalene**	**0.00017**	**0.00032**	**10/17/12**	**1.9**	**J**	**1**	**mg/L**	**1**	**4**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-11 Load Line 4	**Unconsolidated**	**LL4mw-193**	**2,6-Dinitrotoluene**	**4.80E-05**	**7.70E-05**	**07/07/08**	**1.6**	**J**	**1**	**mg/L**	**4**	**138**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-194	2,6-Dinitrotoluene	4.80E-05	7.00E-05	01/29/08	1.5	J	2	mg/L	4	138	4	Yes	To be sampled under the FWGWMP.
RVAAP-11 Load Line 4	**Unconsolidated**	**LL4mw-199**	**Cyanide**	**0.00015**	**0.01**	**09/06/01**	**66.7**	**=**	**1**	**mg/L**	**3**	**64**	**3**	**Yes**	**Well has had 12 consecutive ND results since last detection.**
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-197	Cyanide	0.00015	0.0076	04/04/11	50.7	J	2	mg/L	3	64	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Cyanide	0.00015	0.0013	03/07/06	8.7	J	3	mg/L	3	64	3	No	Well has had 8 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-12 Load Line 12	Sharon Shale	Explosives	2,4,6-Trinitrotoluene	Yes	49	4	0.00009	0.00046	0.00098	1	1	0.00024	0.0017	8/4/2011	11/1/2000	10/31/2000	10/31/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	2,4-Dinitrotoluene	Yes	49	2	0.00009	0.001	0.00024	7	1	0.000069	0.0012	8/4/2011	11/1/2000	11/5/2004	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	2-Nitrotoluene	Yes	49	6	0.0002	0.0006	0.00031	44	4	0.0001	0.0065	8/4/2011	4/19/2007	8/4/2011	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	Nitrobenzene	Yes	49	3	0.00009	0.00029	0.00014	7	1	0.000091	0.00015	8/4/2011	11/1/2000	11/5/2004	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	RDX	Yes	49	7	0.00009	0.0005	0.0007	3	3	0.000053	0.002	8/4/2011	7/10/2007	11/1/2000	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Miscellaneous	Cyanide	Yes	41	5	0.01	0.01	0.00015	41	5	0.0013	0.025	7/13/2010	1/30/2008	7/13/2010	1/30/2008	
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Aldrin**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.00000092**	**49**	**1**	**0.000016**	**0.000016**	**8/4/2011**	**3/7/2006**	**8/4/2011**	**3/7/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**alpha-BHC**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.0000071**	**49**	**1**	**0.000065**	**0.000065**	**8/4/2011**	**10/2/2006**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**beta-BHC**	**No**	**49**	**6**	**0.000029**	**0.0003**	**0.000025**	**44**	**1**	**0.000011**	**0.00057**	**8/4/2011**	**7/13/2010**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Dieldrin**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.0000017**	**49**	**1**	**0.0000093**	**0.0000093**	**8/4/2011**	**10/2/2006**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Heptachlor**	**No**	**49**	**4**	**0.000029**	**0.0003**	**0.0000014**	**49**	**4**	**0.0000072**	**0.000027**	**8/4/2011**	**8/2/2011**	**8/4/2011**	**8/2/2011**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**49**	**4**	**0.000029**	**0.0003**	**0.0000014**	**49**	**4**	**0.000007**	**0.00011**	**8/4/2011**	**10/2/2006**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Lindane**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.000041**	**11**	**1**	**0.0001**	**0.0001**	**8/4/2011**	**10/2/2006**	**10/2/2006**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	Sharon Shale	Pest/PCBs	PCB-1254	Yes	49	1	0.00048	0.0013	0.0000078	49	1	0.000051	0.000051	8/4/2011	10/5/2006	8/4/2011	10/5/2006	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Benz(a)anthracene	Yes	49	2	0.00019	0.01	0.000012	49	2	0.00014	0.00027	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Benzo(a)pyrene	Yes	49	2	0.00019	0.01	0.0000034	49	2	0.00016	0.00029	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Benzo(b)fluoranthene	Yes	49	1	0.00019	0.01	0.000034	49	1	0.0002	0.0002	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	49	18	0.001	0.015	0.0056	27	2	0.00089	0.034	8/4/2011	8/4/2011	8/2/2011	7/9/2008	Potential lab contaminant
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Dibenz(a,h)anthracene	Yes	49	2	0.00019	0.01	0.0000034	49	2	0.0005	0.00095	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	49	2	0.00019	0.01	0.000034	49	2	0.00037	0.00081	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Naphthalene	Yes	49	1	0.00019	0.01	0.00017	49	1	0.00029	0.00029	8/4/2011	7/13/2010	8/4/2011	7/13/2010	
RVAAP-12 Load Line 12	Sharon Shale	VOCs	1,2-Dichloroethane	Yes	49	1	0.001	0.005	0.00017	49	1	0.00046	0.00046	8/4/2011	10/2/2006	8/4/2011	10/2/2006	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2,4,6-Trinitrotoluene	Yes	191	5	0.000049	0.00036	0.00098	1	1	0.00012	0.003	7/22/2015	11/29/2004	11/29/2004	11/29/2004	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2,4-Dinitrotoluene	Yes	191	5	0.000049	0.00068	0.00024	24	5	0.00025	0.00065	7/22/2015	11/7/2000	11/30/2004	11/7/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	191	7	0.000049	0.00074	0.000048	191	7	0.000053	0.0001	7/22/2015	7/8/2008	7/22/2015	7/8/2008	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2-Nitrotoluene	Yes	191	12	0.000098	0.0014	0.00031	132	8	0.000097	0.0063	7/22/2015	4/19/2007	8/3/2011	11/7/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	3-Nitrotoluene	Yes	191	5	0.000098	0.00072	0.00017	146	2	0.000098	0.00078	7/22/2015	1/30/2008	8/3/2011	11/6/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	Nitrobenzene	Yes	191	17	0.000049	0.00023	0.00014	26	4	0.000051	0.00021	7/22/2015	10/7/2008	11/30/2004	11/6/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	Nitroglycerin	Yes	172	2	0.00049	0.0025	0.0002	171	1	0.00018	0.00038	7/22/2015	7/13/2010	7/22/2015	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	RDX	Yes	191	6	0.000049	0.0017	0.0007	6	2	0.000067	0.0015	7/22/2015	7/12/2010	11/29/2004	11/29/2004	
RVAAP-12 Load Line 12	Unconsolidated	Miscellaneous	Cyanide	Yes	120	5	0.01	0.01	0.00015	120	5	0.0016	0.057	1/22/2013	7/12/2010	1/22/2013	7/12/2010	
RVAAP-12 Load Line 12	Unconsolidated	Miscellaneous	Hydrazine	Yes	8	1	0.01	0.01	0.0000011	8	1	0.0192	0.0192	6/5/2009	6/5/2009	6/5/2009	6/5/2009	
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**4,4'-DDD**	**No**	**180**	**2**	**0.0000095**	**0.00095**	**0.000031**	**33**	**1**	**0.000013**	**0.000099**	**7/22/2014**	**4/9/2008**	**4/30/2012**	**11/6/2000**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**4,4'-DDE**	**No**	**180**	**1**	**0.0000095**	**0.00095**	**0.000046**	**29**	**1**	**0.000056**	**0.000056**	**7/22/2014**	**11/6/2000**	**4/30/2012**	**11/6/2000**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**Aldrin**	**No**	**180**	**1**	**0.0000095**	**0.00095**	**0.00000092**	**180**	**1**	**0.000054**	**0.000054**	**7/22/2014**	**11/6/2000**	**7/22/2014**	**11/6/2000**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**180**	**5**	**0.0000095**	**0.00095**	**0.0000071**	**180**	**5**	**0.0000082**	**0.000031**	**7/22/2014**	**8/3/2011**	**7/22/2014**	**8/3/2011**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**180**	**21**	**0.0000095**	**0.00095**	**0.000025**	**135**	**4**	**0.00001**	**0.00018**	**7/22/2014**	**8/20/2013**	**8/20/2013**	**8/20/2013**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**180**	**4**	**0.0000095**	**0.00095**	**0.0000014**	**180**	**4**	**0.000011**	**0.00017**	**7/22/2014**	**8/2/2011**	**7/22/2014**	**8/2/2011**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**180**	**2**	**0.0000095**	**0.00095**	**0.0000014**	**180**	**2**	**0.0000082**	**0.000012**	**7/22/2014**	**4/8/2008**	**7/22/2014**	**4/8/2008**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	Unconsolidated	Pest/PCBs	PCB-1248	Yes	167	1	0.00019	0.0015	0.0000078	167	1	0.00015	0.00015	1/22/2013	1/29/2008	1/22/2013	1/29/2008	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Benz(a)anthracene	Yes	168	1	0.000095	0.01	0.000012	168	1	0.00023	0.00023	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Benzo(b)fluoranthene	Yes	168	1	0.000095	0.01	0.000034	168	1	0.00022	0.00022	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	202	98	0.00048	0.025	0.0056	83	13	0.00055	0.073	7/22/2015	3/10/2015	1/23/2014	8/3/2011	Potential lab contaminant
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Dibenz(a,h)anthracene	Yes	168	1	0.000095	0.01	0.0000034	168	1	0.00021	0.00021	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	168	1	0.000095	0.01	0.000034	168	1	0.00022	0.00022	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Naphthalene	Yes	168	1	0.000095	0.01	0.00017	149	1	0.0014	0.0014	1/22/2013	7/13/2010	8/3/2011	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	VOCs	Benzene	Yes	181	16	0.00025	0.005	0.00045	137	4	0.00022	0.00058	7/22/2014	8/2/2011	8/3/2011	10/7/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer r
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Explosives	Nitroglycerin	17	1	0.0034	0.0002	17	1	0.00037	07/14/10	< 0.00051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	alpha-BHC	18	1	0.00015	0.0000071	18	1	0.000022	04/06/11	< 0.000051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	Heptachlor	18	1	0.00015	0.0000014	18	1	0.000066	03/10/15	< 0.000051 U	07/21/15
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Common Anions	Nitrate	4	3	0.2	3.2	2	2	16.3	10/31/00	< 0.1 U	06/05/09
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Explosives	2,4,6-Trinitrotoluene	9	2	0.00046	0.00098	1	1	0.0017	10/31/00	< 0.000099 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Explosives	2-Nitrotoluene	9	2	0.00057	0.00031	9	2	0.0017	10/31/00	< 0.0005 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Explosives	RDX	9	2	0.0005	0.0007	2	2	0.00093	10/31/00	< 0.000099 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Inorganics	Beryllium	11	5	0.005	0.0025	4	2	0.0168	10/16/09	0.0011	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Miscellaneous	Cyanide	7	1	0.01	0.00015	7	1	0.0087	01/30/08	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Miscellaneous	Total Phosphorus as P	1	1	0.5	0.00004	1	1	1.3	06/05/09	1.3 =	06/05/09
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Pesticides and PCBs	Heptachlor	9	1	0.00014	0.0000014	9	1	0.000008	08/02/11	0.000008 J	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0013	05/02/06	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Pesticides and PCBs	Heptachlor	17	1	0.00015	0.0000014	17	1	0.000027	07/12/10	< 0.000031 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Pesticides and PCBs	Heptachlor epoxide	17	1	0.00015	0.0000014	17	1	0.000007	05/02/06	< 0.000031 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Pesticides and PCBs	PCB-1254	17	1	0.0013	0.0000078	17	1	0.000051	10/05/06	< 0.00052 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Benz(a)anthracene	17	1	0.01	0.000012	17	1	0.00014	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Benzo(a)pyrene	17	1	0.01	0.0000034	17	1	0.00016	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	17	6	0.015	0.0056	9	1	0.0056	10/09/07	0.00089 J	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Dibenz(a,h)anthracene	17	1	0.01	0.0000034	17	1	0.0005	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	17	1	0.01	0.000034	17	1	0.00037	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Explosives	2-Nitrotoluene	15	2	0.0006	0.00031	13	1	0.0026	11/01/00	< 0.0005 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Explosives	RDX	15	3	0.0005	0.0007	1	1	0.002	11/01/00	< 0.000099 U	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Miscellaneous	Cyanide	13	3	0.01	0.00015	13	3	0.025	07/10/07	< 0.01 UJ	07/13/10
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Aldrin	15	1	0.0003	0.00000092	15	1	0.000016	03/07/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	alpha-BHC	15	1	0.0003	0.0000071	15	1	0.000065	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	beta-BHC	15	3	0.0003	0.000025	13	1	0.00057	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Dieldrin	15	1	0.0003	0.0000017	15	1	0.0000093	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Heptachlor	15	2	0.0003	0.0000014	15	2	0.00001	03/07/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Heptachlor epoxide	15	3	0.0003	0.0000014	15	3	0.00011	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Lindane	15	1	0.0003	0.000041	4	1	0.0001	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Benz(a)anthracene	15	1	0.01	0.000012	15	1	0.00027	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Benzo(a)pyrene	15	1	0.01	0.0000034	15	1	0.00029	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Benzo(b)fluoranthene	15	1	0.01	0.000034	15	1	0.0002	07/13/10	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Dibenz(a,h)anthracene	15	1	0.01	0.0000034	15	1	0.00095	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	15	1	0.01	0.000034	15	1	0.00081	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Volatile Organics	1,2-Dichloroethane	15	1	0.005	0.00017	15	1	0.00046	10/02/06	< 0.001 U	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Explosives	2,4-Dinitrotoluene	8	1	0.00036	0.00024	2	1	0.0012	11/01/00	< 0.000097 U	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Explosives	2-Nitrotoluene	8	1	0.00054	0.00031	7	1	0.0065	11/01/00	< 0.00048 U	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Explosives	Nitrobenzene	8	1	0.0002	0.00014	2	1	0.00015	11/01/00	< 0.000097 U	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	4	0.015	0.0056	5	1	0.034	07/09/08	0.0013 J	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Semi-Volatile Organics	Naphthalene	8	1	0.01	0.00017	8	1	0.00029	07/13/10	< 0.00019 U	08/04/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-088	Explosives	2,6-Dinitrotoluene	8	1	0.00074	0.000048	8	1	0.000055	04/08/08	< 0.00011 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-088	Explosives	2-Nitrotoluene	8	1	0.00054	0.00031	7	1	0.0063	11/01/00	< 0.00054 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.015	07/08/08	< 0.01 UJ	07/13/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Pesticides and PCBs	Heptachlor	14	1	0.00015	0.0000014	14	1	0.000011	08/02/11	0.000011 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	14	9	0.025	0.0056	7	2	0.073	01/31/08	0.0012 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	Explosives	RDX	8	1	0.0005	0.0007	1	1	0.00072	10/31/00	< 0.000097 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	Miscellaneous	Total Phosphorus as P	1	1	0.1	0.00004	1	1	0.09	06/03/09	0.09 J	06/03/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.015	0.0056	4	1	0.0095	08/03/11	0.0095 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	2,4-Dinitrotoluene	15	1	0.00036	0.00024	2	1	0.00065	11/06/00	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	2-Nitrotoluene	15	2	0.00059	0.00031	13	1	0.0049	11/06/00	< 0.00051 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	3-Nitrotoluene	15	1	0.00059	0.00017	15	1	0.00078	11/06/00	< 0.00051 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	Nitrobenzene	15	1	0.0002	0.00014	2	1	0.00021	11/06/00	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	4,4'-DDD	15	1	0.00011	0.000031	2	1	0.000099	11/06/00	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	Aldrin	15	1	0.000098	0.00000092	15	1	0.000054	11/06/00	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	beta-BHC	15	3	0.000098	0.000025	14	2	0.0001	07/12/10	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	Heptachlor	15	1	0.00015	0.0000014	15	1	0.00017	04/12/05	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	15	6	0.015	0.0056	8	2	0.012	11/06/00	0.0016 JB	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Explosives	2-Nitrotoluene	8	1	0.0005	0.00031	7	1	0.0039	11/06/00	< 0.0005 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Explosives	Nitrobenzene	8	1	0.0002	0.00014	2	1	0.00019	11/06/00	< 0.000099 UJ	08/03/11

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.057	07/08/08	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Pesticides and PCBs	4,4'-DDE	8	1	0.0001	0.000046	2	1	0.000056	11/06/00	< 0.000029 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Pesticides and PCBs	alpha-BHC	8	1	0.00015	0.0000071	8	1	0.00001	08/03/11	0.00001 JB	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Pesticides and PCBs	beta-BHC	8	3	0.0001	0.000025	6	1	0.000026	01/30/08	< 0.000029 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.015	0.0056	5	2	0.0095	08/03/11	0.0095 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Explosives	2,6-Dinitrotoluene	21	3	0.00043	0.000048	21	3	0.000089	05/02/06	< 0.0001 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Miscellaneous	Cyanide	18	2	0.01	0.00015	18	2	0.0035	01/24/07	< 0.01 UJ	07/13/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Pesticides and PCBs	Heptachlor	21	1	0.00014	0.0000014	21	1	0.000021	04/12/05	< 0.000031 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Pesticides and PCBs	Heptachlor epoxide	21	1	0.00014	0.0000014	21	1	0.000012	05/02/06	< 0.000031 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Benz(a)anthracene	21	1	0.01	0.000012	21	1	0.00023	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Benzo(b)fluoranthene	21	1	0.01	0.000034	21	1	0.00022	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	26	13	0.015	0.0056	10	1	0.0063	10/29/04	< 0.00076 U	01/22/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Dibenz(a,h)anthracene	21	1	0.01	0.0000034	21	1	0.00021	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	21	1	0.01	0.000034	21	1	0.00022	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Explosives	2,4-Dinitrotoluene	8	1	0.00036	0.00024	2	1	0.00058	10/31/00	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Explosives	2-Nitrotoluene	8	1	0.00052	0.00031	7	1	0.004	10/31/00	< 0.0005 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Explosives	Nitrobenzene	8	1	0.0002	0.00014	2	1	0.00016	10/29/04	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Pesticides and PCBs	Heptachlor epoxide	8	1	0.00014	0.0000014	8	1	0.0000082	04/08/08	< 0.000032 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.015	0.0056	4	1	0.011	08/03/11	0.011 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	Common Anions	Nitrate	3	3	40	3.2	3	3	185	11/07/00	171 J	06/04/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	Explosives	2,4-Dinitrotoluene	8	1	0.00036	0.00024	2	1	0.00042	11/07/00	< 0.0001 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	Explosives	2-Nitrotoluene	8	1	0.00052	0.00031	7	1	0.003	11/07/00	< 0.0005 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Common Anions	Nitrate	4	4	200	3.2	4	4	1330	06/05/09	1330 J	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Explosives	2,4-Dinitrotoluene	17	2	0.00036	0.00024	3	2	0.00028	10/31/00	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Explosives	2-Nitrotoluene	17	2	0.00058	0.00031	8	2	0.0023	10/31/00	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Explosives	3-Nitrotoluene	17	1	0.00058	0.00017	9	1	0.0002	10/31/00	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Miscellaneous	Hydrazine	1	1	0.01	0.0000011	1	1	0.0192	06/05/09	0.0192 =	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	17	8	0.015	0.0056	6	2	0.059	10/29/04	< 0.0048 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Explosives	2-Nitrotoluene	8	1	0.00056	0.00031	7	1	0.0032	11/06/00	< 0.0005 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Explosives	Nitrobenzene	8	2	0.0002	0.00014	2	1	0.00019	11/06/00	< 0.0001 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Pesticides and PCBs	Heptachlor	8	1	0.00015	0.0000014	8	1	0.000017	07/12/10	< 0.000029 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Pesticides and PCBs	PCB-1248	8	1	0.0015	0.0000078	8	1	0.00015	01/29/08	< 0.00048 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Miscellaneous	Total Phosphorus as P	1	1	0.1	0.00004	1	1	0.4	06/04/09	0.4 =	06/04/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Volatile Organics	Benzene	14	2	0.001	0.00045	8	2	0.00055	01/30/08	< 0.00025 U	07/22/14
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	2,4,6-Trinitrotoluene	7	1	0.00027	0.00098	1	1	0.003	11/29/04	< 0.00011 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	2,6-Dinitrotoluene	7	1	0.00047	0.000048	7	1	0.000059	07/08/08	< 0.00011 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	Nitroglycerin	7	1	0.0011	0.0002	7	1	0.00038	07/13/10	< 0.0007 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	RDX	7	1	0.00022	0.0007	1	1	0.0015	11/29/04	< 0.00011 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Miscellaneous	Total Phosphorus as P	1	1	0.5	0.00004	1	1	1	06/05/09	1 =	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Pesticides and PCBs	alpha-BHC	7	2	0.00015	0.0000071	7	2	0.000017	08/03/11	0.000017 JB	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	3	0.015	0.0056	5	1	0.011	08/03/11	0.011 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-244	Pesticides and PCBs	alpha-BHC	7	1	0.00015	0.0000071	7	1	0.000031	08/02/11	0.000031 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-244	Volatile Organics	Benzene	7	2	0.001	0.00045	6	1	0.00046	10/07/08	0.00022 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Explosives	2,6-Dinitrotoluene	23	2	0.00043	0.000048	23	2	0.0001	07/22/15	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Miscellaneous	Cyanide	10	1	0.01	0.00015	10	1	0.008	07/12/10	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Miscellaneous	Total Phosphorus as P	1	1	0.1	0.00004	1	1	0.09	06/05/09	0.09 J	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Pesticides and PCBs	alpha-BHC	20	1	0.00015	0.0000071	20	1	0.0000085	07/08/08	< 0.000019 U	07/22/14
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	11	0.015	0.0056	8	1	0.01	08/03/11	< 0.0048 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-246	Miscellaneous	Total Phosphorus as P	2	2	0.1	0.00004	2	2	0.06	06/04/09	0.03 J	06/04/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-246	Semi-Volatile Organics	Naphthalene	10	1	0.00098	0.00017	7	1	0.0014	07/13/10	< 0.000095 U	01/22/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-246	Volatile Organics	Benzene	10	1	0.001	0.00045	7	1	0.00058	10/07/08	< 0.00025 U	01/22/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-247	Pesticides and PCBs	beta-BHC	9	1	0.00095	0.000025	2	1	0.00018	08/20/13	< 0.000022 U	07/22/14

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**1,2-Dichloroethane**	**0.00017**	**0.00046**	**10/02/06**	**2.7**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-113**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.0017**	**10/31/00**	**1.7**	**J**	**1**	**mg/L**	**4**	**49**	**1**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	2,4,6-Trinitrotoluene	0.00098	0.00089	11/01/00	0.9	J	2	mg/L	4	49	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	2,4,6-Trinitrotoluene	0.00098	0.00024	10/30/00	0.2	J	3	mg/L	4	49	1	No	Well has had 14 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**2,4-Dinitrotoluene**	**0.00024**	**0.0012**	**11/01/00**	**5.0**	**J**	**1**	**mg/L**	**2**	**98**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	2,4-Dinitrotoluene	0.00024	6.90E-05	10/30/00	0.3	J	2	mg/L	2	98	1	No	Well has had 14 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**2-Nitrotoluene**	**0.00031**	**0.0065**	**11/01/00**	**21.0**	**J**	**1**	**mg/L**	**6**	**49**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	2-Nitrotoluene	0.00031	0.0026	11/01/00	8.4	J	2	mg/L	6	49	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	2-Nitrotoluene	0.00031	0.0017	10/31/00	5.5	J	3	mg/L	6	49	4	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.034**	**07/09/08**	**6.1**		**1**	**mg/L**	**18**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Bis(2-ethylhexyl)phthalate	0.0056	0.0056	10/09/07	1.0	J	2	mg/L	18	49	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Bis(2-ethylhexyl)phthalate	0.0056	0.0033	07/13/10	0.6	JB	3	mg/L	18	49	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Benz(a)anthracene**	**1.20E-05**	**0.00027**	**11/01/04**	**22.5**	**=**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Benz(a)anthracene	1.20E-05	0.00014	11/01/04	11.7	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Benzo(a)pyrene**	**3.40E-06**	**0.00029**	**11/01/04**	**85.3**	**J**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Benzo(a)pyrene	3.40E-06	0.00016	11/01/04	47.1	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.0002**	**11/01/04**	**5.9**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Cyanide**	**0.00015**	**0.025**	**07/10/07**	**166.7**		**1**	**mg/L**	**5**	**41**	**5**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Cyanide	0.00015	0.0087	01/30/08	58.0	J	2	mg/L	5	41	5	No	Well has had 4 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Cyanide	0.00015	0.0013	05/02/06	8.7	J	3	mg/L	5	41	5	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00095**	**11/01/04**	**279.4**	**J**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Dibenz(a,h)anthracene	3.40E-06	0.0005	11/01/04	147.1	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00081**	**11/01/04**	**23.8**	**=**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Indeno(1,2,3-cd)pyrene	3.40E-05	0.00037	11/01/04	10.9	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**Naphthalene**	**0.00017**	**0.00029**	**07/13/10**	**1.7**		**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**Nitrobenzene**	**0.00014**	**0.00015**	**11/01/00**	**1.1**	**J**	**1**	**mg/L**	**3**	**98**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Nitrobenzene	0.00014	0.00011	10/31/00	0.8	J	2	mg/L	3	98	1	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**RDX**	**0.0007**	**0.002**	**11/01/00**	**2.9**	**J**	**1**	**mg/L**	**7**	**49**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	RDX	0.0007	0.00093	10/31/00	1.3	J	2	mg/L	7	49	3	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	RDX	0.0007	0.00026	11/01/00	0.4	J	3	mg/L	7	49	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-243**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.003**	**11/29/04**	**3.1**	**=**	**1**	**mg/L**	**5**	**191**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	2,4,6-Trinitrotoluene	0.00098	0.00084	10/31/00	0.9	J	2	mg/L	5	191	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	2,4,6-Trinitrotoluene	0.00098	0.00041	10/30/00	0.4	J	3	mg/L	5	191	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-153**	**2,4-Dinitrotoluene**	**0.00024**	**0.00065**	**11/06/00**	**2.7**	**=**	**1**	**mg/L**	**5**	**346**	**5**	**No**	**Well has had 14 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	2,4-Dinitrotoluene	0.00024	0.00058	10/31/00	2.4	J	2	mg/L	5	346	5	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	2,4-Dinitrotoluene	0.00024	0.00042	11/07/00	1.8	=	3	mg/L	5	346	5	Yes	To be sampled uner the FWGWMP.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-245**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0001**	**04/09/08**	**2.1**	**J**	**1**	**mg/L**	**7**	**346**	**7**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	2,6-Dinitrotoluene	4.80E-05	8.90E-05	05/02/06	1.9	J	2	mg/L	7	346	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	2,6-Dinitrotoluene	4.80E-05	5.90E-05	01/24/07	1.2	J	3	mg/L	7	346	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	2,6-Dinitrotoluene	4.80E-05	5.90E-05	07/08/08	1.2	J	3	mg/L	7	346	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-088**	**2-Nitrotoluene**	**0.00031**	**0.0063**	**11/01/00**	**20.3**	**J**	**1**	**mg/L**	**12**	**191**	**8**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	2-Nitrotoluene	0.00031	0.0049	11/06/00	15.8	=	2	mg/L	12	191	8	No	Well has had 4 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	2-Nitrotoluene	0.00031	0.004	10/31/00	12.9	J	3	mg/L	12	191	8	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-153**	**3-Nitrotoluene**	**0.00017**	**0.00078**	**11/06/00**	**4.6**	**=**	**1**	**mg/L**	**5**	**191**	**2**	**No**	**Well has had 14 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	3-Nitrotoluene	0.00017	0.0002	10/31/00	1.2	J	2	mg/L	5	191	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	3-Nitrotoluene	0.00017	0.00017	10/30/00	1.0	J	3	mg/L	5	191	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	3-Nitrotoluene	0.00017	0.00017	10/31/00	1.0	J	3	mg/L	5	191	2	No	Well has had 5 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-107**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.073**	**01/31/08**	**13.0**	**J**	**1**	**mg/L**	**98**	**202**	**6**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Bis(2-ethylhexyl)phthalate	0.0056	0.059	10/29/04	10.5	=	2	mg/L	98	202	6	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Bis(2-ethylhexyl)phthalate	0.0056	0.012	11/06/00	2.1	=	3	mg/L	98	202	6	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Benz(a)anthracene**	**1.20E-05**	**0.00023**	**07/13/10**	**19.2**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-246**	**Benzene**	**0.00045**	**0.00058**	**10/07/08**	**1.3**	**JB**	**1**	**mg/L**	**16**	**181**	**1**	**No**	**Well has had 5 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Benzene	0.00045	0.00055	01/30/08	1.2	J	2	mg/L	16	181	1	Yes	To be sampled uner the FWGWMP.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-244	Benzene	0.00045	0.00046	10/07/08	1.0	JB	3	mg/L	16	181	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.00022**	**07/13/10**	**6.5**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-154**	**Cyanide**	**0.00015**	**0.057**	**07/08/08**	**380.0**		**1**	**mg/L**	**5**	**120**	**5**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Cyanide	0.00015	0.015	07/08/08	100.0		2	mg/L	5	120	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Cyanide	0.00015	0.008	07/12/10	53.3	J	3	mg/L	5	120	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00021**	**07/13/10**	**61.8**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-187**	**Hydrazine**	**1.10E-06**	**0.0192**	**06/05/09**	**17454.5**	**=**	**1**	**mg/L**	**1**	**8**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00022**	**07/13/10**	**6.5**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-246**	**Naphthalene**	**0.00017**	**0.0014**	**07/13/10**	**8.2**		**1**	**mg/L**	**1**	**168**	**1**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-153**	**Nitrobenzene**	**0.00014**	**0.00021**	**11/06/00**	**1.5**	**=**	**1**	**mg/L**	**17**	**346**	**4**	**No**	**Well has had 14 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Nitrobenzene	0.00014	0.00019	11/06/00	1.4	J	2	mg/L	17	346	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Nitrobenzene	0.00014	0.00019	11/06/00	1.4	J	2	mg/L	17	346	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Nitrobenzene	0.00014	0.00016	10/31/00	1.1	J	3	mg/L	17	346	4	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-243**	**Nitroglycerin**	**0.0002**	**0.00038**	**07/13/10**	**1.9**	**J**	**1**	**mg/L**	**2**	**172**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Nitroglycerin	0.0002	0.00018	11/30/04	0.9	J	2	mg/L	2	172	1	Yes	To be sampled uner the FWGWMP.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-183**	**PCB-1254**	**0.0000078**	**0.000051**	**10/05/06**	**6.5**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**No**	**Well has had 5 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-188**	**PCB-1248**	**0.0000078**	**0.00015**	**01/29/08**	**19.2**	**J**	**1**	**mg/L**	**1**	**167**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-243**	**RDX**	**0.0007**	**0.0015**	**11/29/04**	**2.1**	**=**	**1**	**mg/L**	**6**	**191**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	RDX	0.0007	0.00072	10/31/00	1.0	J	2	mg/L	6	191	2	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	RDX	0.0007	0.00034	11/07/00	0.5	J	3	mg/L	6	191	2	Yes	To be sampled uner the FWGWMP.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-13 Building 1200	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**25**	**16**	**0.00076**	**0.016**	**0.0056**	**9**	**1**	**0.00096**	**0.011**	**1/23/2013**	**1/23/2013**	**4/5/2011**	**1/19/2009**	**Lab contaminant**
RVAAP-13 Building 1200	Sharon	SVOCs	Di-n-octylphthalate	Yes	25	1	0.00076	0.01	0.02	1	1	0.025	0.025	1/23/2013	7/25/2012	7/25/2012	7/25/2012	
RVAAP-13 Building 1200	Sharon	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	25	1	0.000095	0.0004	0.000034	25	1	0.00072	0.00072	1/23/2013	4/10/2008	1/23/2013	4/10/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, exce
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-13 Building 1200	Sharon	B12mw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.015	0.0056	3	1	0.011	01/19/09	< 0.01 U	04/05/11
RVAAP-13 Building 1200	Sharon	B12mw-010	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	6	1	0.0004	0.000034	6	1	0.00072	04/10/08	< 0.0002 U	04/05/11
RVAAP-13 Building 1200	Sharon	B12mw-012	Semi-Volatile Organics	Di-n-octylphthalate	9	1	0.0093	0.02	1	1	0.025	07/25/12	< 0.00076 U	01/23/13
Site-wide Background Areas	Sharon	BKGmw-010	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0021	03/09/06	< 0.01 U	04/05/11
Site-wide Background Areas	Sharon	BKGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	4	0.015	0.0056	6	1	0.024	04/19/07	< 0.01 U	04/05/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-13 Building 1200	Sharon	B12mw-012	Di-n-octylphthalate	0.02	0.025	07/25/12	1.3		1	mg/L	1	25	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-13 Building 1200	Sharon	B12mw-010	Indeno(1,2,3-cd)pyrene	3.40E-05	0.00072	04/10/08	21.2		1	mg/L	1	25	1	No	Well has had 4 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2,4,6-Trinitrotoluene	Yes	62	16	0.000095	0.001	0.00098	13	12	0.000048	0.062	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2,4-Dinitrotoluene	Yes	63	10	0.000095	0.001	0.00024	20	9	0.000057	0.0006	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2,6-Dinitrotoluene	Yes	63	5	0.000095	0.001	0.000048	63	5	0.000052	0.00014	7/20/2015	1/20/2014	7/20/2015	1/20/2014	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2-Amino-4,6-Dinitrotoluene	Yes	62	16	0.000095	0.001	0.0039	12	12	0.00019	0.028	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	4-Amino-2,6-Dinitrotoluene	Yes	62	19	0.000095	0.001	0.0039	12	12	0.000063	0.039	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	Nitrobenzene	Yes	63	2	0.000095	0.001	0.00014	14	1	0.000054	0.00017	7/20/2015	4/14/2008	1/27/2009	11/20/2003	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Miscellaneous	Cyanide	Yes	41	3	0.01	0.01	0.00015	41	3	0.005	0.0062	1/19/2011	7/11/2008	1/19/2011	7/11/2008	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**Pest/PCBs**	**Aldrin**	**No**	**63**	**1**	**0.00002**	**0.0024**	**0.00000092**	**63**	**1**	**0.000029**	**0.000029**	**7/20/2015**	**1/27/2009**	**7/20/2015**	**1/27/2009**	**Pesticide from historical agricultural use**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**Pest/PCBs**	**beta-BHC**	**No**	**63**	**2**	**0.00002**	**0.0024**	**0.000025**	**62**	**2**	**0.00021**	**0.00024**	**7/20/2015**	**3/23/2015**	**7/20/2015**	**3/23/2015**	**Pesticide from historical agricultural use**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**VOCs**	**Methylene chloride**	**No**	**56**	**8**	**0.002**	**0.002**	**0.005**	**10**	**8**	**0.0051**	**0.0075**	**10/11/2011**	**11/19/2003**	**11/20/2003**	**11/19/2003**	**Lab contaminant**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	VOCs	Trichloroethene	Yes	58	2	0.001	0.001	0.00028	58	2	0.0071	0.012	10/11/2011	11/12/2003	10/11/2011	11/12/2003	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	19	2	0.000097	0.00011	0.000048	19	2	0.000064	0.000094	1/27/2009	10/8/2008	1/27/2009	10/8/2008	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	18	11	0.01	0.01	0.0056	8	2	0.001	0.0087	1/27/2009	1/27/2009	1/27/2009	7/11/2008	Potential lab contaminant
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Unconsolidated**	**VOCs**	**Methylene chloride**	**No**	**17**	**2**	**0.002**	**0.002**	**0.005**	**3**	**2**	**0.0061**	**0.0066**	**1/27/2009**	**11/18/2003**	**11/20/2003**	**11/18/2003**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-168	Volatile Organics	Methylene chloride	5	1	0.002	0.005	1	1	0.0058	11/19/03	< 0.002 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-169	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0057	11/18/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-170	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0051	11/12/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-170	Volatile Organics	Trichloroethene	7	1	0.001	0.00028	7	1	0.012	11/12/03	< 0.001 U	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Explosives	2,6-Dinitrotoluene	6	1	0.00011	0.000048	6	1	0.000052	04/14/08	< 0.00011 U	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0055	07/11/08	< 0.01 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Volatile Organics	Methylene chloride	6	1	0.002	0.005	1	1	0.0064	11/12/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Volatile Organics	Trichloroethene	6	1	0.001	0.00028	6	1	0.0071	11/12/03	< 0.001 U	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Explosives	2,6-Dinitrotoluene	7	1	0.0001	0.000048	7	1	0.000063	04/14/08	< 0.000097 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.005	07/11/08	< 0.01 UJ	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Pesticides and PCBs	Aldrin	7	1	0.00003	0.00000092	7	1	0.000029	01/27/09	< 0.00003 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Volatile Organics	Methylene chloride	7	2	0.002	0.005	2	2	0.0075	11/19/03	< 0.002 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	Explosives	Nitrobenzene	6	1	0.0001	0.00014	1	1	0.00017	11/20/03	< 0.000096 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2,4,6-Trinitrotoluene	12	12	0.001	0.00098	12	12	0.062	04/14/08	0.021	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2,4-Dinitrotoluene	12	10	0.001	0.00024	11	9	0.0006	07/20/15	0.0006 J	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2,6-Dinitrotoluene	12	3	0.001	0.000048	12	3	0.00014	01/19/11	< 0.0001 U	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2-Amino-4,6-Dinitrotoluene	12	12	0.001	0.0039	12	12	0.028	01/27/09	0.02	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	4-Amino-2,6-Dinitrotoluene	12	12	0.001	0.0039	12	12	0.039	01/19/11	0.028	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Pesticides and PCBs	beta-BHC	12	2	0.0024	0.000025	11	2	0.00024	04/14/08	< 0.000048 U	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0058	11/18/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-175	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0062	07/11/08	< 0.01 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-175	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0066	11/19/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-166	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000094	10/08/08	< 0.000099 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-166	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	4	3	0.01	0.0056	2	1	0.0062	07/11/08	0.0017 JB	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-167	Volatile Organics	Methylene chloride	6	2	0.002	0.005	2	2	0.0066	11/18/03	< 0.002 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-176	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	3	0.01	0.0056	6	1	0.0087	07/11/08	< 0.01 U	01/27/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.062**	**04/14/08**	**63.3**		**1**	**mg/L**	**17**	**63**	**13**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	2,4,6-Trinitrotoluene	0.00098	0.0019	11/20/03	1.9		2	mg/L	17	63	13	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2,4-Dinitrotoluene**	**0.00024**	**0.0006**	**07/20/15**	**2.5**	**J**	**1**	**mg/L**	**10**	**121**	**9**	**Yes**	**No Mann-Kendall Trend** **Decreasing to Stable OLS Regression Line** **Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00014**	**01/19/11**	**2.9**		**1**	**mg/L**	**5**	**121**	**5**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	2,6-Dinitrotoluene	4.80E-05	6.30E-05	04/14/08	1.3	J	2	mg/L	5	121	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	2,6-Dinitrotoluene	4.80E-05	5.20E-05	04/14/08	1.1	J	3	mg/L	5	121	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.028**	**01/27/09**	**7.2**		**1**	**mg/L**	**17**	**63**	**12**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	2-Amino-4,6-Dinitrotoluene	0.0039	0.0029	11/20/03	0.7		2	mg/L	17	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-168	2-Amino-4,6-Dinitrotoluene	0.0039	0.00031	01/27/09	0.1	J	3	mg/L	17	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	2-Amino-4,6-Dinitrotoluene	0.0039	0.00031	04/14/08	0.1		3	mg/L	17	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.039**	**01/19/11**	**10.0**		**1**	**mg/L**	**20**	**63**	**12**	**Yes**	**No Mann-Kendall Trend** **Decreasing to Stable OLS Regression Line** **Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	4-Amino-2,6-Dinitrotoluene	0.0039	0.0027	11/20/03	0.7		2	mg/L	20	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-168	4-Amino-2,6-Dinitrotoluene	0.0039	0.00036	01/27/09	0.1	J	3	mg/L	20	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Unconsolidated**	**FBQmw-176**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.0087**	**07/11/08**	**1.6**	**J**	**1**	**mg/L**	**12**	**19**	**2**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-166	Bis(2-ethylhexyl)phthalate	0.0056	0.0062	07/11/08	1.1	J	2	mg/L	12	19	2	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-167	Bis(2-ethylhexyl)phthalate	0.0056	0.0026	11/18/03	0.5	J	3	mg/L	12	19	2	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-175**	**Cyanide**	**0.00015**	**0.0062**	**07/11/08**	**41.3**	**JB**	**1**	**mg/L**	**3**	**41**	**1**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 4 samples**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Cyanide	0.00015	0.0055	07/11/08	36.7	JB	2	mg/L	3	41	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 4 samples

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Cyanide	0.00015	0.005	07/11/08	33.3	J	3	mg/L	3	41	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 5 samples
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-173**	**Nitrobenzene**	**0.00014**	**0.00017**	**11/20/03**	**1.2**		**1**	**mg/L**	**2**	**121**	**1**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-170	Nitrobenzene	0.00014	5.40E-05	04/14/08	0.4	J	2	mg/L	2	121	1	No	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing to Stable Theil-Sen Trend Line Well has had 4 consecutive ND results since last detection.
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-170**	**Trichloroethene**	**0.00028**	**0.012**	**11/12/03**	**42.9**	**=**	**1**	**mg/L**	**2**	**58**	**2**	**No**	**Insufficient data for statistical evaluation, 1 detection out of 6 samples.** **Well has had 5 consecutive ND results since last detection.**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Trichloroethene	0.00028	0.0071	11/12/03	25.4	=	2	mg/L	2	58	2	Yes	Insufficient data for statistical evaluation, 1 detection out of 6 samples
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Unconsolidated**	**FBQmw-166**	**2,6-Dinitrotoluene**	**4.80E-05**	**9.40E-05**	**10/08/08**	**2.0**	**J**	**1**	**mg/L**	**2**	**38**	**2**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2,4,6-Trinitrotoluene	0.00098	0.022	03/23/15	22.4		1	mg/L	5	5	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2,4-Dinitrotoluene	0.00024	0.0006	07/20/15	2.5	J	1	mg/L	5	5	5	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2,6-Dinitrotoluene	0.000048	0.00011	01/20/14	2.3	J	1	mg/L	1	5	1	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2-Amino-4,6-Dinitrotoluene	0.0039	0.02	07/20/15	5.1		1	mg/L	5	5	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	4-Amino-2,6-Dinitrotoluene	0.0039	0.028	07/20/15	7.2		1	mg/L	5	5	5	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	26	2	0.000095	0.00062	0.000048	26	2	0.000057	0.00007	1/19/2011	1/27/2009	1/19/2011	1/27/2009	
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	Miscellaneous	Cyanide	Yes	21	1	0.01	0.01	0.00015	21	1	0.0099	0.0099	1/19/2011	7/9/2008	1/19/2011	7/9/2008	
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	26	16	0.01	0.015	0.0056	11	1	0.00081	0.015	1/19/2011	1/19/2011	10/8/2008	1/12/2005	Potential lab contaminant

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-025	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0099	07/09/08	< 0.01 UJ	01/19/11
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-025	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	6	0.015	0.0056	1	1	0.015	01/12/05	0.00081 J	01/19/11
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-026	Explosives	2,6-Dinitrotoluene	6	2	0.00058	0.000048	6	2	0.00007	10/08/08	0.000057 J	01/27/09

Notes
COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).
DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-19 Landfill North of Winklepeck Burning Grounds	**Unconsolidated**	**LNWmw-026**	**2,6-Dinitrotoluene**	**4.80E-05**	**7.00E-05**	**10/08/08**	**1.5**	**J**	**1**	**mg/L**	**2**	**52**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-19 Landfill North of Winklepeck Burning Grounds	**Unconsolidated**	**LNWmw-025**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**1.50E-02**	**01/12/05**	**2.7**	**=**	**1**	**mg/L**	**16**	**26**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-027	Bis(2-ethylhexyl)phthalate	5.60E-03	4.50E-03	01/27/09	0.8	JB	2	mg/L	16	26	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at LNWmw-025.
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-024	Bis(2-ethylhexyl)phthalate	5.60E-03	4.10E-03	10/08/08	0.7	J	3	mg/L	16	26	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at LNWmw-025.
RVAAP-19 Landfill North of Winklepeck Burning Grounds	**Unconsolidated**	**LNWmw-025**	**Cyanide**	**0.00015**	**0.0099**	**07/09/08**	**66.0**	**J**	**1**	**mg/L**	**1**	**21**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	25	1	0.000095	0.00012	0.000048	25	1	0.000062	0.000062	1/18/2011	10/14/2008	1/18/2011	10/14/2008	
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	Miscellaneous	Cyanide	Yes	25	1	0.01	0.01	0.00015	25	1	0.0075	0.0075	1/18/2011	7/15/2008	1/18/2011	7/15/2008	
RVAAP-28 Suspected Mustard Agent Burial Site	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**25**	**19**	**0.01**	**0.01**	**0.0056**	**7**	**1**	**0.00083**	**0.011**	**1/18/2011**	**1/28/2009**	**1/18/2011**	**7/15/2008**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-006	2,6-Dinitrotoluene	4.80E-05	6.20E-05	10/14/08	1.3	J	1	mg/L	1	50	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-004	Cyanide	0.00015	0.0075	07/15/08	50.0	J	1	mg/L	1	25	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	39	2	0.000096	0.00012	0.000048	39	2	0.000054	0.000073	1/20/2011	7/10/2008	1/20/2011	7/10/2008	
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	Miscellaneous	Cyanide	Yes	39	1	0.01	0.01	0.00015	39	1	0.0072	0.0072	1/20/2011	7/10/2008	1/20/2011	7/10/2008	
RVAAP-29 Upper and Lower Cobbs Ponds	**Unconsolidated**	**Pest/PCBs**	**4,4'-DDD**	**No**	**39**	**1**	**0.00003**	**0.00003**	**0.000031**	**1**	**1**	**0.00035**	**0.00035**	**1/20/2011**	**9/4/2001**	**9/4/2001**	**9/4/2001**	**Pesticide from historical agricultural use**
RVAAP-29 Upper and Lower Cobbs Ponds	**Unconsolidated**	**Pest/PCBs**	**Endrin**	**No**	**39**	**1**	**0.00003**	**0.00003**	**0.00023**	**1**	**1**	**0.00031**	**0.00031**	**1/20/2011**	**9/4/2001**	**9/4/2001**	**9/4/2001**	**Pesticide from historical agricultural use**
RVAAP-29 Upper and Lower Cobbs Ponds	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**39**	**19**	**0.01**	**0.012**	**0.0056**	**22**	**2**	**0.0012**	**0.016**	**1/20/2011**	**1/20/2011**	**1/20/2011**	**7/9/2008**	**Lab contaminant**
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	SVOCs	Naphthalene	Yes	39	1	0.0002	0.00024	0.00017	39	1	0.00034	0.00034	1/20/2011	1/20/2009	1/20/2011	1/20/2009	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-001	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0072	07/10/08	< 0.01 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.01	0.0056	4	1	0.016	07/09/08	< 0.01 U	01/20/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000073	07/10/08	< 0.000098 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	4,4'-DDD	5	1	0.00003	0.000031	1	1	0.00035	09/04/01	< 0.00003 UJ	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	Endrin	5	1	0.00003	0.00023	1	1	0.00031	09/04/01	< 0.00003 UJ	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	7	0.012	0.0056	6	1	0.016	07/27/01	< 0.01 UJ	01/20/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Naphthalene	12	1	0.00024	0.00017	12	1	0.00034	01/20/09	< 0.0002 U	01/20/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	2,6-Dinitrotoluene	4.80E-05	7.30E-05	07/10/08	1.5	J	1	mg/L	2	71	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-001	Cyanide	0.00015	0.0072	07/10/08	48.0	J	1	mg/L	1	39	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Naphthalene	0.00017	0.00034	01/20/09	2.0	J	1	mg/L	1	39	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-33 Load Line 6	Homewood	Explosives	Nitroglycerin	Yes	27	1	0.0005	0.00074	0.0002	27	1	0.00035	0.00035	1/23/2013	7/15/2008	1/23/2013	7/15/2008	
RVAAP-33 Load Line 6	Homewood	SVOCs	4-Nitrobenzenamine	Yes	27	1	0.00076	0.002	0.0038	1	1	0.0041	0.0041	1/23/2013	12/15/2003	12/15/2003	12/15/2003	
RVAAP-33 Load Line 6	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**32**	**16**	**0.00076**	**0.04**	**0.0056**	**12**	**2**	**0.00092**	**0.069**	**1/23/2013**	**1/23/2013**	**10/12/2011**	**4/22/2009**	**Lab contaminant**
RVAAP-33 Load Line 6	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	20	1	0.000097	0.00011	0.000048	20	1	0.00009	0.00009	1/23/2013	10/12/2009	1/23/2013	10/12/2009	
RVAAP-33 Load Line 6	Unconsolidated	Miscellaneous	Cyanide	Yes	20	1	0.01	0.01	0.00015	20	1	0.0073	0.0073	1/23/2013	7/15/2008	1/23/2013	7/15/2008	
RVAAP-33 Load Line 6	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	24	11	0.00076	0.012	0.0056	12	4	0.00076	0.022	1/23/2013	7/25/2012	7/25/2012	7/25/2012	Potential lab contaminant

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present abo
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime ca
DL - laboratory method detection limit
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mg/L - milligrams per liter
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Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-33 Load Line 6	Homewood	LL6mw-003	Explosives	Nitroglycerin	5	1	0.0007	0.0002	5	1	0.00035	07/15/08	< 0.00063 U	01/21/09
RVAAP-33 Load Line 6	Homewood	LL6mw-004	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.04	0.0056	2	1	0.069	04/22/09	0.002 J	10/12/10
RVAAP-33 Load Line 6	Homewood	LL6mw-005	Semi-Volatile Organics	4-Nitrobenzenamine	7	1	0.002	0.0038	1	1	0.0041	12/15/03	< 0.002 U	10/12/10
RVAAP-33 Load Line 6	Homewood	LL6mw-005	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	3	0.01	0.0056	6	1	0.0091	12/15/03	< 0.00078 U	01/23/13
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-001	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.0073	07/15/08	< 0.01 U	10/12/10
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-001	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.012	0.0056	4	1	0.014	12/17/03	< 0.01 U	10/13/10
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-002	Inorganics	Beryllium	11	2	0.001	0.0025	1	1	0.0027	10/21/09	< 0.00009 U	01/23/13
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	4	0.011	0.0056	3	1	0.022	07/25/12	< 0.00076 U	01/23/13
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-006	Explosives	2,6-Dinitrotoluene	5	1	0.00011	0.000048	5	1	0.00009	10/12/09	0.00009 J	10/12/09
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	2	0.01	0.0056	5	2	0.014	12/17/03	< 0.01 U	10/12/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-33 Load Line 6	**Homewood**	**LL6mw-005**	**4-Nitrobenzenamine**	**0.0038**	**0.0041**	**12/15/03**	**1.1**	**J**	**1**	**mg/L**	**1**	**27**	**1**	**No**	**Well has had 5 consecutive ND results since last detection.**
RVAAP-33 Load Line 6	**Homewood**	**LL6mw-004**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**6.90E-02**	**04/22/09**	**12.3**	**B**	**1**	**mg/L**	**16**	**32**	**1**	**No**	**The need for characterization of DEHP will be based on confirmation of the constituent at LL6mw-007.**
RVAAP-33 Load Line 6	Homewood	LL6mw-005	Bis(2-ethylhexyl)phthalate	5.60E-03	9.10E-03	12/15/03	1.6	=	2	mg/L	16	32	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at LL6mw-007.
RVAAP-33 Load Line 6	Homewood	LL6mw-007	Bis(2-ethylhexyl)phthalate	5.60E-03	2.00E-03	04/22/09	0.4	JB	3	mg/L	16	32	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	**Homewood**	**LL6mw-003**	**Nitroglycerin**	**0.0002**	**0.00035**	**07/15/08**	**1.8**	**J**	**1**	**mg/L**	**1**	**27**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-33 Load Line 6	**Unconsolidated**	**LL6mw-006**	**2,6-Dinitrotoluene**	**4.80E-05**	**9.00E-05**	**10/12/09**	**1.9**	**J**	**1**	**mg/L**	**1**	**35**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-33 Load Line 6	**Unconsolidated**	**LL6mw-002**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**2.20E-02**	**07/25/12**	**3.9**		**1**	**mg/L**	**11**	**24**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-001	Bis(2-ethylhexyl)phthalate	5.60E-03	1.40E-02	12/17/03	2.5	=	2	mg/L	11	24	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-006	Bis(2-ethylhexyl)phthalate	5.60E-03	1.40E-02	12/17/03	2.5	=	2	mg/L	11	24	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-008	Bis(2-ethylhexyl)phthalate	5.60E-03	1.10E-03	07/25/12	0.2		3	mg/L	11	24	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	**Unconsolidated**	**LL6mw-001**	**Cyanide**	**0.00015**	**0.0073**	**07/15/08**	**48.7**	**J**	**1**	**mg/L**	**1**	**20**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-38 NACA Test Area	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	77	4	0.000096	0.00077	0.000048	77	4	0.000052	0.000077	7/20/2015	10/14/2008	7/20/2015	10/14/2008	
RVAAP-38 NACA Test Area	Unconsolidated	Miscellaneous	Cyanide	Yes	58	4	0.01	0.01	0.00015	58	4	0.0056	0.0076	1/24/2013	7/15/2008	1/24/2013	7/15/2008	
RVAAP-38 NACA Test Area	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**72**	**1**	**0.0000095**	**0.00019**	**0.0000071**	**72**	**1**	**0.0000072**	**0.0000072**	**1/24/2013**	**10/14/2008**	**1/24/2013**	**10/14/2008**	**Pesticide from historical agricultural use**
RVAAP-38 NACA Test Area	Unconsolidated	Pest/PCBs	PCB-1248	Yes	74	1	0.00019	0.0015	0.0000078	74	1	0.00025	0.00025	1/24/2013	10/14/2008	1/24/2013	10/14/2008	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Benz(a)anthracene	Yes	80	1	0.000095	0.0002	0.000012	80	1	0.00014	0.00014	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Benzo(a)pyrene	Yes	80	1	0.000095	0.00041	0.0000034	80	1	0.00012	0.00012	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Benzo(b)fluoranthene	Yes	80	1	0.000095	0.00041	0.000034	80	1	0.0001	0.0001	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**80**	**43**	**0.0005**	**0.015**	**0.0056**	**33**	**2**	**0.00042**	**0.0076**	**7/20/2015**	**8/21/2013**	**1/18/2011**	**7/15/2008**	**Lab contaminant**
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Dibenz(a,h)anthracene	Yes	80	1	0.000095	0.00041	0.0000034	80	1	0.00024	0.00024	7/20/2015	12/1/2004	7/20/2015	12/1/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	80	2	0.000095	0.00041	0.000034	80	2	0.00009	0.00021	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Naphthalene	Yes	80	6	0.000095	0.001	0.00017	70	2	0.00011	0.00026	7/20/2015	1/23/2014	10/16/2012	10/16/2012	

Notes

Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-001	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	3	0.01	0.0056	3	1	0.011	07/15/08	< 0.01 U	01/18/11
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-004	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0075	07/15/08	< 0.01 U	01/28/09
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-006	Explosives	2,6-Dinitrotoluene	4	1	0.00011	0.000048	4	1	0.000062	10/14/08	< 0.0001 U	01/28/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-109	Pesticides and PCBs	PCB-1248	7	1	0.0015	0.0000078	7	1	0.00025	10/14/08	< 0.00019 U	01/24/13
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Explosives	2,6-Dinitrotoluene	8	1	0.00043	0.000048	8	1	0.000074	10/14/08	< 0.000098 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Pesticides and PCBs	alpha-BHC	8	1	0.00015	0.0000071	8	1	0.0000072	10/14/08	< 0.00003 UJ	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Benz(a)anthracene	8	1	0.0002	0.000012	8	1	0.00014	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Benzo(a)pyrene	8	1	0.0004	0.0000034	8	1	0.00012	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Benzo(b)fluoranthene	8	1	0.0004	0.000034	8	1	0.0001	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	4	0.015	0.0056	5	1	0.0076	07/15/08	0.003 JB	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	8	1	0.0004	0.000034	8	1	0.00009	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-114	Explosives	2,6-Dinitrotoluene	6	1	0.00073	0.000048	6	1	0.000052	04/15/08	< 0.0001 UJ	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-115	Explosives	2,6-Dinitrotoluene	5	1	0.00077	0.000048	5	1	0.000077	04/15/08	< 0.0001 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-115	Miscellaneous	Cyanide	4	2	0.01	0.00015	4	2	0.0076	04/15/08	< 0.01 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0058	07/15/08	< 0.01 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.015	0.0056	4	1	0.0061	12/01/04	< 0.01 UJ	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Semi-Volatile Organics	Dibenz(a,h)anthracene	6	1	0.0004	0.0000034	6	1	0.00024	12/01/04	< 0.0002 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	6	1	0.0004	0.000034	6	1	0.00021	12/01/04	< 0.0002 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-117	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0056	04/15/08	< 0.01 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-118	Explosives	2,6-Dinitrotoluene	5	1	0.00071	0.000048	5	1	0.000058	04/15/08	< 0.0001 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-119	Semi-Volatile Organics	Naphthalene	9	6	0.0001	0.00017	2	2	0.00026	10/16/12	< 0.000095 U	07/20/15

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-115**	**2,6-Dinitrotoluene**	**4.80E-05**	**7.70E-05**	**04/15/08**	**1.6**	**J**	**1**	**mg/L**	**4**	**151**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	2,6-Dinitrotoluene	4.80E-05	7.40E-05	10/14/08	1.5	J	2	mg/L	4	151	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-118	2,6-Dinitrotoluene	4.80E-05	5.80E-05	04/15/08	1.2	J	3	mg/L	4	151	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-113**	**Benz(a)anthracene**	**1.20E-05**	**0.00014**	**12/14/04**	**11.7**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-113**	**Benzo(a)pyrene**	**3.40E-06**	**0.00012**	**12/14/04**	**35.3**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-113**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.0001**	**12/14/04**	**2.9**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-115**	**Cyanide**	**0.00015**	**0.0076**	**04/15/08**	**50.7**	**J**	**1**	**mg/L**	**4**	**58**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Cyanide	0.00015	0.0058	07/15/08	38.7	J	2	mg/L	4	58	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-117	Cyanide	0.00015	0.0056	04/15/08	37.3	J	3	mg/L	4	58	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-116**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00024**	**12/01/04**	**70.6**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-116**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00021**	**12/01/04**	**6.2**	**J**	**1**	**mg/L**	**2**	**80**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Indeno(1,2,3-cd)pyrene	3.40E-05	9.00E-05	12/14/04	2.6	J	2	mg/L	2	80	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-119**	**Naphthalene**	**0.00017**	**0.00026**	**10/16/12**	**1.5**		**1**	**mg/L**	**6**	**80**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-109**	**PCB-1248**	**0.0000078**	**0.00025**	**10/14/08**	**32.1**	**J**	**1**	**mg/L**	**1**	**74**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-39 Load Line 5	Homewood	Miscellaneous	Cyanide	Yes	24	1	0.01	0.01	0.00015	24	1	0.0079	0.0079	1/22/2009	10/10/2008	1/22/2009	10/10/2008	
RVAAP-39 Load Line 5	Homewood	Pest/PCBs	PCB-1248	Yes	30	1	0.0005	0.0015	0.0000078	30	1	0.00041	0.00041	1/22/2009	10/10/2008	1/22/2009	10/10/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Resi
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-39 Load Line 5	Homewood	LL5mw-001	Pesticides and PCBs	PCB-1248	5	1	0.0014	0.0000078	5	1	0.00041	10/10/08	< 0.0005 UJ	01/21/09
RVAAP-39 Load Line 5	Homewood	LL5mw-002	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0079	10/10/08	< 0.01 U	01/21/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-39 Load Line 5	Homewood	LL5mw-002	Cyanide	0.00015	0.0079	10/10/08	52.7	J	1	mg/L	1	24	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-39 Load Line 5	Homewood	LL5mw-001	PCB-1248	0.0000078	0.00041	10/10/08	52.6	J	1	mg/L	1	30	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-40 Load Line 7	Homewood	Explosives	RDX	Yes	40	9	0.00005	0.00023	0.0007	2	2	0.00018	0.00081	7/23/2015	10/12/2009	10/12/2009	10/12/2009	
RVAAP-40 Load Line 7	Homewood	Miscellaneous	Cyanide	Yes	31	1	0.01	0.01	0.00015	31	1	0.025	0.025	10/13/2010	10/12/2010	10/13/2010	10/12/2010	
RVAAP-40 Load Line 7	**Homewood**	**Pest/PCBs**	**beta-BHC**	**No**	**38**	**5**	**0.00003**	**0.0001**	**0.000025**	**34**	**1**	**0.0000087**	**0.000027**	**10/13/2010**	**10/12/2009**	**10/13/2010**	**7/13/2009**	**Pesticide from historical agricultural use**
RVAAP-40 Load Line 7	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**39**	**24**	**0.005**	**0.015**	**0.0056**	**15**	**1**	**0.00096**	**0.0058**	**7/23/2015**	**10/13/2010**	**10/13/2010**	**7/13/2009**	**Lab contaminant**
RVAAP-40 Load Line 7	Homewood	VOCs	1,1-Dichloroethane	Yes	40	8	0.0005	0.001	0.0027	4	4	0.0016	0.0035	7/23/2015	7/23/2015	10/12/2009	10/12/2009	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer presen
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifet
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-40 Load Line 7	Homewood	LL7mw-001	Inorganics	Beryllium	9	1	0.002	0.0025	1	1	0.0054	10/12/09	< 0.001 U	07/23/15
RVAAP-40 Load Line 7	Homewood	LL7mw-001	Volatile Organics	1,1-Dichloroethane	8	8	0.001	0.0027	4	4	0.0035	01/22/09	0.0016	07/23/15
RVAAP-40 Load Line 7	Homewood	LL7mw-001	Volatile Organics	1,1-Dichloroethene	8	8	0.001	0.007	2	2	0.0084	10/12/09	0.0043	07/23/15
RVAAP-40 Load Line 7	Homewood	LL7mw-002	Pesticides and PCBs	beta-BHC	5	1	0.0001	0.000025	5	1	0.000027	07/13/09	< 0.00003 UJ	10/12/09
RVAAP-40 Load Line 7	Homewood	LL7mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	2	0.015	0.0056	4	1	0.0058	07/13/09	< 0.01 U	10/12/09
RVAAP-40 Load Line 7	Homewood	LL7mw-005	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.025	10/12/10	0.025 J	10/12/10
RVAAP-40 Load Line 7	Homewood	LL7mw-006	Explosives	RDX	9	9	0.0002	0.0007	2	2	0.00081	10/12/09	0.00078 J	10/12/09
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-001	Explosives	Nitroglycerin	8	1	0.0033	0.0002	8	1	0.00054	01/18/11	< 0.00069 U	04/06/11
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-001	Miscellaneous	Cyanide	8	1	0.01	0.00015	8	1	0.0076	01/18/10	< 0.01 U	04/06/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-40 Load Line 7	Homewood	LL7mw-001	1,1-Dichloroethane	0.0027	0.0035	01/22/09	1.3		1	mg/L	8	40	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-40 Load Line 7	Homewood	LL7mw-001	1,1-Dichloroethene	0.007	0.0084	10/12/09	1.2		1	mg/L	8	40	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-40 Load Line 7	Homewood	LL7mw-005	Cyanide	0.00015	0.025	10/12/10	166.7	J	1	mg/L	1	31	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-40 Load Line 7	Homewood	LL7mw-006	RDX	0.0007	0.00081	10/12/09	1.2	J	1	mg/L	9	40	2	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-41 Load Line 8	Unconsolidated	Miscellaneous	Cyanide	Yes	17	1	0.01	0.01	0.00015	17	1	0.0057	0.0057	10/13/2010	4/27/2009	10/13/2010	4/27/2009	
RVAAP-41 Load Line 8	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**22**	**11**	**0.01**	**0.016**	**0.0056**	**12**	**1**	**0.001**	**0.03**	**10/13/2010**	**7/14/2009**	**10/13/2010**	**1/22/2009**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present abov
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime can
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-41 Load Line 8	Unconsolidated	LL8mw-001	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0057	04/27/09	< 0.01 U	10/13/09
RVAAP-41 Load Line 8	Unconsolidated	LL8mw-003	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.015	0.0056	4	1	0.03	01/22/09	< 0.01 U	10/13/10

Notes
COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).
DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-41 Load Line 8	Unconsolidated	LL8mw-001	Cyanide	0.00015	0.0057	04/27/09	38.0	J	1	mg/L	1	17	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-42 Load Line 9	Homewood	Explosives	2,6-Dinitrotoluene	Yes	41	4	0.000095	0.00011	0.000048	41	4	0.000061	0.000085	10/13/2010	10/13/2009	10/13/2010	10/13/2009	
RVAAP-42 Load Line 9	**Homewood**	**Pest/PCBs**	**beta-BHC**	**No**	**41**	**8**	**0.00003**	**0.00003**	**0.000025**	**34**	**1**	**0.0000086**	**0.00015**	**10/13/2010**	**7/14/2009**	**10/13/2010**	**7/14/2009**	**Pesticide from historical agricultural use**
RVAAP-42 Load Line 9	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**41**	**26**	**0.01**	**0.01**	**0.0056**	**10**	**2**	**0.00087**	**0.02**	**10/13/2010**	**10/13/2009**	**10/13/2010**	**10/13/2009**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer pres
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lif
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-42 Load Line 9	Homewood	LL9mw-002	Explosives	2,6-Dinitrotoluene	6	1	0.0001	0.000048	6	1	0.000061	01/22/09	< 0.0001 U	10/13/10
RVAAP-42 Load Line 9	Homewood	LL9mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.01	0.0056	3	2	0.02	01/22/09	< 0.01 U	10/13/10
RVAAP-42 Load Line 9	Homewood	LL9mw-003	Explosives	2,6-Dinitrotoluene	5	1	0.0001	0.000048	5	1	0.000085	04/29/09	< 0.0001 U	10/13/09
RVAAP-42 Load Line 9	Homewood	LL9mw-006	Pesticides and PCBs	beta-BHC	5	2	0.00003	0.000025	4	1	0.00015	07/14/09	< 0.00003 UJ	10/13/09
RVAAP-42 Load Line 9	Homewood	LL9mw-007	Explosives	2,6-Dinitrotoluene	6	2	0.0001	0.000048	6	2	0.000085	10/13/09	0.000085 JB	10/13/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-42 Load Line 9	**Homewood**	**LL9mw-003**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.50E-05**	**04/29/09**	**1.8**	**J**	**1**	**mg/L**	**4**	**74**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-42 Load Line 9	**Homewood**	**LL9mw-007**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.50E-05**	**10/13/09**	**1.8**	**JB**	**1**	**mg/L**	**4**	**74**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-42 Load Line 9	Homewood	LL9mw-002	2,6-Dinitrotoluene	4.80E-05	6.10E-05	01/22/09	1.3	J	2	mg/L	4	74	3	No	Well has had 4 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-43 Load Line 10	Homewood	Explosives	2,4,6-Trinitrotoluene	Yes	28	2	0.000096	0.00048	0.00098	1	1	0.00017	0.0012	10/13/2010	1/10/2005	1/10/2005	1/10/2005	
RVAAP-43 Load Line 10	Homewood	Explosives	2,6-Dinitrotoluene	Yes	28	1	0.000096	0.00082	0.000048	28	1	0.000089	0.000089	10/13/2010	1/22/2009	10/13/2010	1/22/2009	
RVAAP-43 Load Line 10	Homewood	Miscellaneous	Cyanide	Yes	28	1	0.01	0.01	0.00015	28	1	0.0071	0.0071	10/13/2010	4/28/2009	10/13/2010	4/28/2009	
RVAAP-43 Load Line 10	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**30**	**14**	**0.0048**	**0.016**	**0.0056**	**15**	**1**	**0.00083**	**0.0081**	**7/23/2015**	**10/13/2009**	**10/13/2010**	**10/13/2009**	**Lab contaminant**
RVAAP-43 Load Line 10	Homewood	VOCs	Carbon tetrachloride	Yes	36	18	0.00025	0.001	0.00045	36	18	0.00047	0.0061	7/23/2015	7/23/2015	7/23/2015	7/23/2015	
RVAAP-43 Load Line 10	**Homewood**	**VOCs**	**Chloroform**	**No**	**36**	**11**	**0.00025**	**0.001**	**0.00022**	**35**	**10**	**0.00022**	**0.00064**	**7/23/2015**	**3/11/2015**	**7/23/2015**	**3/11/2015**	**Lab contaminant**
RVAAP-43 Load Line 10	Unconsolidated	Miscellaneous	Cyanide	Yes	9	1	0.01	0.01	0.00015	9	1	0.007	0.007	10/14/2009	4/27/2009	10/14/2009	4/27/2009	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present ab
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime c
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-43 Load Line 10	Homewood	L10mw-001	Explosives	2,4,6-Trinitrotoluene	5	1	0.00033	0.00098	1	1	0.0012	01/10/05	< 0.000098 U	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-001	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0071	04/28/09	< 0.01 U	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-001	Volatile Organics	Carbon tetrachloride	5	4	0.001	0.00045	5	4	0.0016	10/13/09	0.0016 J	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-001	Volatile Organics	Chloroform	5	2	0.001	0.00022	4	1	0.00026	10/13/09	0.00026 J	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-002	Explosives	2,6-Dinitrotoluene	6	1	0.00043	0.000048	6	1	0.000089	01/22/09	< 0.000096 U	10/13/10
RVAAP-43 Load Line 10	Homewood	L10mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.015	0.0056	4	1	0.0081	10/13/09	< 0.01 U	10/13/10
RVAAP-43 Load Line 10	Homewood	L10mw-003	Volatile Organics	Carbon tetrachloride	14	14	0.001	0.00045	14	14	0.0061	07/24/14	0.0013	07/23/15
RVAAP-43 Load Line 10	Homewood	L10mw-003	Volatile Organics	Chloroform	14	9	0.001	0.00022	14	9	0.00064	03/11/15	< 0.001 U	07/23/15
RVAAP-43 Load Line 10	Unconsolidated	L10mw-006	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.007	04/27/09	< 0.01 U	10/14/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-43 Load Line 10	**Homewood**	**L10mw-001**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.0012**	**01/10/05**	**1.2**		**1**	**mg/L**	**2**	**28**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-43 Load Line 10	Homewood	L10mw-002	2,4,6-Trinitrotoluene	0.00098	0.00017	01/10/05	0.2	J	2	mg/L	2	28	1	No	Well has had 5 consecutive ND results since last detection.
RVAAP-43 Load Line 10	**Homewood**	**L10mw-002**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.90E-05**	**01/22/09**	**1.9**	**J**	**1**	**mg/L**	**1**	**58**	**1**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-43 Load Line 10	**Homewood**	**L10mw-003**	**Carbon tetrachloride**	**0.00045**	**0.0061**	**07/24/14**	**13.6**		**1**	**mg/L**	**18**	**36**	**18**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-43 Load Line 10	Homewood	L10mw-001	Carbon tetrachloride	0.00045	0.0016	10/13/09	3.6	J	2	mg/L	18	36	18	Yes	Trend analysis to be conducted after RI sampling
RVAAP-43 Load Line 10	Homewood	L10mw-003	Carbon tetrachloride	0.00045	0.0016	01/17/05	3.6	=	2	mg/L	18	36	18	Yes	Trend analysis to be conducted after RI sampling
RVAAP-43 Load Line 10	**Homewood**	**L10mw-001**	**Cyanide**	**0.00015**	**0.0071**	**04/28/09**	**47.3**	**J**	**1**	**mg/L**	**1**	**28**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-43 Load Line 10	**Unconsolidated**	**L10mw-006**	**Cyanide**	**0.00015**	**0.007**	**04/27/09**	**46.7**	**J**	**1**	**mg/L**	**1**	**9**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-43 Load Line 10	Homewood	L10mw-003	Carbon tetrachloride	0.00045	0.0061	07/24/14	13.6		1	mg/L	6	6	6	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-44 Load Line 11	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	84	4	0.000049	0.00013	0.000048	84	4	0.000084	0.00011	1/24/2013	4/23/2009	1/24/2013	4/23/2009	
RVAAP-44 Load Line 11	Unconsolidated	Miscellaneous	Cyanide	Yes	81	1	0.01	0.01	0.00015	81	1	0.0015	0.0015	1/24/2013	3/8/2006	1/24/2013	3/8/2006	
RVAAP-44 Load Line 11	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**84**	**6**	**0.0000095**	**0.00003**	**0.000025**	**64**	**3**	**0.000012**	**0.00021**	**1/24/2013**	**10/14/2009**	**10/13/2010**	**7/15/2009**	**Pesticide from historical agricultural use**
RVAAP-44 Load Line 11	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**84**	**2**	**0.0000095**	**0.00003**	**0.0000014**	**84**	**2**	**0.000024**	**0.000087**	**1/24/2013**	**5/3/2006**	**1/24/2013**	**5/3/2006**	**Pesticide from historical agricultural use**
RVAAP-44 Load Line 11	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	84	39	0.00076	0.1	0.0056	42	6	0.00083	0.35	1/24/2013	1/24/2013	10/13/2010	10/14/2009	Potential lab contaminant
RVAAP-44 Load Line 11	Unconsolidated	VOCs	Trichloroethene	Yes	84	2	0.00025	0.001	0.00028	77	2	0.002	0.003	1/24/2013	12/20/2000	10/13/2010	12/20/2000	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer r
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-001	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.1	3	1	0.35	10/14/09	< 0.01 U	10/13/10	0.01
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Explosives	2,6-Dinitrotoluene	16	1	0.00012	16	1	0.000084	07/11/06	< 0.0001 U	10/13/10	0.0001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Pesticides and PCBs	beta-BHC	16	3	0.00003	14	2	0.00021	04/17/07	< 0.00003 UJ	10/13/10	0.00003
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Pesticides and PCBs	Heptachlor	16	2	0.00003	16	2	0.000087	04/13/05	< 0.00003 UJ	10/13/10	0.00003
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	16	3	0.01	10	1	0.03	12/14/00	0.0028 J	10/13/10	0.0028
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-003	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	4	0.01	2	1	0.0086	10/14/09	0.0086 J	10/14/09	0.0086
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-006	Explosives	2,6-Dinitrotoluene	5	1	0.00012	5	1	0.000084	04/23/09	< 0.0001 U	10/14/09	0.0001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-007	Miscellaneous	Cyanide	14	1	0.01	14	1	0.0015	03/08/06	< 0.01 U	10/13/10	0.01
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-008	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	4	0.01	2	1	0.0094	01/23/09	0.00083 J	10/14/09	0.00083
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-008	Volatile Organics	Trichloroethene	5	1	0.001	5	1	0.003	12/20/00	< 0.001 U	10/14/09	0.001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Pesticides and PCBs	beta-BHC	6	1	0.00003	5	1	0.000029	07/15/09	< 0.00003 UJ	10/13/10	0.00003
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	2	0.01	5	1	0.0059	07/15/09	< 0.01 U	10/13/10	0.01
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Volatile Organics	Trichloroethene	6	1	0.001	6	1	0.002	12/15/00	< 0.001 U	10/13/10	0.001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-010	Explosives	2,6-Dinitrotoluene	9	2	0.00012	9	2	0.00011	04/23/09	< 0.000098 UJ	10/14/09	0.000098
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.01	5	1	0.0057	10/14/09	0.0057 J	10/14/09	0.0057

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-010**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00011**	**04/23/09**	**2.3**	**J**	**1**	**mg/L**	**4**	**151**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	2,6-Dinitrotoluene	4.80E-05	8.40E-05	07/11/06	1.8	J	2	mg/L	4	151	4	Yes	Well has had 6 consecutive ND results since last detection. Well will be sampled to confirm current conditions still support delineation to below MDLs.
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-006	2,6-Dinitrotoluene	4.80E-05	8.40E-05	04/23/09	1.8	J	2	mg/L	4	151	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-001**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**3.50E-01**	**10/14/09**	**62.5**		**1**	**mg/L**	**39**	**84**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Bis(2-ethylhexyl)phthalate	5.60E-03	3.00E-02	12/14/00	5.4	=	2	mg/L	39	84	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-008	Bis(2-ethylhexyl)phthalate	5.60E-03	9.40E-03	01/23/09	1.7	JB	3	mg/L	39	84	4	No	The need for characterization of DEHP will be based on confirmation of the constituent at LL11mw-001.
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-007**	**Cyanide**	**0.00015**	**0.0015**	**03/08/06**	**10.0**	**J**	**1**	**mg/L**	**1**	**81**	**1**	**No**	**Well has had 8 consecutive ND results since last detection.**
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-008**	**Trichloroethene**	**0.00028**	**0.003**	**12/20/00**	**10.7**	**=**	**1**	**mg/L**	**2**	**84**	**2**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Trichloroethene	0.00028	0.002	12/15/00	7.1	=	2	mg/L	2	84	2	No	Well has had 5 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-49 Central Burn Pits	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**7**	**7**	**0.00076**	**0.00083**	**0.0056**	**1**	**1**	**0.00081**	**0.032**	**1/23/2013**	**1/23/2013**	**5/1/2012**	**5/1/2012**	**Lab contaminant**
RVAAP-49 Central Burn Pits	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	62	5	0.000095	0.00011	0.000048	62	5	0.000053	0.000082	1/20/2011	7/10/2008	1/20/2011	7/10/2008	
RVAAP-49 Central Burn Pits	Unconsolidated	Explosives	Nitroglycerin	Yes	45	1	0.00062	0.00073	0.0002	45	1	0.00038	0.00038	1/20/2011	1/21/2009	1/20/2011	1/21/2009	
RVAAP-49 Central Burn Pits	Unconsolidated	Miscellaneous	Cyanide	Yes	62	3	0.01	0.01	0.00015	62	3	0.0018	0.011	1/20/2011	10/9/2008	1/20/2011	10/9/2008	
RVAAP-49 Central Burn Pits	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**65**	**2**	**0.0000095**	**0.00003**	**0.0000014**	**65**	**2**	**0.000014**	**0.000085**	**1/22/2013**	**10/10/2008**	**1/22/2013**	**10/10/2008**	**Pesticide from historical agricultural use**
RVAAP-49 Central Burn Pits	Unconsolidated	Pest/PCBs	PCB-1248	Yes	65	3	0.00019	0.001	0.0000078	65	3	0.0001	0.00022	1/22/2013	10/9/2008	1/22/2013	10/9/2008	
RVAAP-49 Central Burn Pits	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	65	28	0.00076	0.01	0.0056	30	1	0.00091	0.008	1/22/2013	7/24/2012	1/20/2011	10/10/2008	Potential lab contaminant

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk o
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-49 Central Burn Pits	Sharon	CBPmw-009	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	7	0.00083	0.0056	1	1	0.032	05/01/12	0.001 J	01/23/13
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-001	Explosives	Nitroglycerin	6	1	0.00072	0.0002	6	1	0.00038	01/21/09	< 0.00072 U	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-001	Pesticides and PCBs	PCB-1248	6	1	0.0005	0.0000078	6	1	0.00011	10/09/08	< 0.0005 UJ	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-002	Explosives	2,6-Dinitrotoluene	5	1	0.000099	0.000048	5	1	0.000075	07/10/08	< 0.000099 U	01/21/09
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-002	Pesticides and PCBs	PCB-1248	8	1	0.0005	0.0000078	8	1	0.00022	10/09/08	< 0.00019 UJ	01/22/13
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-003	Explosives	2,6-Dinitrotoluene	5	1	0.00011	0.000048	5	1	0.000063	07/09/08	< 0.00011 U	01/21/09
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Explosives	2,6-Dinitrotoluene	10	1	0.00011	0.000048	10	1	0.000065	04/09/08	< 0.00011 U	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Miscellaneous	Cyanide	10	1	0.01	0.00015	10	1	0.0065	10/09/08	< 0.01 UJ	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Pesticides and PCBs	PCB-1248	10	1	0.0005	0.0000078	10	1	0.0001	10/09/08	< 0.0005 UJ	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-005	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.0018	03/08/06	< 0.01 UJ	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-005	Pesticides and PCBs	Heptachlor	11	1	0.00003	0.0000014	11	1	0.000085	07/14/05	< 0.00003 UJ	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-006	Inorganics	Beryllium	7	2	0.001	0.0025	1	1	0.0037	10/21/09	0.0037	10/21/09
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-006	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.011	04/17/07	< 0.01 UJ	04/09/08
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-007	Explosives	2,6-Dinitrotoluene	14	1	0.0001	0.000048	14	1	0.000082	10/03/05	< 0.0001 U	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-008	Explosives	2,6-Dinitrotoluene	6	1	0.0001	0.000048	6	1	0.000053	04/09/08	< 0.000096 U	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-008	Pesticides and PCBs	Heptachlor	6	1	0.00003	0.0000014	6	1	0.000014	10/10/08	< 0.00003 U	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-008	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.01	0.0056	4	1	0.008	10/10/08	< 0.01 U	01/19/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	7	0.012	0.0056	6	1	0.016	07/27/01	< 0.01 UJ	01/20/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Naphthalene	12	1	0.00024	0.00017	12	1	0.00034	01/20/09	< 0.0002 U	01/20/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-49 Central Burn Pits	**Sharon**	**CBPmw-009**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**3.20E-02**	**05/01/12**	**5.7**	**J**	**1**	**mg/L**	**7**	**7**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-007**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.20E-05**	**10/03/05**	**1.7**	**J**	**1**	**mg/L**	**5**	**116**	**5**	**No**	**Well has had 9 consecutive ND results since last detection.**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-002	2,6-Dinitrotoluene	4.80E-05	7.50E-05	07/10/08	1.6	J	2	mg/L	5	116	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	2,6-Dinitrotoluene	4.80E-05	6.50E-05	04/09/08	1.4	J	3	mg/L	5	116	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-008**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**8.00E-03**	**10/10/08**	**1.4**	**J**	**1**	**mg/L**	**28**	**65**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-007	Bis(2-ethylhexyl)phthalate	5.60E-03	4.30E-03	07/10/07	0.8	J	2	mg/L	28	65	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at CBPmw-008.
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Bis(2-ethylhexyl)phthalate	5.60E-03	3.70E-03	07/10/08	0.7	J	3	mg/L	28	65	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-006**	**Cyanide**	**0.00015**	**0.011**	**04/17/07**	**73.3**	**J**	**1**	**mg/L**	**3**	**62**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Cyanide	0.00015	0.0065	10/09/08	43.3	J	2	mg/L	3	62	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-005	Cyanide	0.00015	0.0018	03/08/06	12.0	J	3	mg/L	3	62	3	No	Well has had 5 consecutive ND results since last detection.
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-001**	**Nitroglycerin**	**0.0002**	**0.00038**	**01/21/09**	**1.9**	**J**	**1**	**mg/L**	**1**	**45**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-002**	**PCB-1248**	**0.0000078**	**0.00022**	**10/09/08**	**28.2**	**J**	**1**	**mg/L**	**3**	**65**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-001	PCB-1248	0.0000078	0.00011	10/09/08	14.1	J	2	mg/L	3	65	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	PCB-1248	0.0000078	0.0001	10/09/08	12.8	J	3	mg/L	3	65	3	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-50 Atlas Scrap Yard	Sharon	Explosives	2,6-Dinitrotoluene	Yes	38	1	0.000096	0.00082	0.000048	38	1	0.00006	0.00006	4/7/2011	1/20/2010	4/7/2011	1/20/2010	
RVAAP-50 Atlas Scrap Yard	Sharon	Miscellaneous	Cyanide	Yes	30	1	0.01	0.02	0.00015	30	1	0.0059	0.0059	4/7/2011	4/28/2009	4/7/2011	4/28/2009	
RVAAP-50 Atlas Scrap Yard	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**38**	**23**	**0.01**	**0.015**	**0.0056**	**16**	**1**	**0.0009**	**0.058**	**4/7/2011**	**1/21/2010**	**4/7/2011**	**12/1/2004**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present a
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
Sharon	ASYmw-003	RVAAP-50 Atlas Scrap Yard	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	3	0.015	0.0056	5	1	0.058	12/01/04	< 0.01 UJB	04/07/11
Sharon	ASYmw-004	RVAAP-50 Atlas Scrap Yard	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0059	04/28/09	< 0.01 UJ	01/21/10
Sharon	ASYmw-005	RVAAP-50 Atlas Scrap Yard	Explosives	2,6-Dinitrotoluene	5	1	0.00049	0.000048	5	1	0.00006	01/20/10	0.00006 J	01/20/10
Unconsolidated	ASYmw-008	RVAAP-50 Atlas Scrap Yard	Inorganics	Beryllium	10	3	0.002	0.0025	2	2	0.0046	10/15/09	< 0.001 U	01/20/10

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-50 Atlas Scrap Yard	Sharon	ASYmw-005	2,6-Dinitrotoluene	4.80E-05	6.00E-05	01/20/10	1.3	J	1	mg/L	1	76	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-50 Atlas Scrap Yard	Sharon	ASYmw-004	Cyanide	0.00015	0.0059	04/28/09	39.3	J	1	mg/L	1	30	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Non-AOC Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-66 Facility-wide Groundwater	Homewood	FWGmw-005	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	4	0.00082	0.0056	1	1	0.011	7/25/2012	< 0.00076 U	1/23/2013
RVAAP-66 Facility-wide Groundwater	Sharon	FWGmw-013	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0071	10/17/2012	< 0.01 U	1/24/2013
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-002	Semi-Volatile Organics	Naphthalene	4	1	0.0001	0.00017	1	1	0.0002	1/22/2013	0.0002	1/22/2013
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-003	Semi-Volatile Organics	Naphthalene	4	1	0.00011	0.00017	1	1	0.00027	7/25/2012	< 0.000099 U	1/23/2013
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-004	Miscellaneous	Cyanide	7	1	0.01	0.00015	7	1	0.0064	10/15/2012	< 0.005 U	7/24/2014
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-006	Volatile Organics	Benzene	5	2	0.00025	0.00045	2	2	0.0015	5/2/2012	< 0.00025 U	8/21/2013
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	4	2	0.00078	0.0056	1	1	0.04	10/15/2012	< 0.00078 U	1/21/2013
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-011	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.0051	0.0056	1	1	0.013	8/20/2013	< 0.0048 U	7/22/2015
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-001	Explosives	Nitroglycerin	8	1	0.0033	0.0002	8	1	0.00054	1/18/2011	< 0.00069 U	4/6/2011
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-001	Miscellaneous	Cyanide	8	1	0.01	0.00015	8	1	0.0076	1/18/2010	< 0.01 U	4/6/2011
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Explosives	Nitroglycerin	17	1	0.0034	0.0002	17	1	0.00037	7/14/2010	< 0.00051 U	7/21/2015
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	alpha-BHC	18	1	0.00015	0.0000071	18	1	0.000022	4/6/2011	< 0.000051 U	7/21/2015
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	Heptachlor	18	1	0.00015	0.0000014	18	1	0.000066	3/10/2015	< 0.000051 U	7/21/2015
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-004	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.013	10/12/2010	< 0.01 U	4/5/2011
Site-wide Background Areas	Sharon	BKGmw-006	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.022	1/22/2007	< 0.01 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	13	3	0.01	0.0056	8	1	0.0059	3/9/2006	< 0.01 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-008	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0014	5/3/2006	< 0.01 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-008	Pesticides and PCBs	Heptachlor	14	1	0.00003	0.0000014	14	1	0.000011	3/7/2006	< 0.00003 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-010	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0021	3/9/2006	< 0.01 U	4/5/2011
Site-wide Background Areas	Sharon	BKGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	4	0.015	0.0056	6	1	0.024	4/19/2007	< 0.01 U	4/5/2011
Site-wide Background Areas	Sharon	BKGmw-012	Pesticides and PCBs	beta-BHC	11	5	0.00003	0.000025	7	1	0.000026	10/10/2007	0.000026 J	10/10/2007
Site-wide Background Areas	Sharon	BKGmw-012	Pesticides and PCBs	Heptachlor	11	1	0.00003	0.0000014	11	1	0.0000076	4/12/2005	< 0.00003 UJ	10/10/2007
Site-wide Background Areas	Sharon	BKGmw-012	Volatile Organics	Benzene	11	5	0.001	0.00045	10	4	0.0011	10/3/2006	< 0.001 U	10/10/2007
Site-wide Background Areas	Sharon	BKGmw-015	Miscellaneous	Cyanide	14	2	0.01	0.00015	14	2	0.015	5/21/1998	< 0.01 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-015	Pesticides and PCBs	Dieldrin	12	1	0.00003	0.0000017	12	1	0.000053	7/12/2005	< 0.00003 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-015	Pesticides and PCBs	Heptachlor	12	1	0.00003	0.0000014	12	1	0.0000094	7/12/2005	< 0.00003 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-015	Pesticides and PCBs	PCB-1242	12	1	0.001	0.0000078	12	1	0.009	7/12/2005	< 0.0005 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-015	Pesticides and PCBs	PCB-1260	12	1	0.001	0.0000078	12	1	0.0067	7/12/2005	< 0.0005 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-015	Pesticides and PCBs	Toxaphene	12	1	0.002	0.000015	12	1	0.0053	7/12/2005	< 0.002 U	4/6/2011
Site-wide Background Areas	Sharon	BKGmw-018	Miscellaneous	Cyanide	15	2	0.01	0.00015	15	2	0.041	1/22/2007	< 0.01 U	4/7/2011
Site-wide Background Areas	Unconsolidated	BKGmw-004	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0051	7/10/2007	< 0.01 UJ	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-004	Pesticides and PCBs	Heptachlor epoxide	14	1	0.00003	0.0000014	14	1	0.000022	4/13/2005	< 0.00003 UJ	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-004	Volatile Organics	Chloroform	14	2	0.005	0.00022	14	2	0.00074	5/19/1998	< 0.001 U	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-005	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0032	7/12/2006	< 0.01 U	4/7/2011
Site-wide Background Areas	Unconsolidated	BKGmw-005	Pesticides and PCBs	Heptachlor	17	1	0.00003	0.0000014	17	1	0.0000078	3/8/2006	< 0.0000095 UJ	1/23/2013
Site-wide Background Areas	Unconsolidated	BKGmw-005	Pesticides and PCBs	Toxaphene	17	1	0.002	0.000015	17	1	0.00036	10/5/2006	< 0.00048 UJ	1/23/2013
Site-wide Background Areas	Unconsolidated	BKGmw-013	Miscellaneous	Cyanide	15	3	0.01	0.00015	15	3	0.0095	1/25/2007	< 0.01 U	10/10/2007
Site-wide Background Areas	Unconsolidated	BKGmw-016	Explosives	2-Amino-4,6-Dinitrotoluene	12	1	0.00011	0.0039	1	1	0.007	4/18/2007	< 0.00011 U	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-016	Miscellaneous	Cyanide	14	2	0.01	0.00015	14	2	0.052	1/24/2007	< 0.01 UJ	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-016	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	3	0.01	0.0056	7	1	0.037	7/11/2006	0.0043 J	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-017	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	2	0.01	0.0056	8	1	0.0072	4/14/2005	< 0.01 U	10/10/2007
Site-wide Background Areas	Unconsolidated	BKGmw-019	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0042	7/11/2007	< 0.01 UJ	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-020	Miscellaneous	Cyanide	15	2	0.01	0.00015	15	2	0.009	1/22/2007	< 0.01 UJ	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-020	Pesticides and PCBs	Heptachlor	13	1	0.00003	0.0000014	13	1	0.0000097	7/12/2006	< 0.00003 U	10/11/2007
Site-wide Background Areas	Unconsolidated	BKGmw-021	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0015	3/8/2006	< 0.01 U	4/6/2011
Site-wide Background Areas	Unconsolidated	BKGmw-021	Pesticides and PCBs	Heptachlor	16	1	0.00003	0.0000014	16	1	0.00019	3/8/2006	< 0.00001 U	1/22/2013

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Summary of Detected Constituents - Installation Boundary Monitoring Wells
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
October 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Miscellaneous	Cyanide	9	2	0.01	0.00015	9	2	0.019	04/07/08	< 0.01 U	07/08/10
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Pesticides and PCBs	Heptachlor epoxide	9	1	0.00005	0.0000014	9	1	0.00022	09/19/01	< 0.000029 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.01	0.0056	5	1	0.021	04/07/08	0.00092 J	08/02/11
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-064	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.011	07/07/08	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-065	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	19	8	0.01	0.0056	9	3	0.0086	07/14/10	< 0.0048 U	07/23/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Explosives	Nitroglycerin	9	1	0.00053	0.0002	9	1	0.00033	07/24/14	< 0.00051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Pesticides and PCBs	beta-BHC	9	2	0.000051	0.000025	3	1	0.000027	07/23/12	< 0.000051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Pesticides and PCBs	Heptachlor	9	1	0.000051	0.0000014	9	1	0.000029	03/10/15	< 0.000051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-088	Pesticides and PCBs	alpha-BHC	6	1	0.000053	0.0000071	6	1	0.000028	10/21/14	< 0.000051 U	07/21/15
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Explosives	2,4-Dinitrotoluene	25	22	0.00024	0.00024	16	16	0.00086	10/08/07	< 0.0001 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0058	07/08/10	0.0058 J	07/08/10
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	Heptachlor	19	1	0.00005	0.0000014	19	1	0.00002	04/12/05	< 0.00001 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	Heptachlor epoxide	19	4	0.000052	0.0000014	19	4	0.00046	10/04/05	< 0.000052 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	PCB-1242	19	1	0.001	0.0000078	19	1	0.00085	09/20/01	< 0.00041 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Semi-Volatile Organics	2,4-Dinitrotoluene	16	3	0.01	0.00024	16	3	0.00064	10/08/07	< 0.00078 U	01/30/12
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	6	0.01	0.0056	9	1	0.0071	05/02/06	< 0.005 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Miscellaneous	Cyanide	9	2	0.01	0.00015	9	2	0.019	04/07/08	< 0.01 U	07/08/10
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Pesticides and PCBs	Heptachlor epoxide	9	1	0.00005	0.0000014	9	1	0.00022	09/19/01	< 0.000029 U	08/02/11
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	5	0.01	0.0056	5	1	0.021	04/07/08	< 0.0048 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Explosives	2,6-Dinitrotoluene	19	2	0.00013	0.000048	19	2	0.000092	04/07/08	< 0.0001 U	07/23/14
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Pesticides and PCBs	PCB-1242	16	1	0.00058	0.0000078	16	1	0.00072	09/19/01	< 0.00038 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	20	10	0.01	0.0056	8	2	0.017	10/06/08	< 0.005 U	07/23/14
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0014	03/09/06	< 0.01 UJ	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Pesticides and PCBs	Heptachlor epoxide	18	2	0.00005	0.0000014	18	2	0.000051	04/12/05	< 0.00001 U	01/21/13
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	18	7	0.01	0.0056	7	1	0.029	01/18/11	< 0.00083 U	01/21/13
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Semi-Volatile Organics	Pentachlorophenol	15	1	0.01	0.00004	15	1	0.003	10/04/05	< 0.005 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Explosives	2,6-Dinitrotoluene	7	2	0.00013	0.000048	7	2	0.000079	01/28/08	0.000077 J	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Miscellaneous	Cyanide	7	2	0.01	0.00015	7	2	0.02	01/28/08	0.0056 J	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-244	Miscellaneous	Chromium, hexavalent	12	12	0.00002	0.000035	12	12	0.000361	08/20/13	0.000195	07/21/15
RVAAP-11 Load Line 4	Sharon	LL4mw-201	Semi-Volatile Organics	Naphthalene	4	1	0.000097	0.00017	1	1	0.00032	10/17/12	< 0.000096 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Miscellaneous	Cyanide	18	1	0.01	0.00015	18	1	0.01	04/04/11	< 0.01 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	beta-BHC	21	3	0.00005	0.000025	17	2	0.000043	03/07/06	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Dieldrin	21	1	0.00005	0.0000017	21	1	0.000027	03/07/06	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Heptachlor	21	1	0.00005	0.0000014	21	1	0.000013	04/13/05	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Heptachlor epoxide	21	1	0.00005	0.0000014	21	1	0.000022	10/05/05	< 0.0000095 U	01/23/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-247	Miscellaneous	Chromium, hexavalent	9	1	0.00002	0.000035	1	1	0.000265	07/24/12	< 0.00001 U	07/21/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-247	Pesticides and PCBs	beta-BHC	9	1	0.00095	0.000025	2	1	0.00018	08/20/13	< 0.000022 U	07/22/14
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-003	Semi-Volatile Organics	Naphthalene	4	1	0.00011	0.00017	1	1	0.00027	07/25/12	< 0.000099 U	01/23/13
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-004	Miscellaneous	Cyanide	7	1	0.01	0.00015	7	1	0.0064	10/15/12	< 0.005 U	07/24/14
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-011	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.0051	0.0056	1	1	0.013	08/20/13	< 0.0048 U	07/22/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Explosives	Nitroglycerin	17	1	0.0034	0.0002	17	1	0.00037	07/14/10	< 0.00051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	alpha-BHC	18	1	0.00015	0.0000071	18	1	0.000022	04/06/11	< 0.000051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	Heptachlor	18	1	0.00015	0.0000014	18	1	0.000066	03/10/15	< 0.000051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-004	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.013	10/12/10	< 0.01 U	04/05/11
Site-wide Background Areas	Unconsolidated	BKGmw-005	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0032	07/12/06	< 0.01 U	04/07/11
Site-wide Background Areas	Unconsolidated	BKGmw-005	Pesticides and PCBs	Heptachlor	17	1	0.00003	0.0000014	17	1	0.0000078	03/08/06	< 0.0000095 UJ	01/23/13
Site-wide Background Areas	Unconsolidated	BKGmw-005	Pesticides and PCBs	Toxaphene	17	1	0.002	0.000015	17	1	0.00036	10/05/06	< 0.00048 UJ	01/23/13

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

APPENDIX C
SUMMARY OF ProUCL OUTPUTS
MANN-KENDALL TREND ANALYSIS

The historical sampling data sets for four sites at Camp Ravenna (Fuze and Booster Quarry, Load Line 1, Load Line 2 and Load Line 3) were evaluated using the USEPA ProUCL software, Version 5.1, to support the selection of wells to be included in the pending Facility-Wide Remedial Investigation groundwater characterization sampling. Individual well concentration trends were evaluated using the ordinary least squares (OLS) of regression and trend analysis, and two nonparametric trend tests (Mann-Kendall test and Theil-Sen test) available under the Statistical Tests module of ProUCL. The two nonparametric trend tests, Mann-Kendall test and Theil-Sen test, are meant to identify trends in time series data (data collected over a certain period of time such as daily, monthly, quarterly, etc.) with distinct values of the time variable (time of sampling events).

The output data generated from ProUCL displays a concentration vs. time graph with statistical information to the right. Each output graph is representative of a specific analyte (e.g., RDX, 2,6-dinitrotoluene, nitrobenzene) observed at a specific monitoring well station. The concentration (y-axis) indicates an analyte's concentration in units of milligrams per liter (mg/L). The date (x-axis) shown is in units of days modified in Microsoft Excel to a format compatible with ProUCL. The date range for the data at Load Line 1, Load Line 2, and Load Line 3 is between August 1996 and July 2015. The date range for the data at the Fuze and Booster Quarry is between November 2003 and July 2015. Best-fit lines for the OLS and Theil-Sen trends are also provided on the graphs in blue and red, respectively. The graphic outputs also provide an indication on whether sufficient statistical evidence is provided by the available datasets. In the cases where insufficient sampling history is present, the data plots were visually evaluated for concentration trends.

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FUZE AND BOOSTER QUARRY ProUCL OUTPUT

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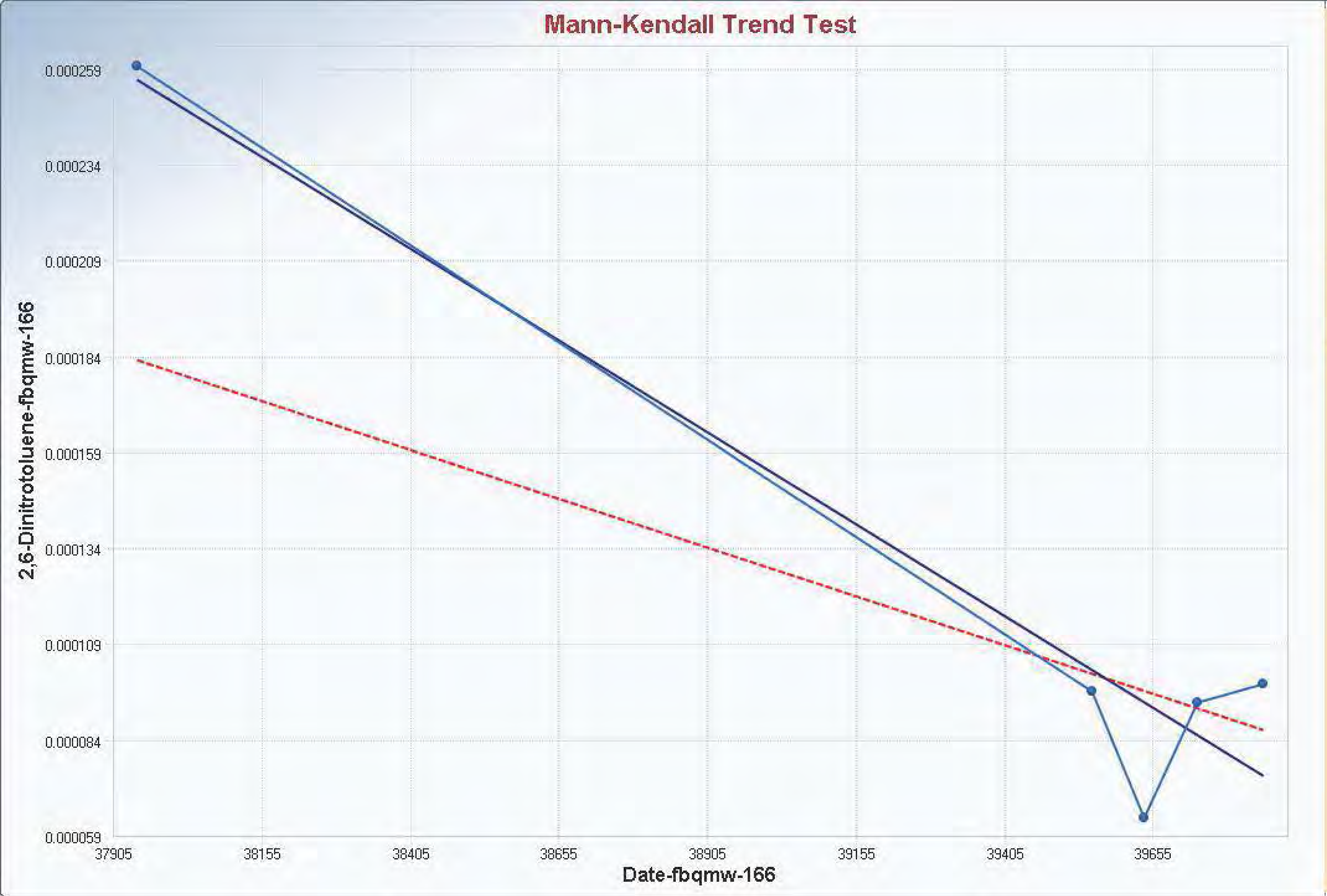


Mann-Kendall Trend Analysis

n	5
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	4.0825
Standardized Value of S	-0.2449
Test Value (S)	-2
Tabulated p-value	0.4080
Approximate p-value	0.4032

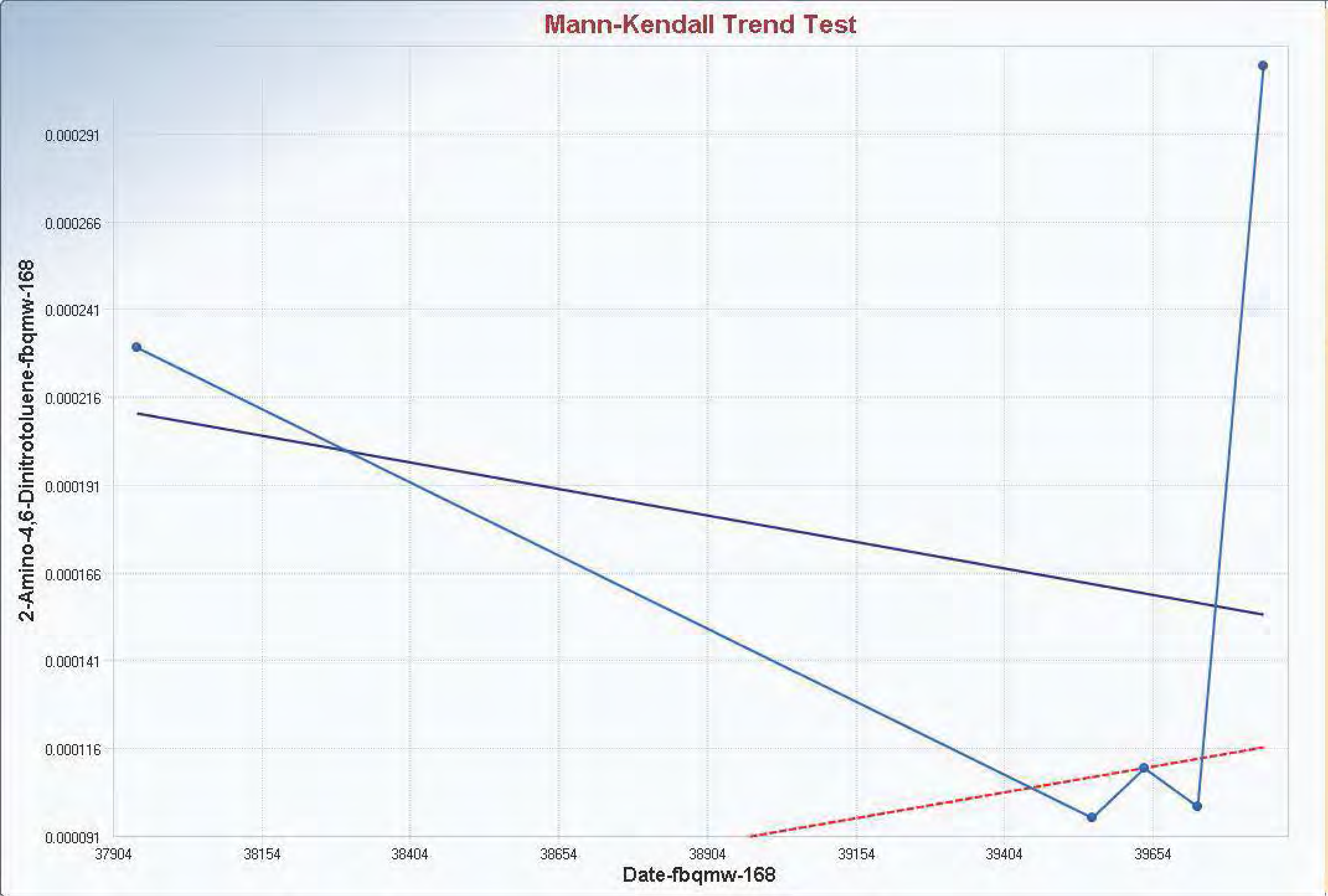
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0039

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0021

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	5
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	4.0825
Standardized Value of S	0.2449
Test Value (S)	2
Tabulated p-value	0.4080
Approximate p-value	0.4032

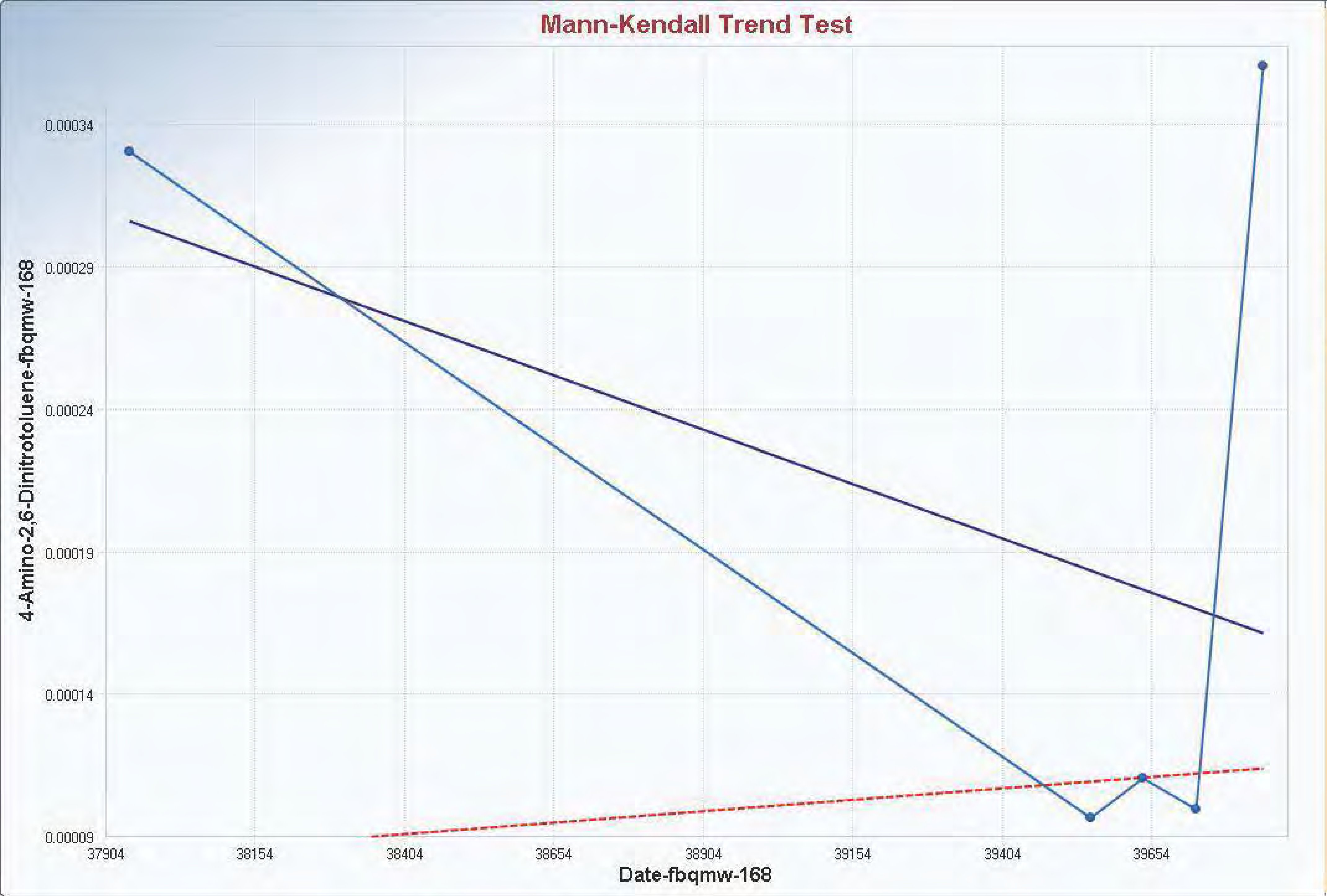
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0014

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0011

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	5
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	4.0825
Standardized Value of S	0.2449
Test Value (S)	2
Tabulated p-value	0.4080
Approximate p-value	0.4032

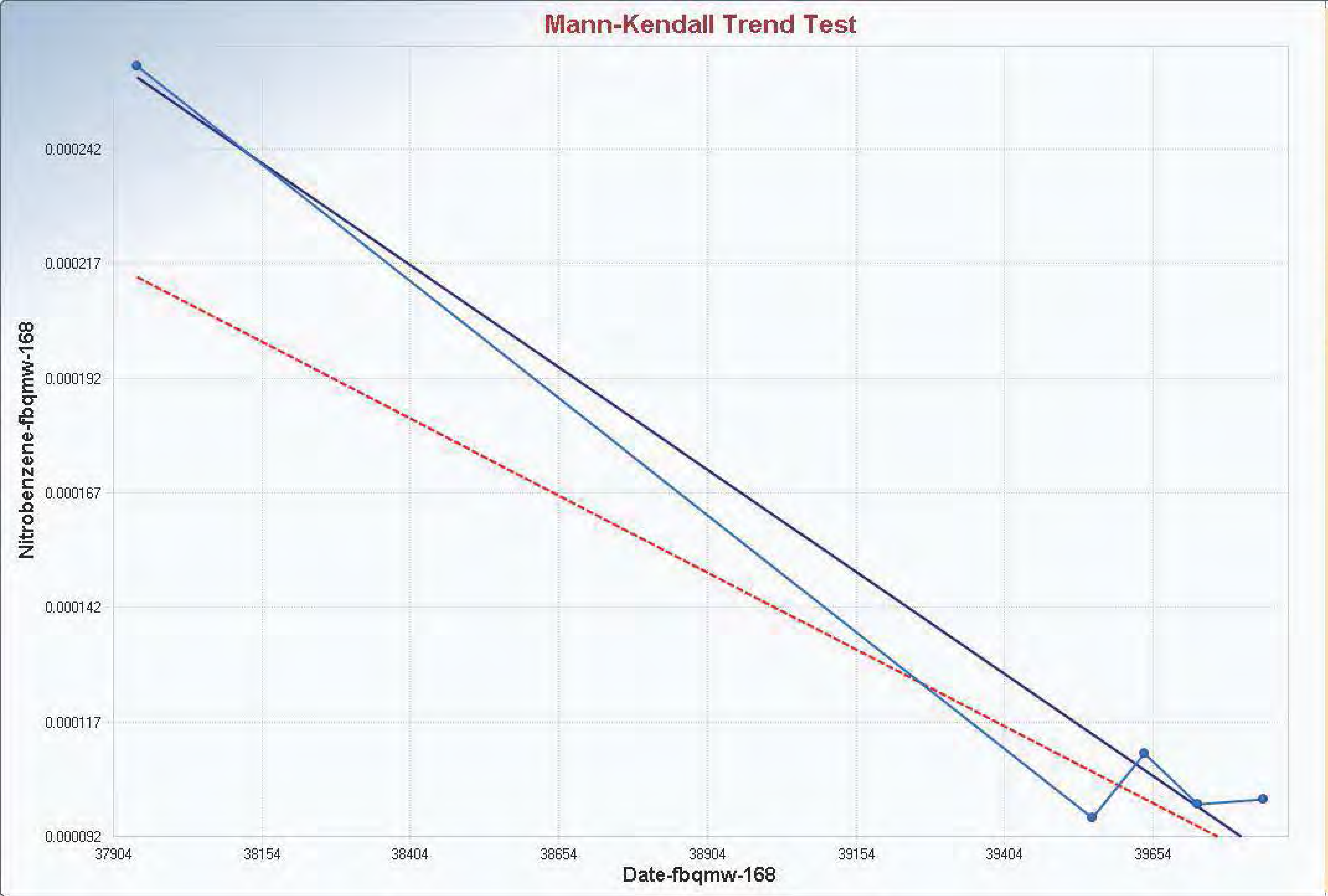
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0032

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0005

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	5
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	4.0825
Standardized Value of S	-0.2449
Test Value (S)	-2
Tabulated p-value	0.4080
Approximate p-value	0.4032

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0036

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0028

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.2281
Standardized Value of S	0.1913
Test Value (S)	2
Tabulated p-value	0.3600
Approximate p-value	0.4242

OLS Regression Line (Blue)

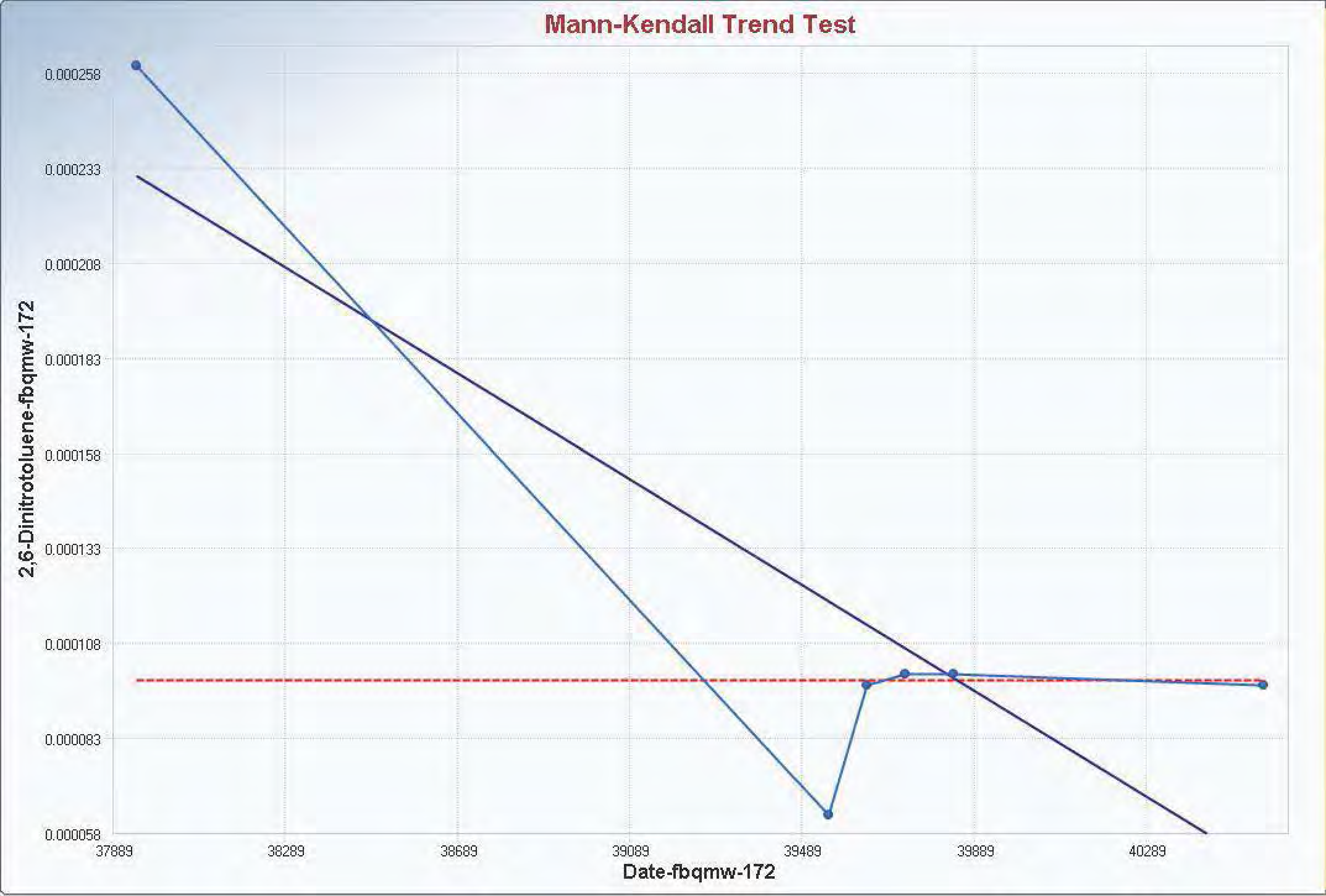
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0025

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0000

Insufficient statistical evidence of a significant trend at the specified level of significance.


Mann-Kendall Trend Test
2,6-Dinitrotoluene-fbqmw-171
0.000247
0.000222
0.000197
0.000172
0.000147
0.000122
0.000097
0.000072
0.000047
37876
38376
38876
39376
39876
40376
40876
Date-fbqmw-171
Mann-Kendall Trend Analysis
n 6
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 5.1316
Standardized Value of S 0.0000
Test Value (S) -1
Tabulated p-value 0.5000
Approximate p-value 0.5000
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0024
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0001
Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.1316
Standardized Value of S	0.0000
Test Value (S)	-1
Tabulated p-value	0.5000
Approximate p-value	0.5000

OLS Regression Line (Blue)

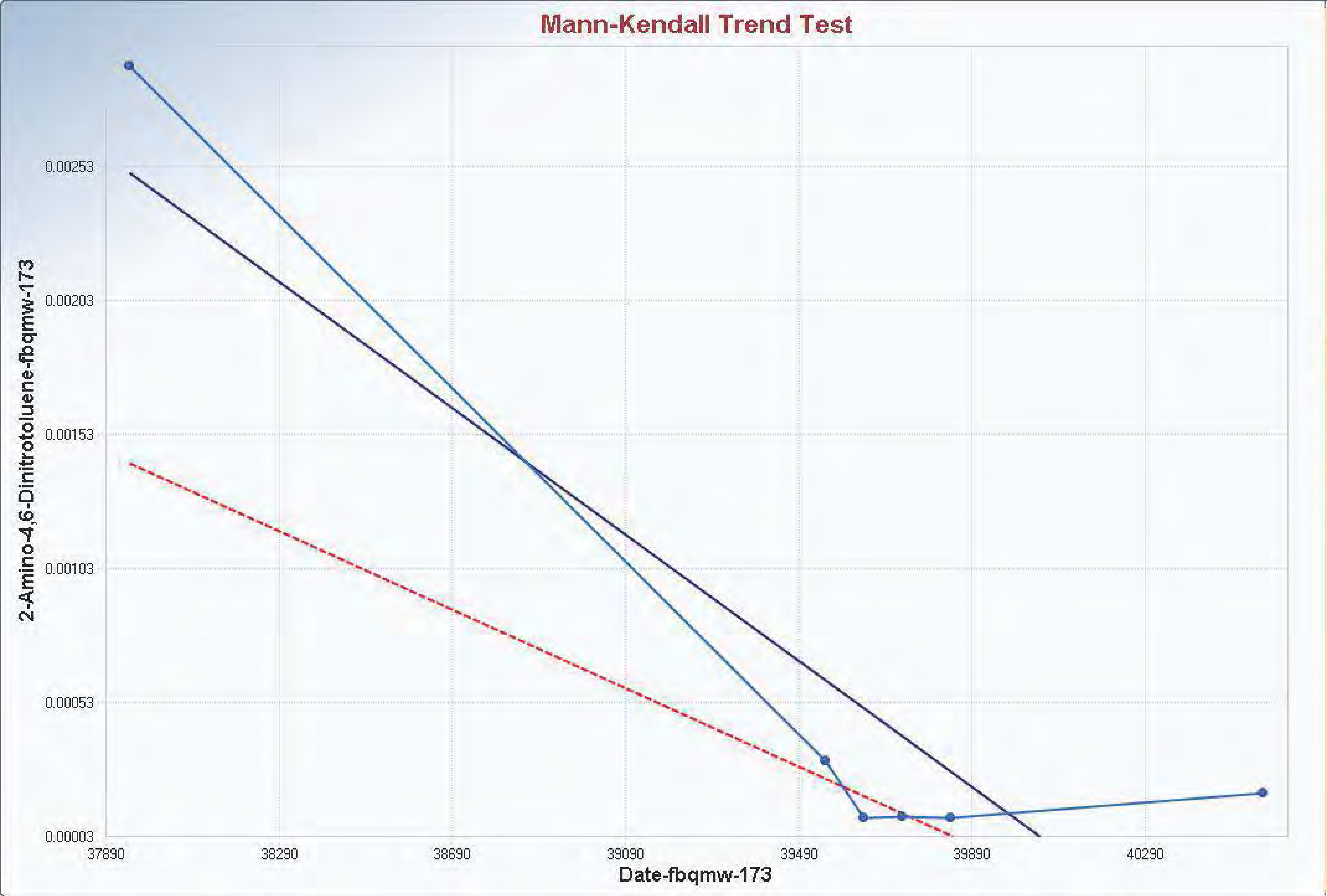
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0029

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.


Mann-Kendall Trend Test
2,4,6-Trinitrotoluene-fbqmw-173
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
37890
38290
38690
39090
39490
39890
40290
Date-fbqmw-173
Mann-Kendall Trend Analysis
n 6
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 5.3229
Standardized Value of S -1.1272
Test Value (S) -7
Tabulated p-value 0.1360
Approximate p-value 0.1298
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0316
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0019
Insufficient statistical evidence
of a significant trend at the
specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.3229
Standardized Value of S	-0.7515
Test Value (S)	-5
Tabulated p-value	0.2350
Approximate p-value	0.2262

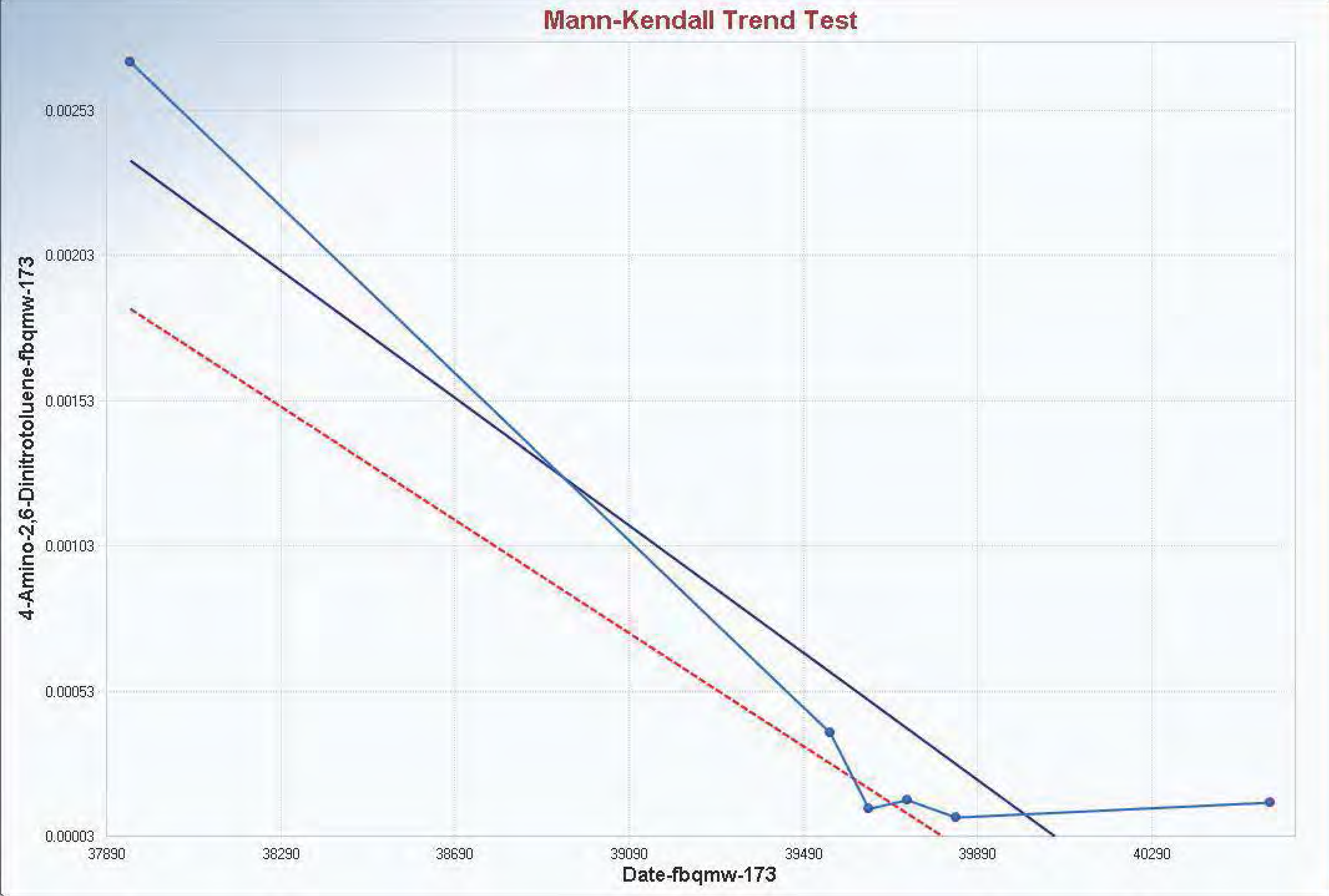
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0472

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0292

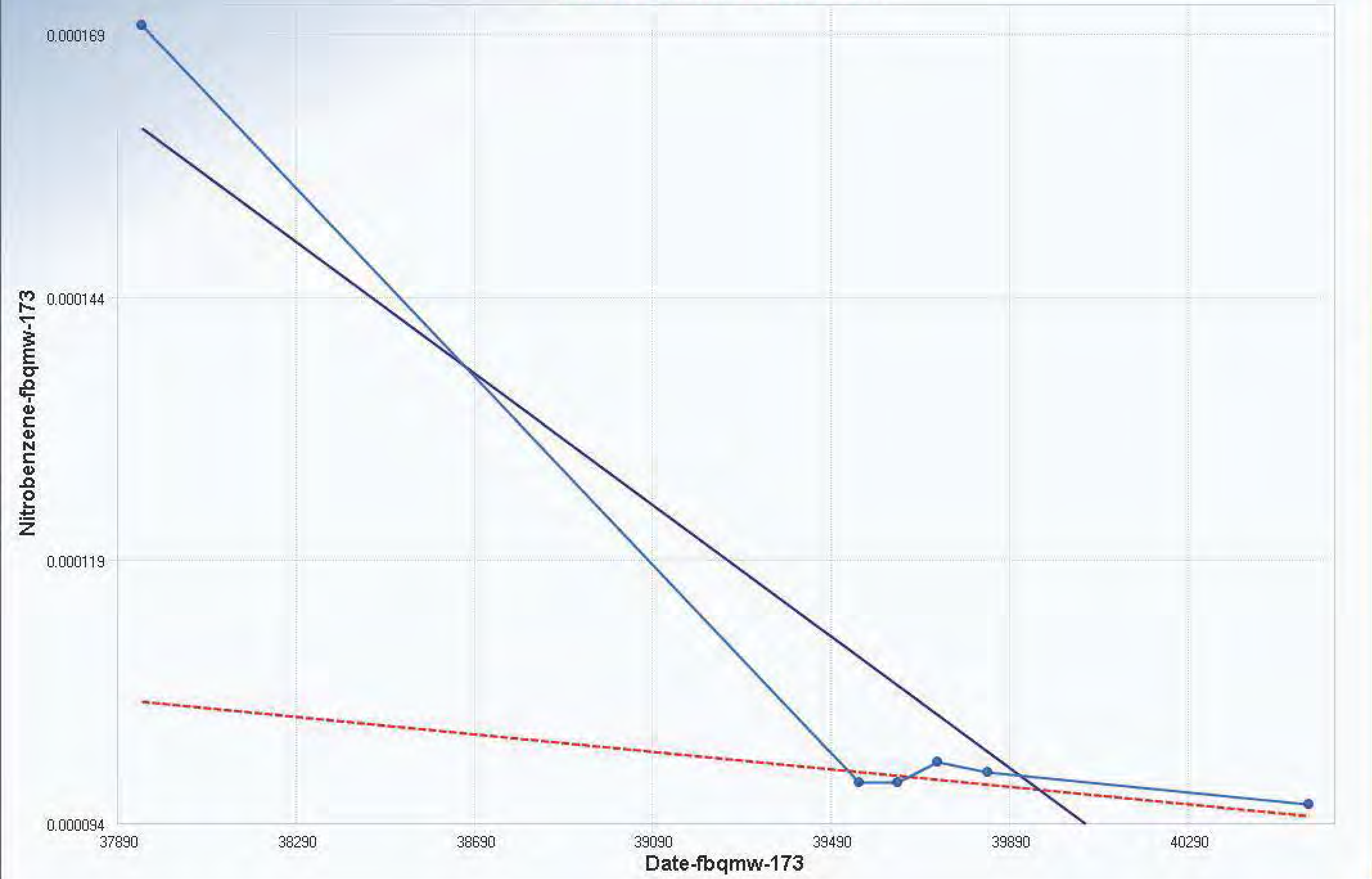
Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis	
n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.3229
Standardized Value of S	-1.5029
Test Value (S)	-9
Tabulated p-value	0.0680
Approximate p-value	0.0664
OLS Regression Line (Blue)	
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0441
Theil-Sen Trend Line (Red)	
Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0388

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.2281
Standardized Value of S	-0.9564
Test Value (S)	-6
Tabulated p-value	0.1360
Approximate p-value	0.1694

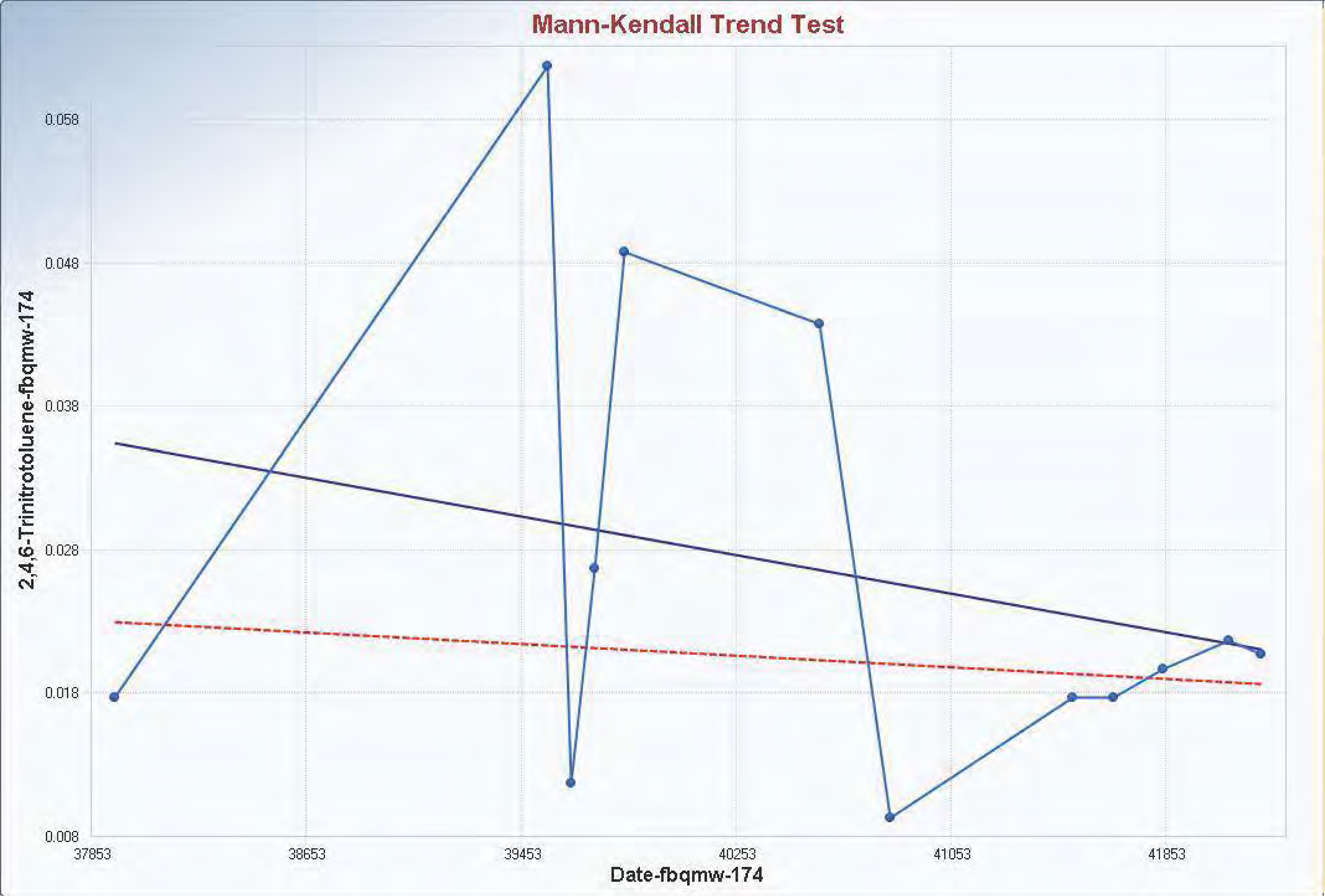
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0013

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0003

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.4568
Standardized Value of S	-0.1383
Test Value (S)	-3
Tabulated p-value	0.4730
Approximate p-value	0.4450

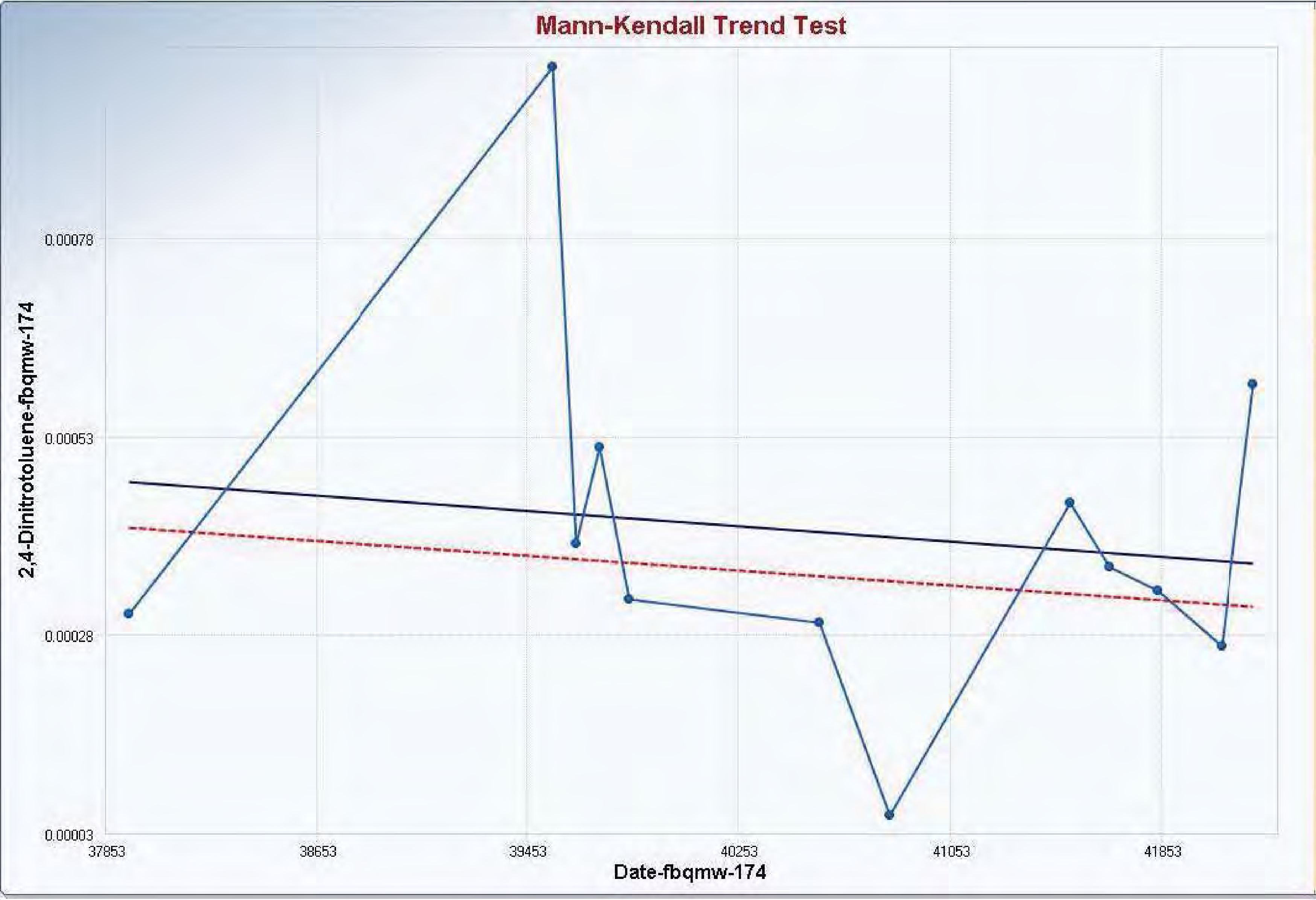
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.1634

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0616

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.5831
Standardized Value of S	-0.4800
Test Value (S)	-8
Tabulated p-value	0.3190
Approximate p-value	0.3156

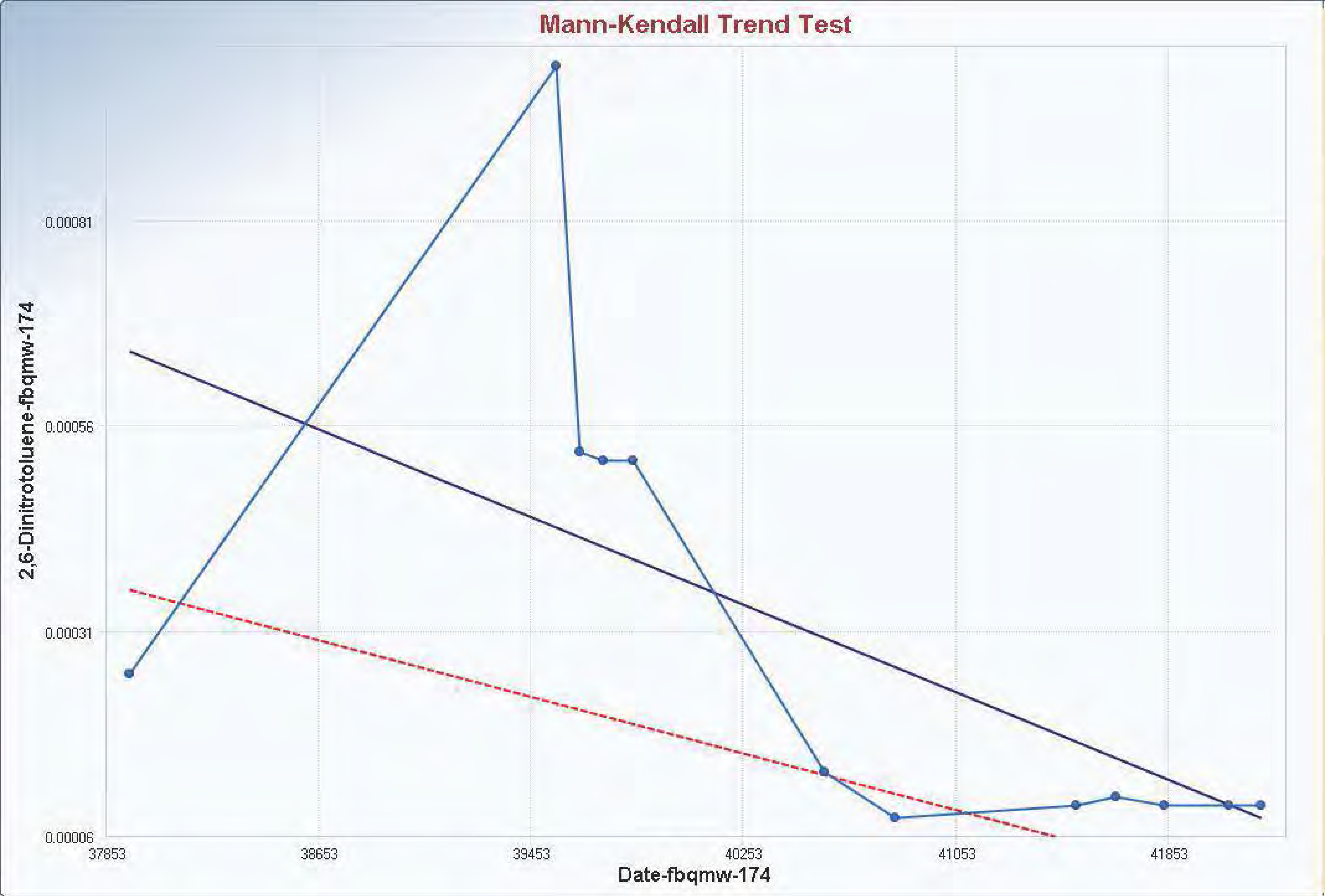
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0014

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0013

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.2478
Standardized Value of S	-2.6671
Test Value (S)	-39
Tabulated p-value	0.0040
Approximate p-value	0.0038

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0057

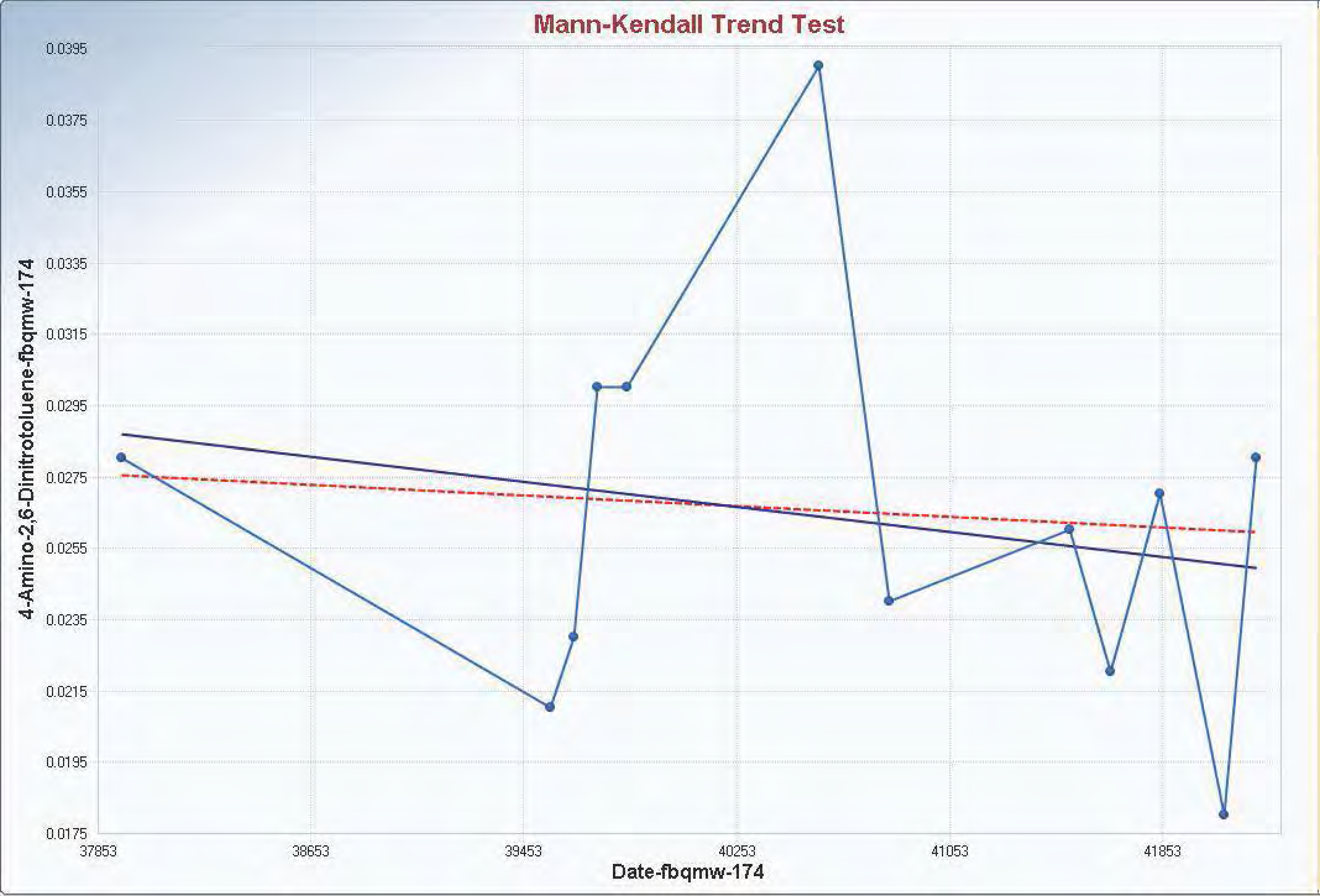
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0036

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis	
n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.5144
Standardized Value of S	-1.9980
Test Value (S)	-30
Tabulated p-value	0.0220
Approximate p-value	0.0229
OLS Regression Line (Blue)	
OLS Regression Slope	0.0000
OLS Regression Intercept	0.1703
Theil-Sen Trend Line (Red)	
Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.1578

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.5144
Standardized Value of S	-0.2067
Test Value (S)	-4
Tabulated p-value	0.4200
Approximate p-value	0.4181

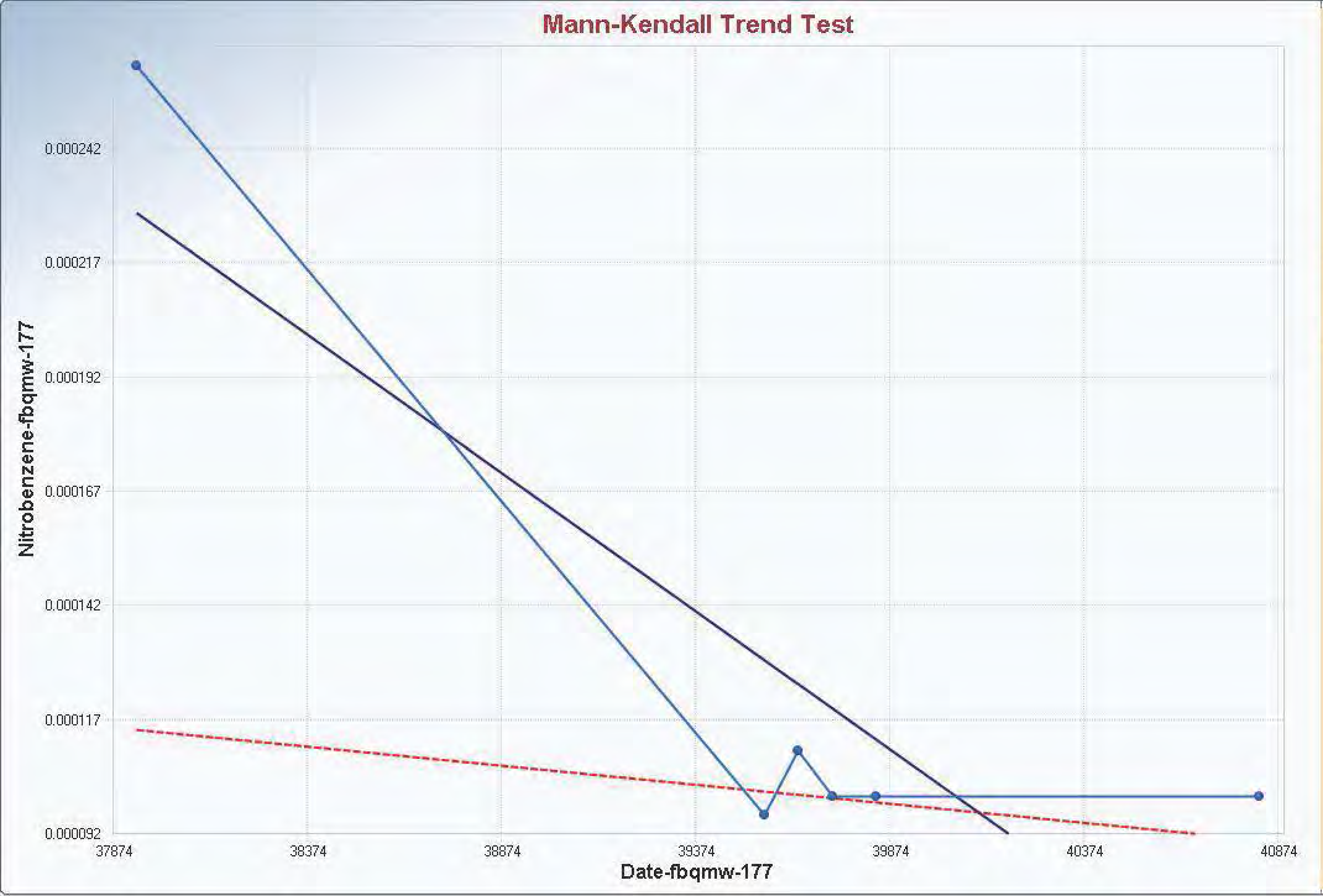
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0619

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0418

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	4.9666
Standardized Value of S	-0.6040
Test Value (S)	-4
Tabulated p-value	0.2350
Approximate p-value	0.2729

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0025

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0004

Insufficient statistical evidence of a significant trend at the specified level of significance.

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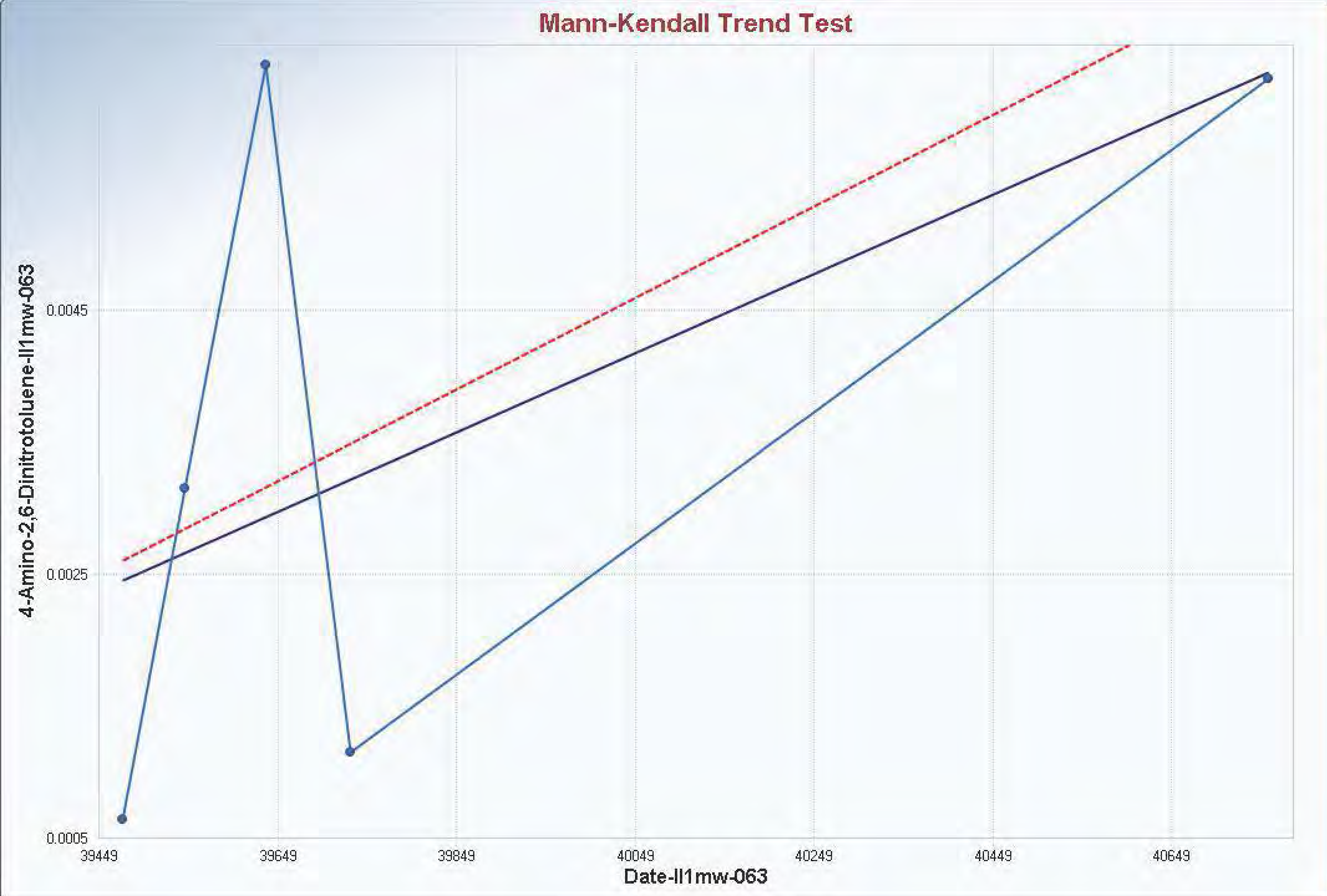


Mann-Kendall Trend Analysis

n	5
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	4.0825
Standardized Value of S	0.7348
Test Value (S)	4
Tabulated p-value	0.2420
Approximate p-value	0.2312

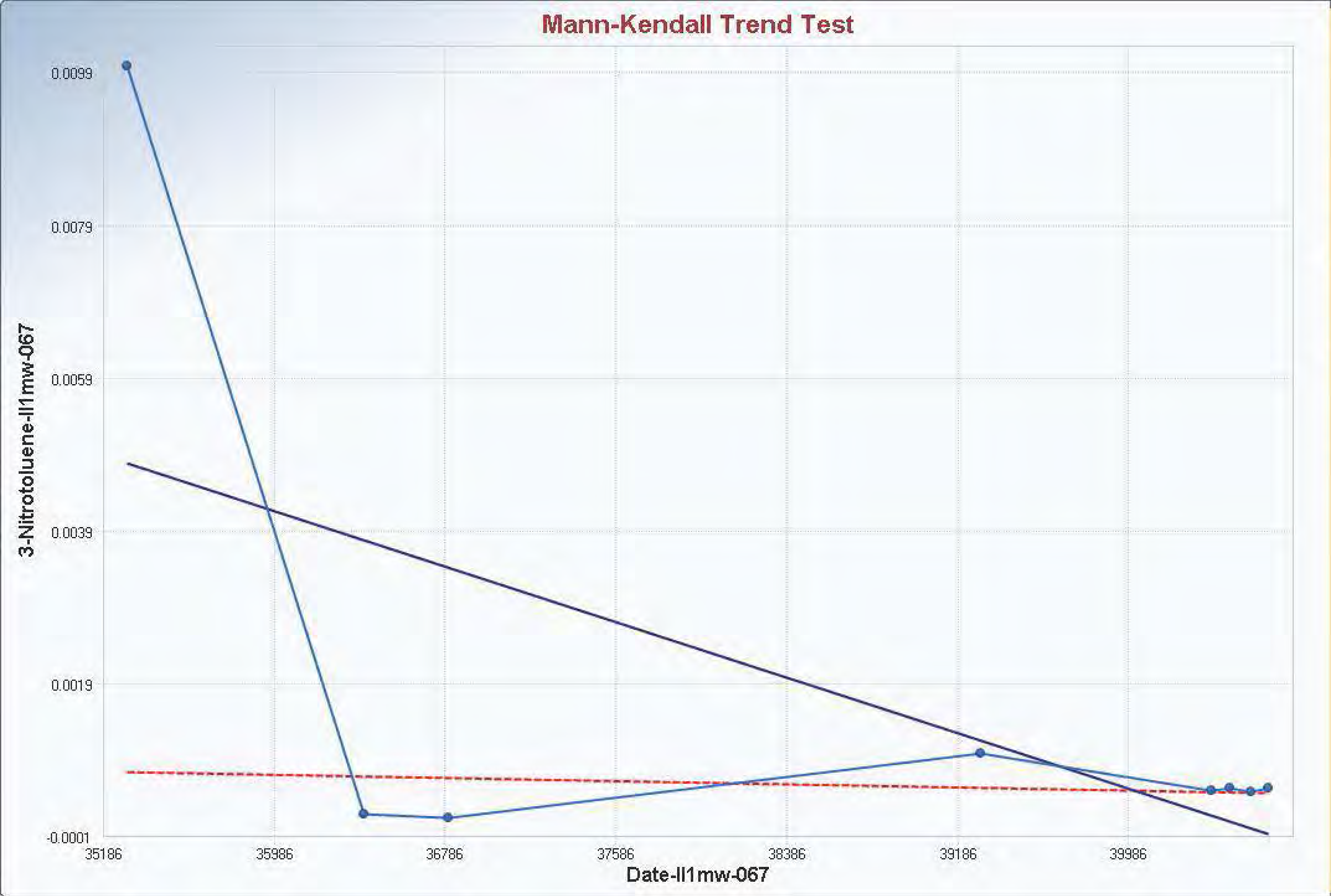
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.1160

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.1343

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	8
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	8.0208
Standardized Value of S	0.0000
Test Value (S)	-1
Tabulated p-value	0.5480
Approximate p-value	0.5000

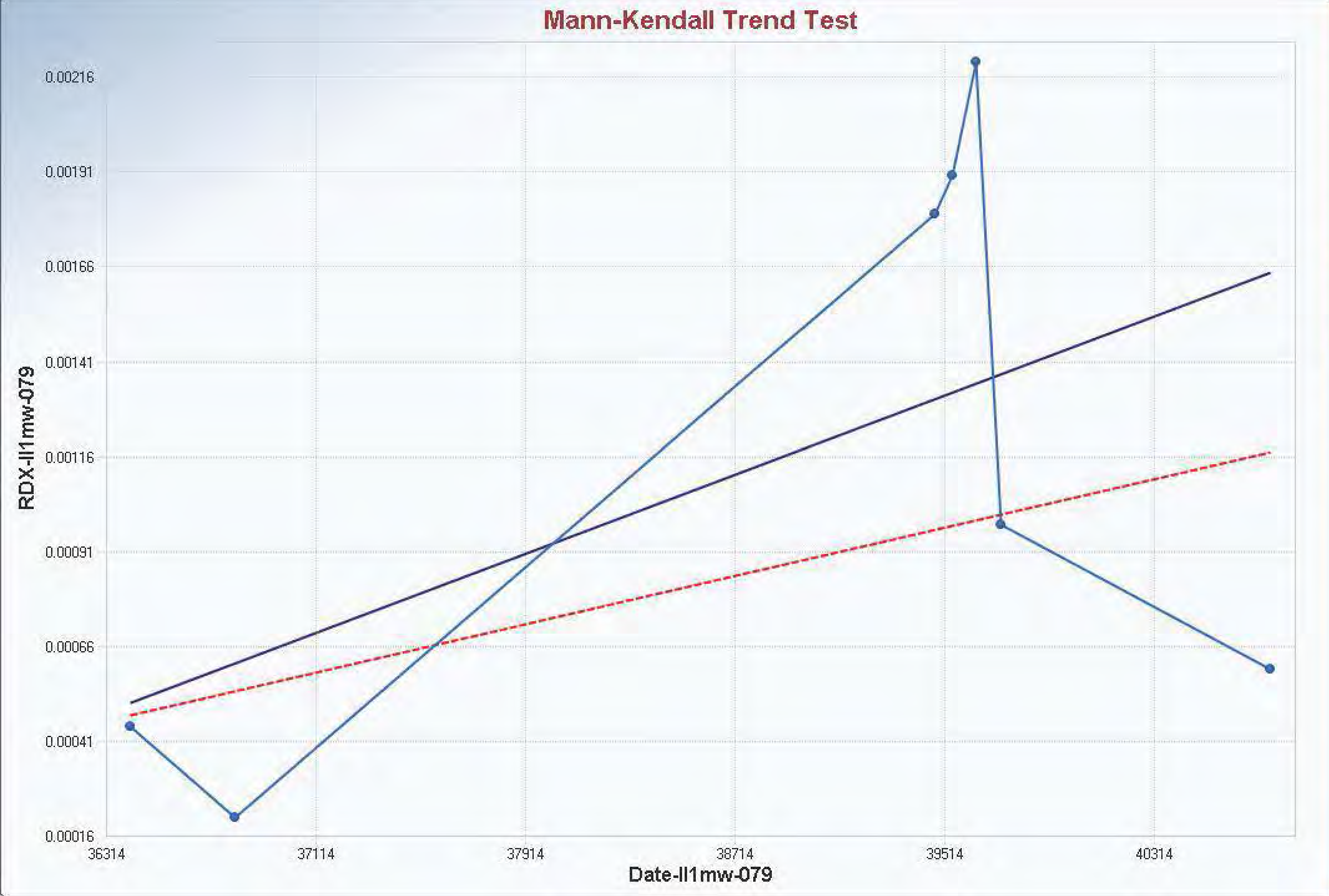
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0369

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0025

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	7
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	6.6583
Standardized Value of S	0.6008
Test Value (S)	5
Tabulated p-value	0.2810
Approximate p-value	0.2740

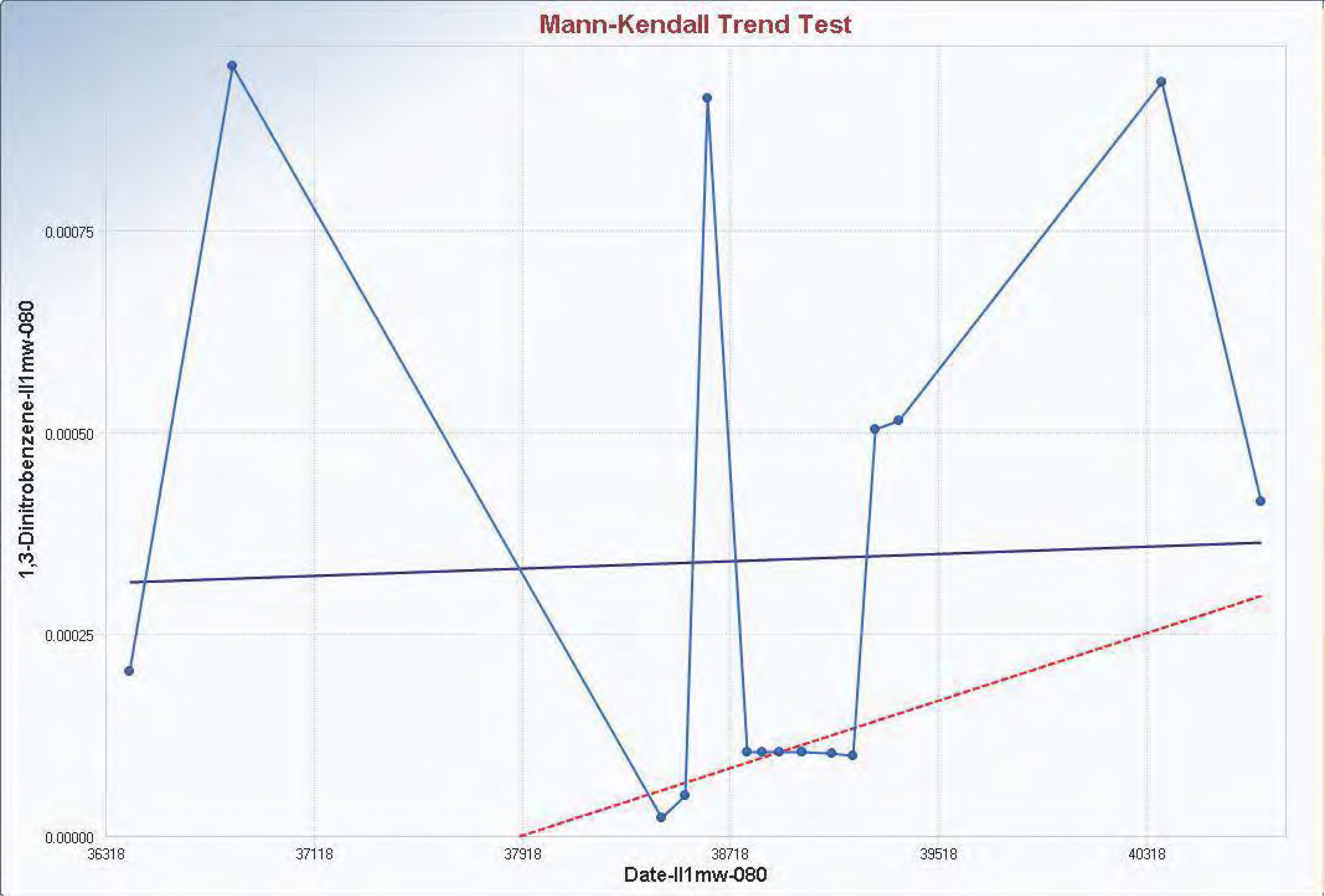
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0090

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0053

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	15
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	19.9917
Standardized Value of S	0.7003
Test Value (S)	15
Tabulated p-value	0.2480
Approximate p-value	0.2419

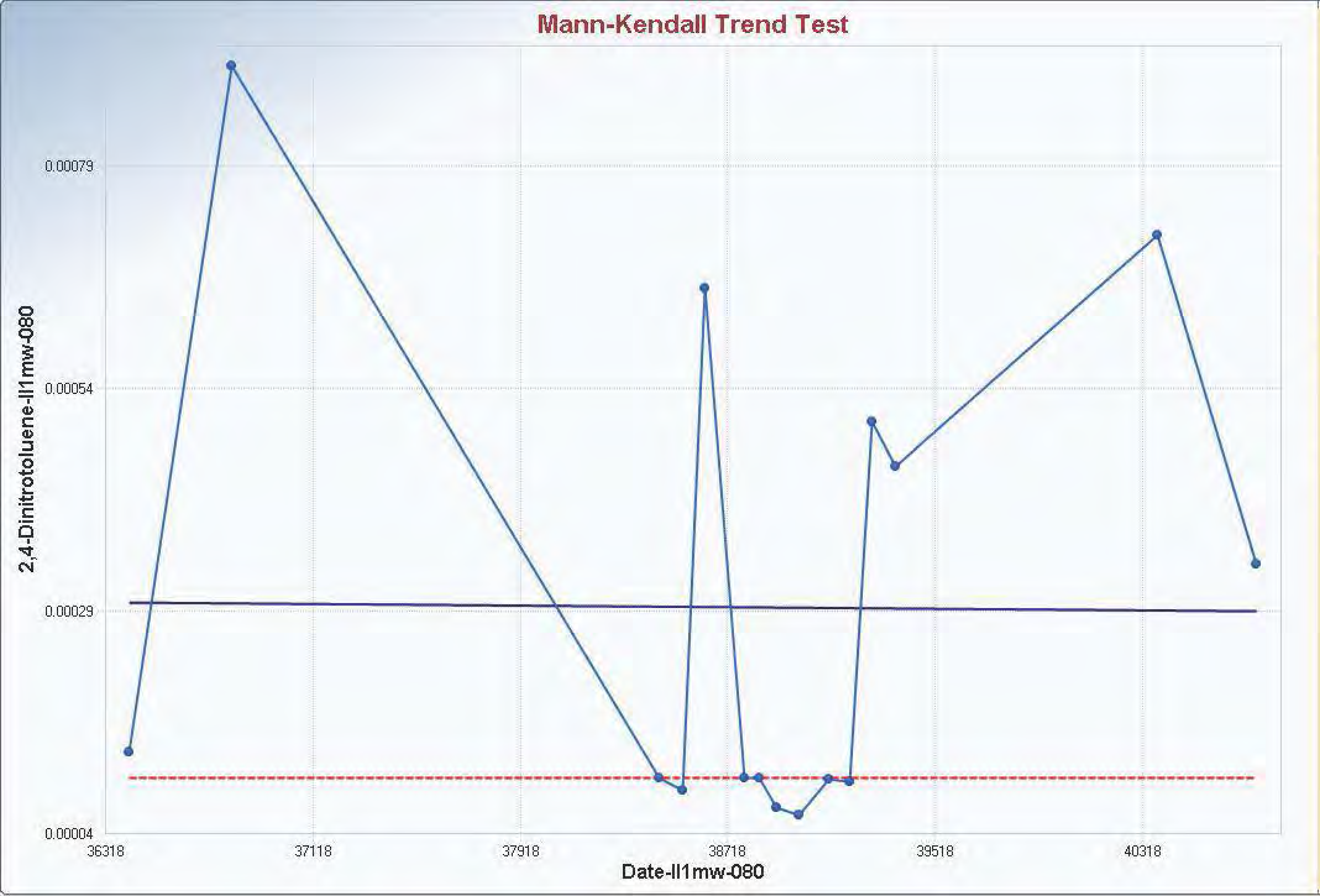
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0001

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0040

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	15
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	20.1163
Standardized Value of S	
Test Value (S)	0
Tabulated p-value	0.5000
Approximate p-value	

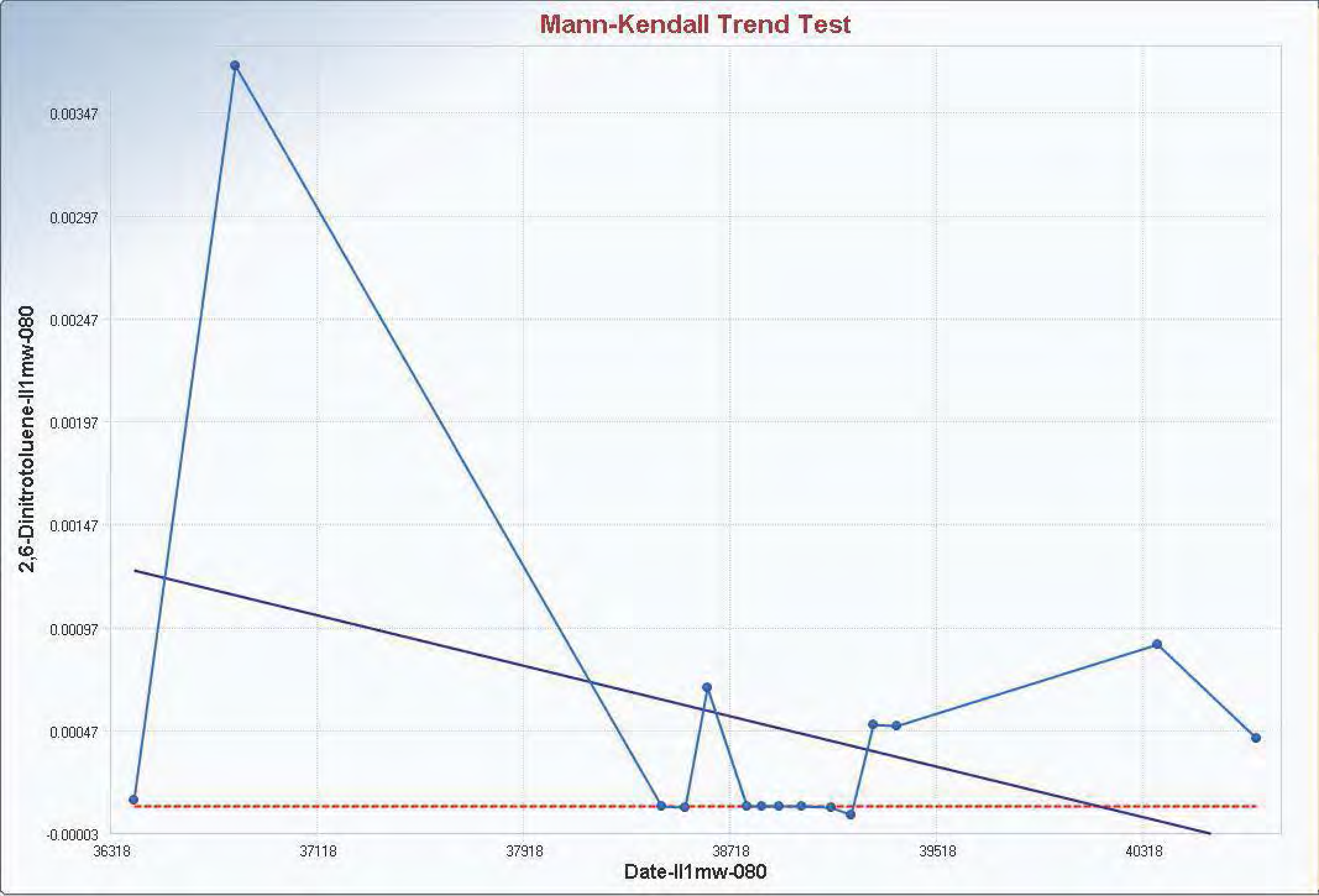
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0004

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	15
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	19.7906
Standardized Value of S	0.0000
Test Value (S)	1
Tabulated p-value	0.5000
Approximate p-value	0.5000

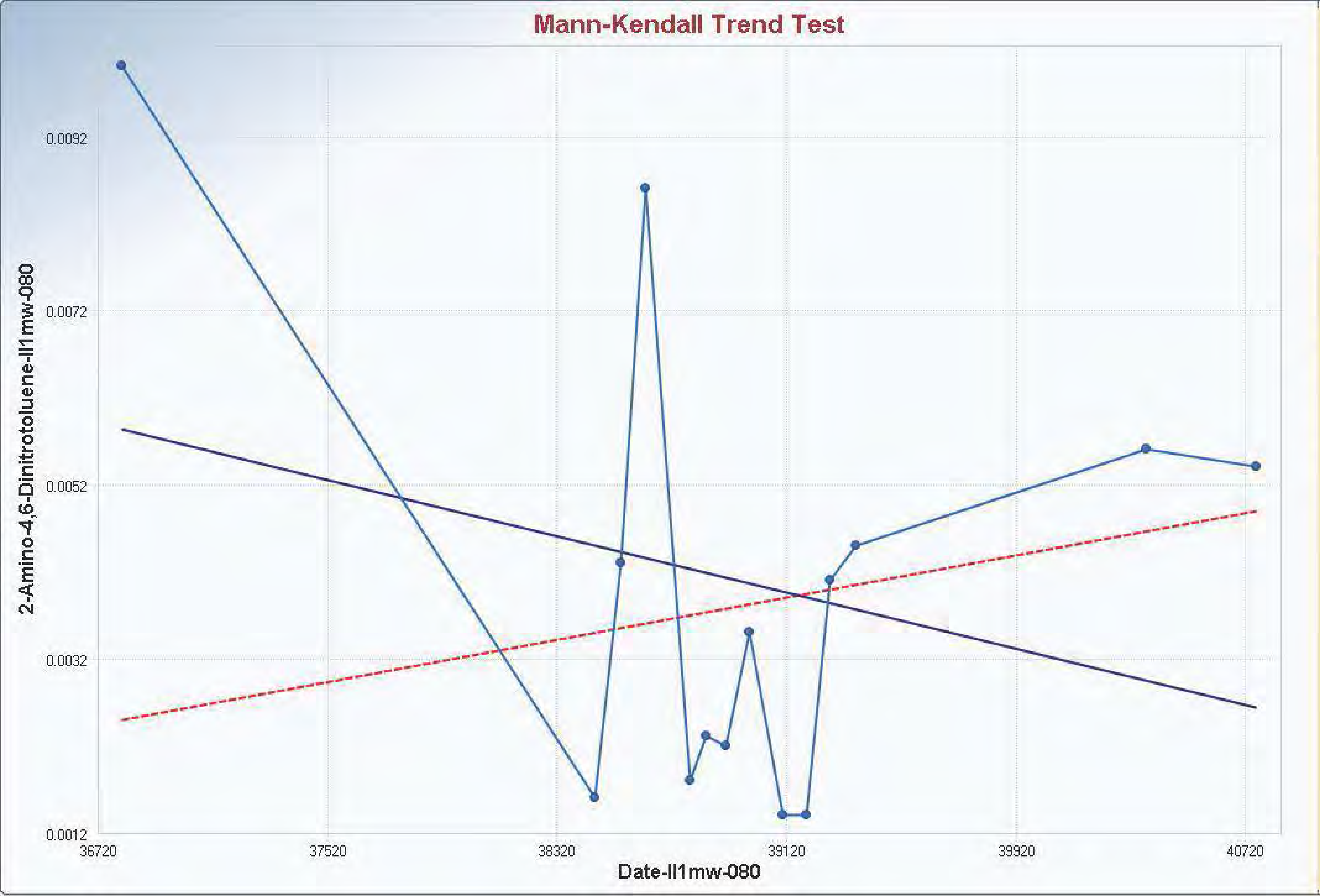
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0125

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.2392
Standardized Value of S	0.2741
Test Value (S)	6
Tabulated p-value	0.3740
Approximate p-value	0.3920

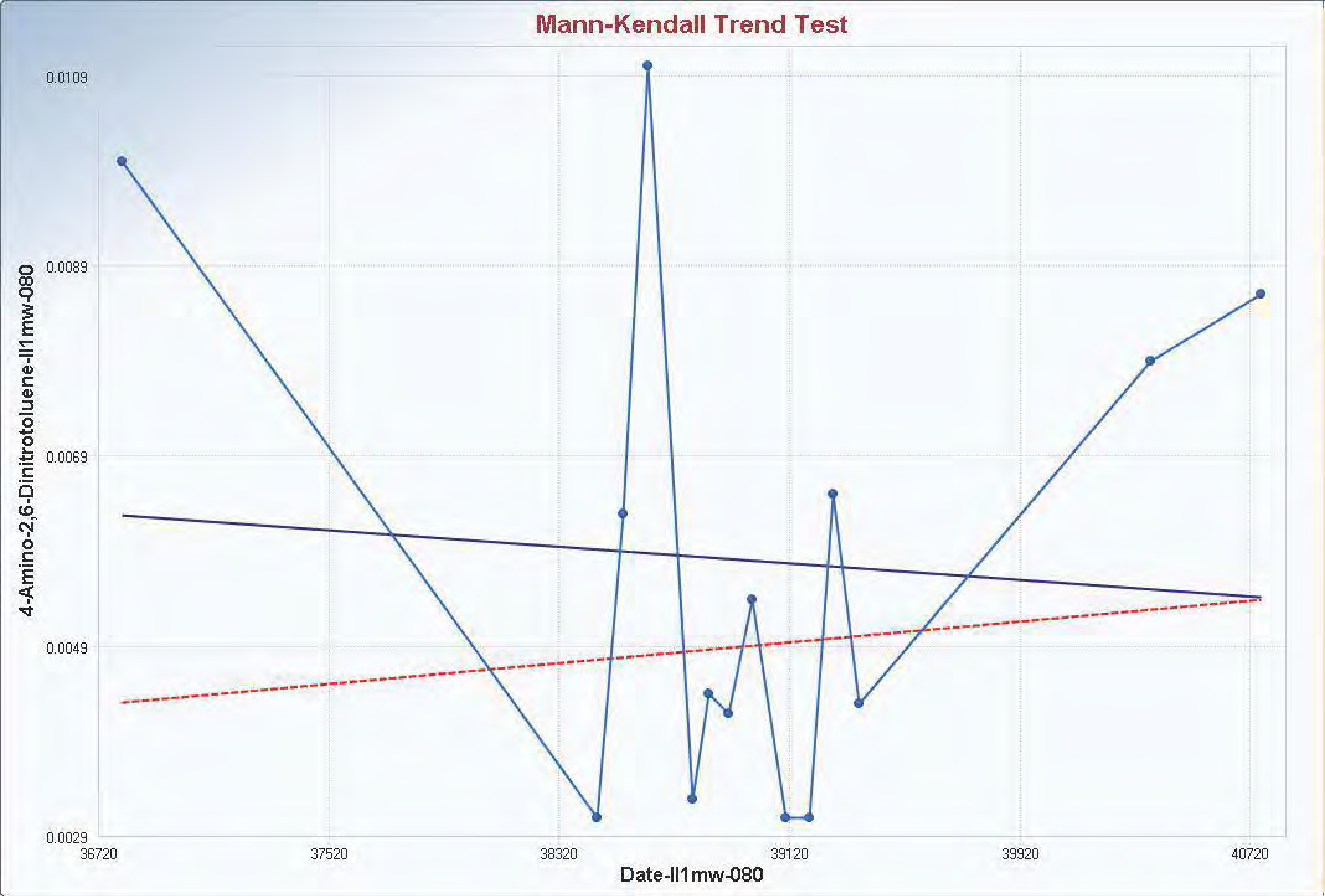
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0355

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0199

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.1659
Standardized Value of S	0.2752
Test Value (S)	6
Tabulated p-value	0.3740
Approximate p-value	0.3916

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0143

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0058

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	7
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	6.2981
Standardized Value of S	-0.9527
Test Value (S)	-7
Tabulated p-value	0.1910
Approximate p-value	0.1704

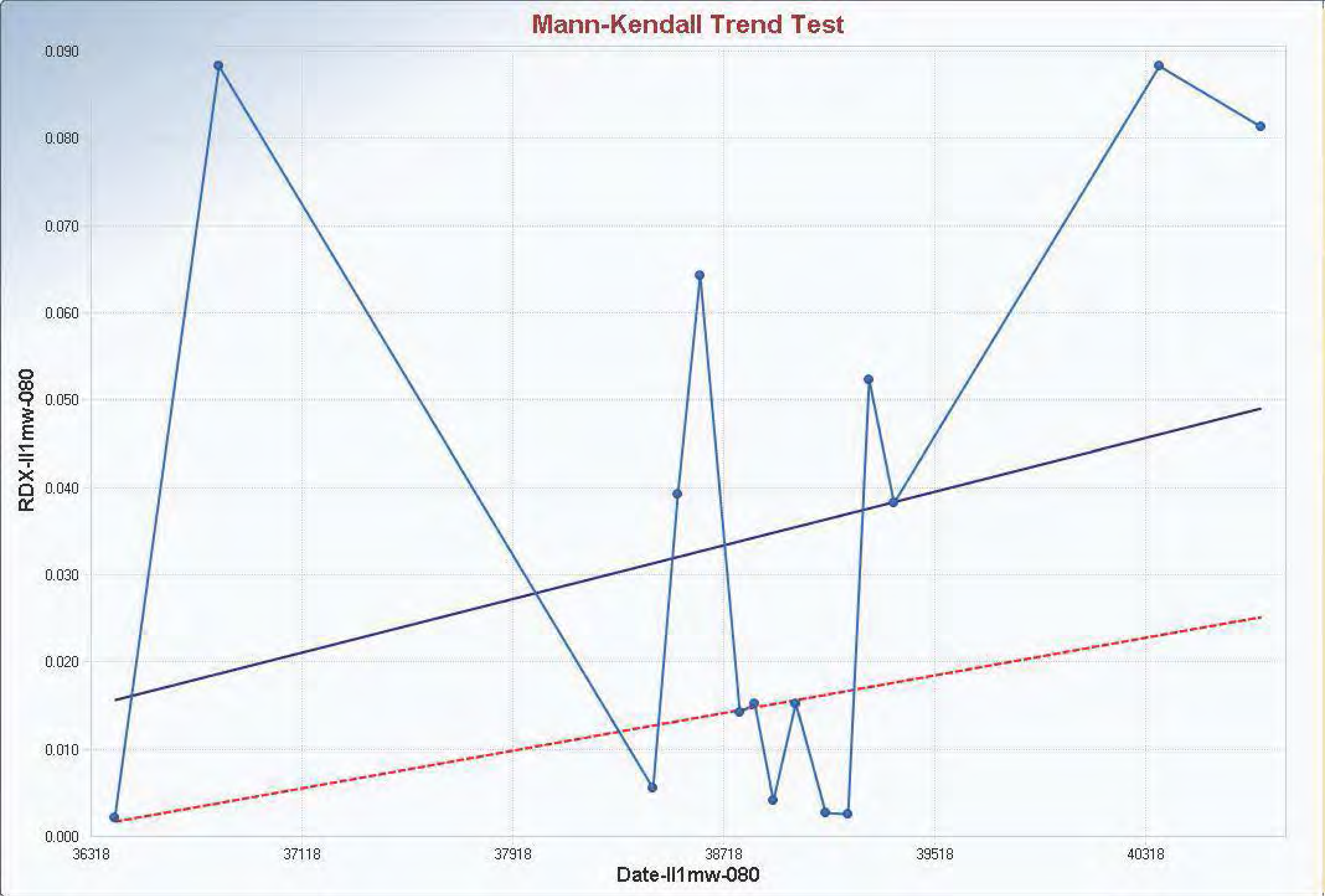
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.1385

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0208

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	15
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	20.1577
Standardized Value of S	0.7937
Test Value (S)	17
Tabulated p-value	0.2180
Approximate p-value	0.2137

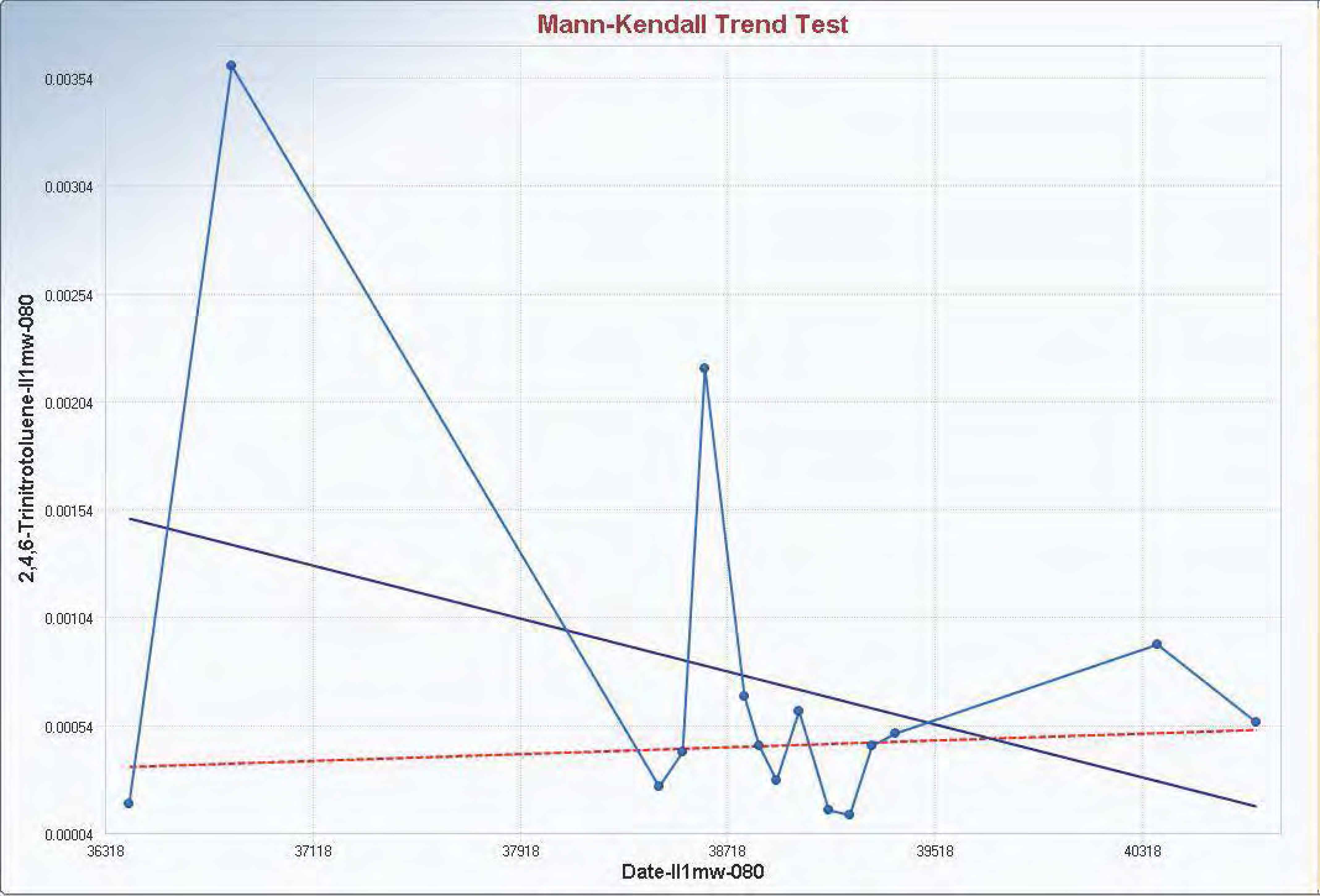
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.2639

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.1948

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	15
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	20.1825
Standardized Value of S	0.1486
Test Value (S)	4
Tabulated p-value	0.4230
Approximate p-value	0.4409

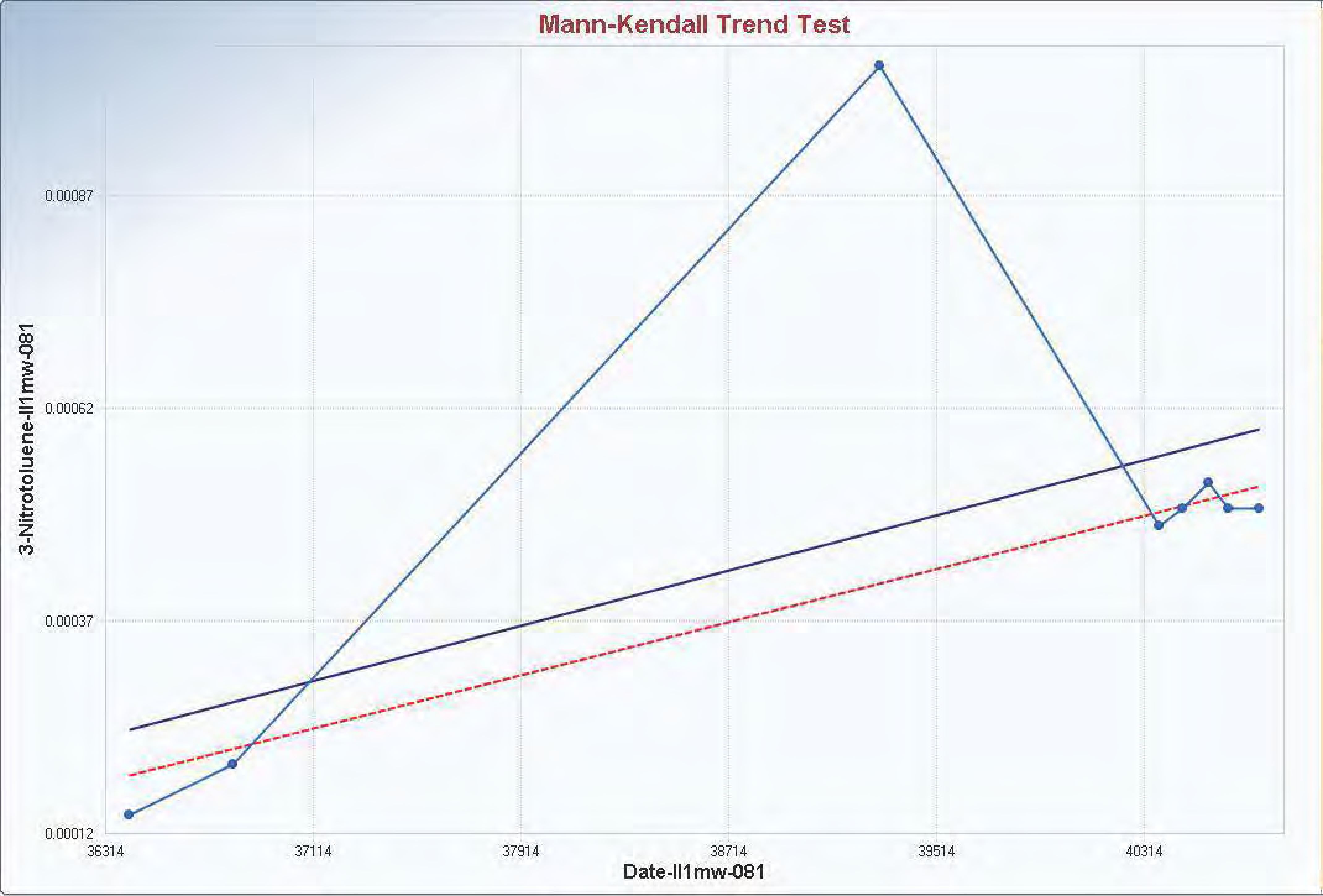
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0127

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0011

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	8
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	7.8528
Standardized Value of S	1.2734
Test Value (S)	11
Tabulated p-value	0.1380
Approximate p-value	0.1014

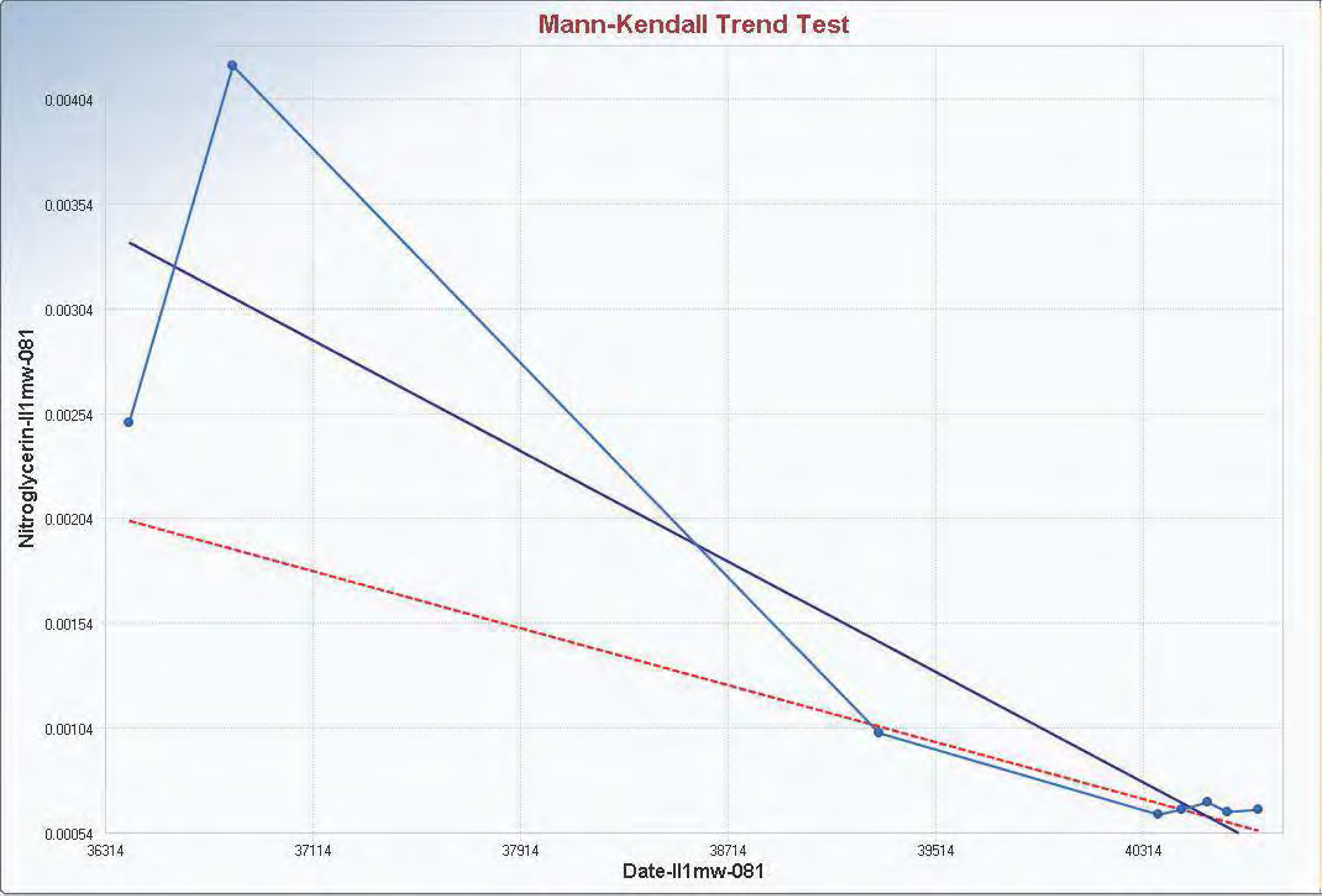
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0027

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0027

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	8
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	8.0208
Standardized Value of S	-1.4961
Test Value (S)	-13
Tabulated p-value	0.0890
Approximate p-value	0.0673

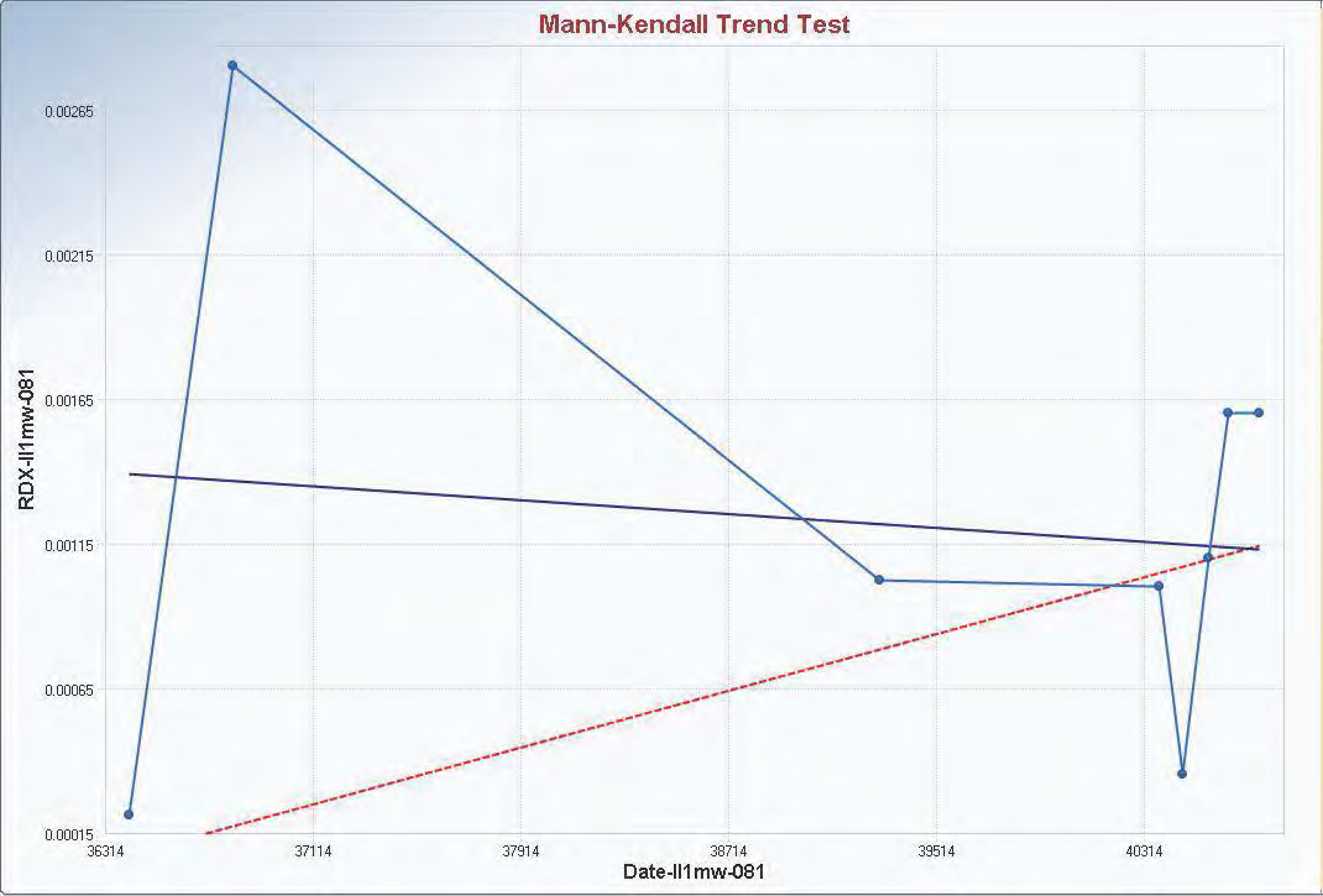
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0274

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0144

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	8
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	8.0208
Standardized Value of S	0.9974
Test Value (S)	9
Tabulated p-value	0.1190
Approximate p-value	0.1593

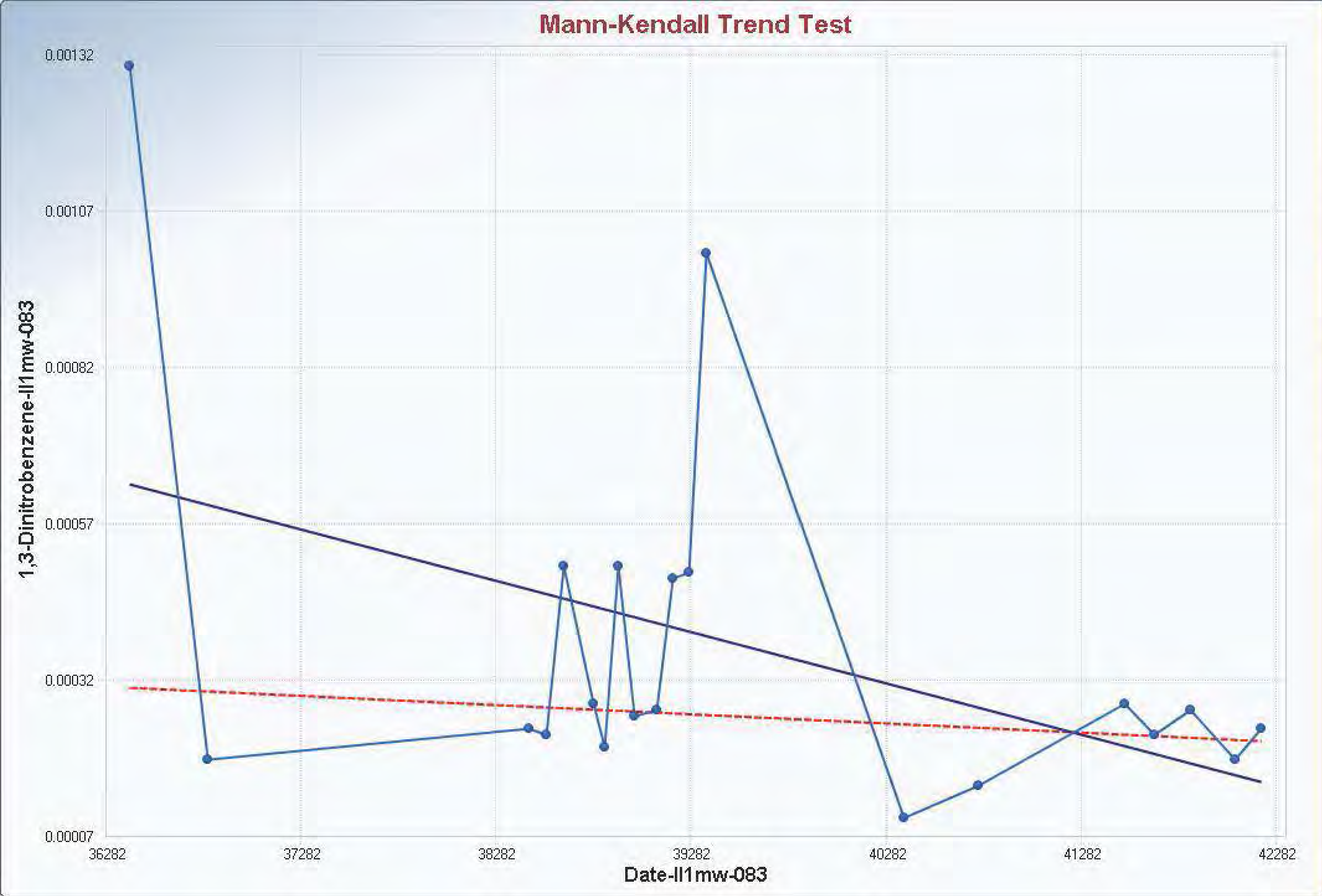
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0036

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0089

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	20
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	30.7246
Standardized Value of S	-0.8137
Test Value (S)	-26
Tabulated p-value	0.2110
Approximate p-value	0.2079

OLS Regression Line (Blue)

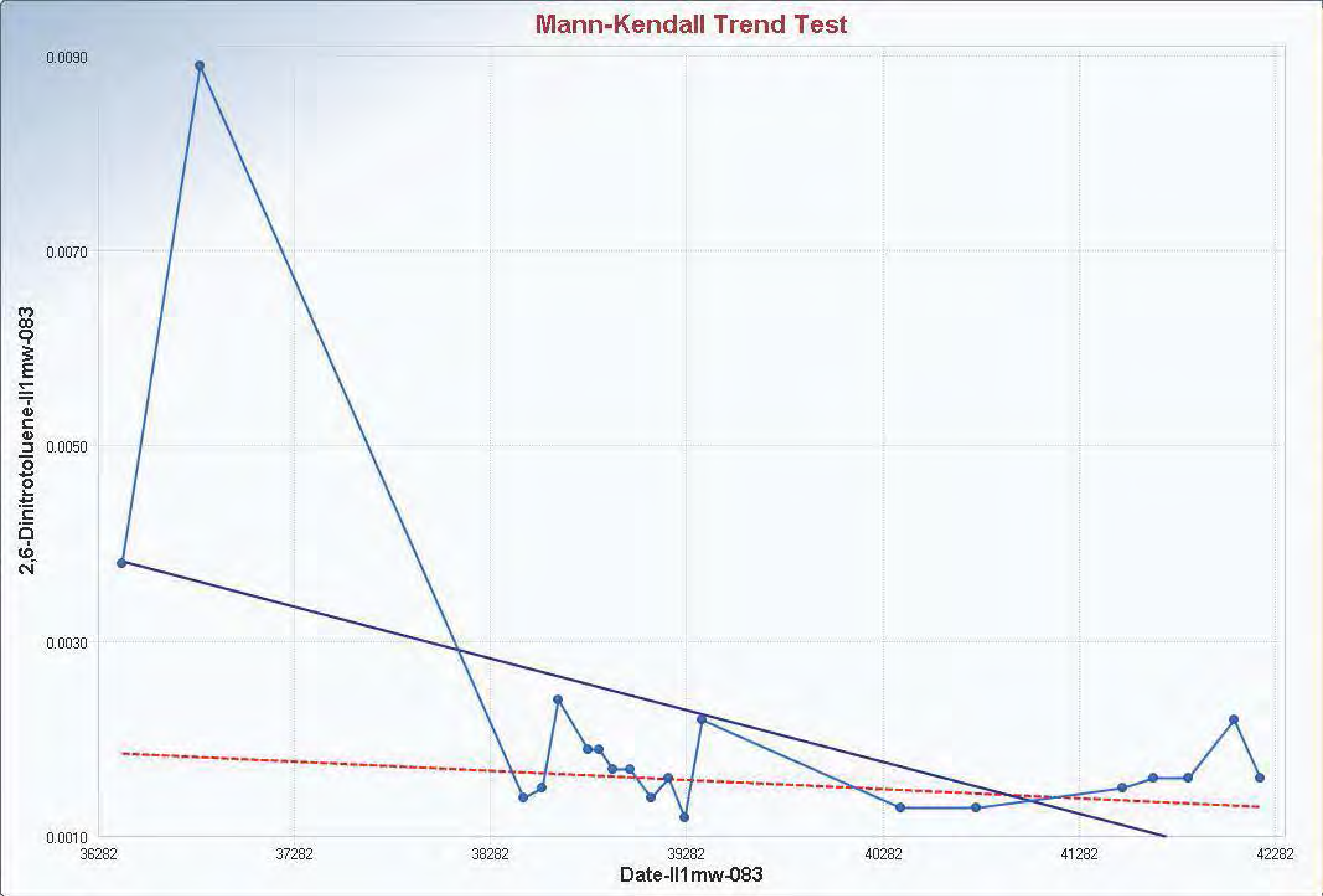
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0036

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0008

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Test
2,4-Dinitrotoluene-II1mw-083
Date-II1mw-083
0.00483
0.00433
0.00383
0.00333
0.00283
0.00233
36282
37282
38282
39282
40282
41282
42282
Mann-Kendall Trend Analysis
n 20
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 30.6159
Standardized Value of S -2.6457
Test Value (S) -82
Tabulated p-value 0.0040
Approximate p-value 0.0041
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0149
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0118
Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	20
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	30.5832
Standardized Value of S	-1.4714
Test Value (S)	-46
Tabulated p-value	0.0730
Approximate p-value	0.0706

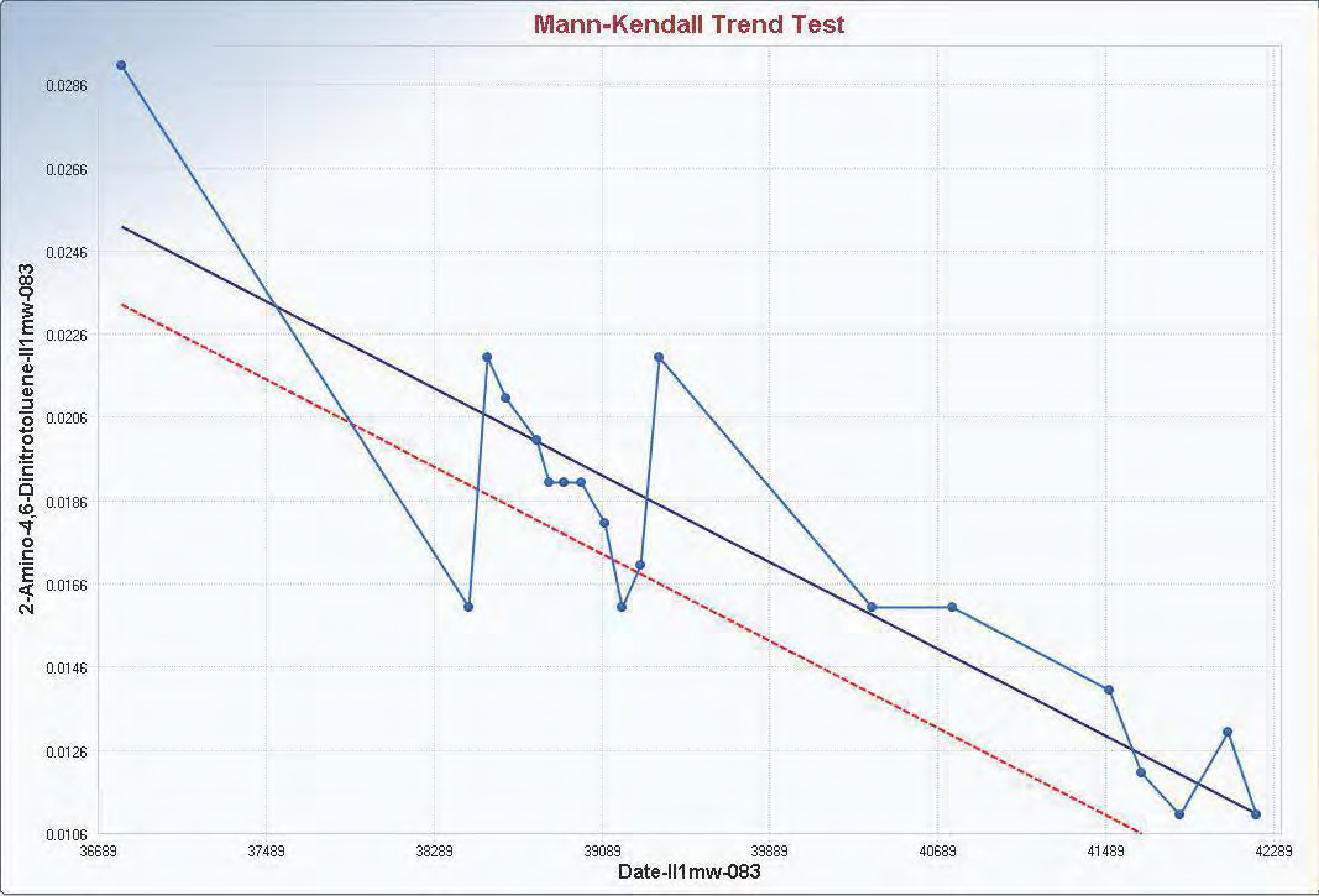
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0232

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0053

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.3314
Standardized Value of S	-4.2003
Test Value (S)	-120
Tabulated p-value	0.0000
Approximate p-value	0.0000

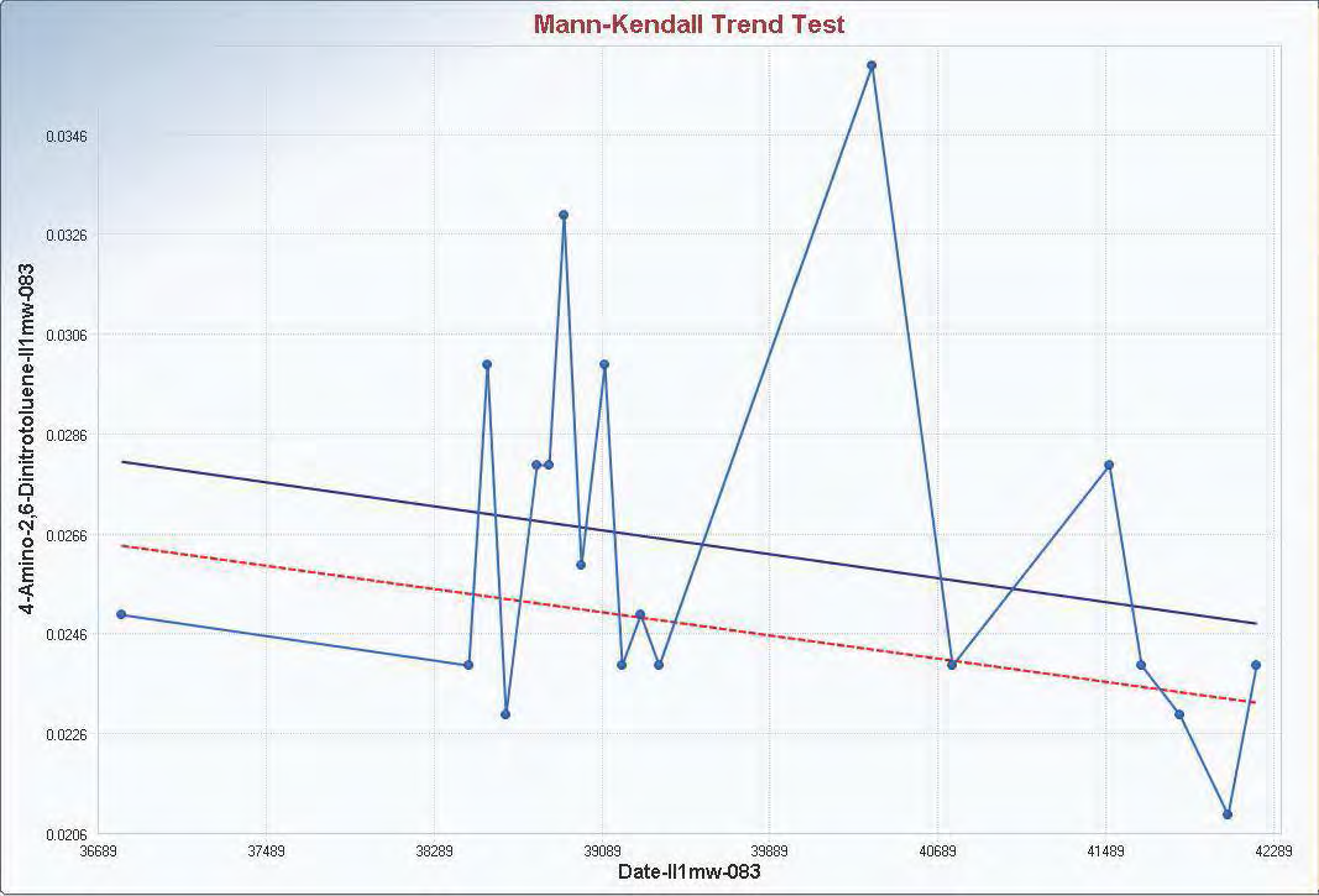
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.1213

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.1198

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	27.9643
Standardized Value of S	-1.5377
Test Value (S)	-44
Tabulated p-value	0.0620
Approximate p-value	0.0621

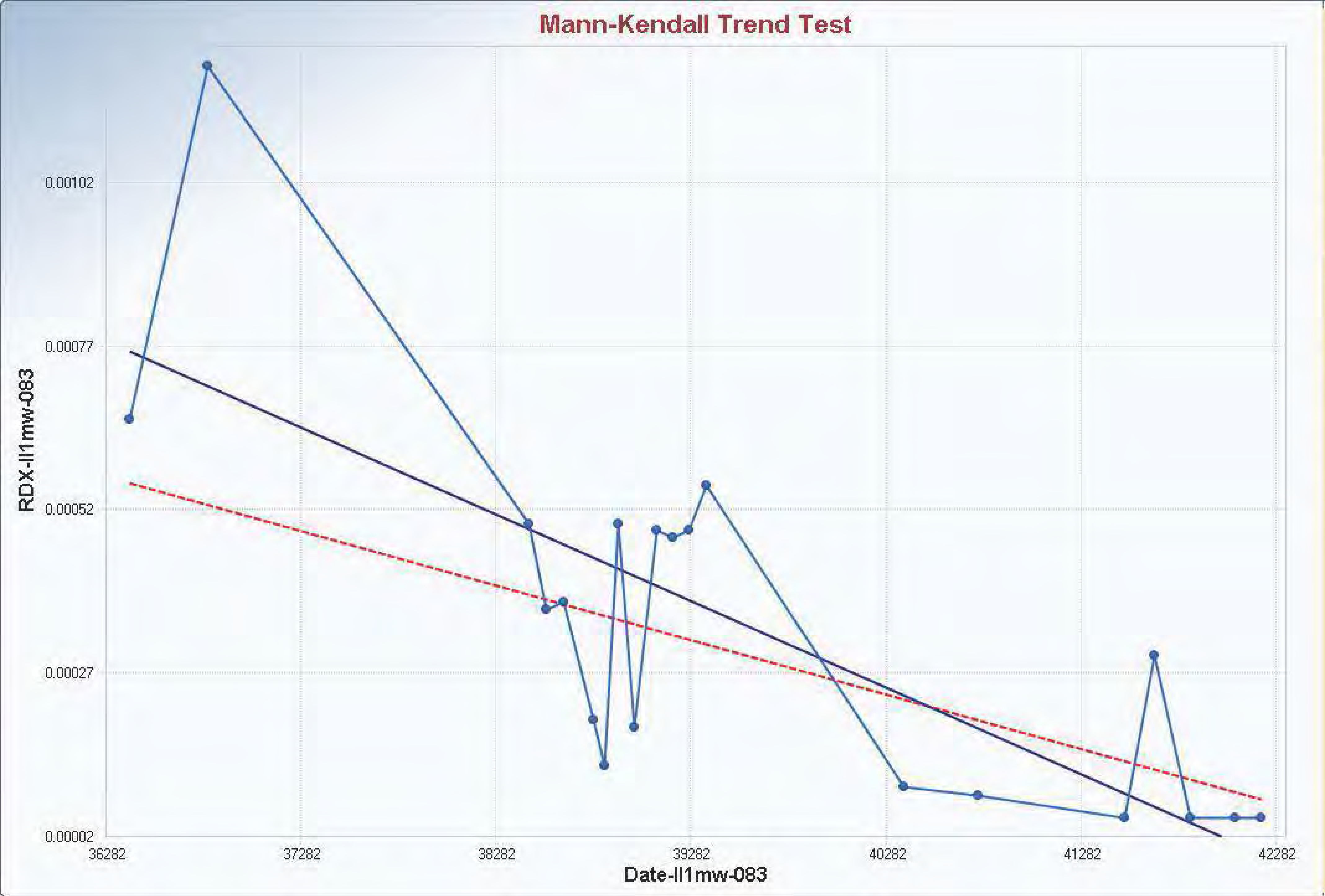
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0501

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0478

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	20
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	30.6485
Standardized Value of S	-3.3607
Test Value (S)	-104
Tabulated p-value	0.0000
Approximate p-value	0.0004

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0056

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0036

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Test
2,4,6-Trinitrotoluene-II1mw-083
0.0092
0.0072
0.0052
0.0032
36282
37282
38282
39282
40282
41282
42282
Date-II1mw-083
Mann-Kendall Trend Analysis
n 20
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 30.7896
Standardized Value of S -4.1897
Test Value (S) -130
Tabulated p-value 0.0000
Approximate p-value 0.0000
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0485
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0460
Statistically significant evidence
of a decreasing trend at the
specified level of significance.

Mann-Kendall Trend Analysis

n	13
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.3911
Standardized Value of S	-2.2573
Test Value (S)	-38
Tabulated p-value	0.0110
Approximate p-value	0.0120

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0051

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0046

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	13
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.2481
Standardized Value of S	-3.5081
Test Value (S)	-58
Tabulated p-value	0.0000
Approximate p-value	0.0002

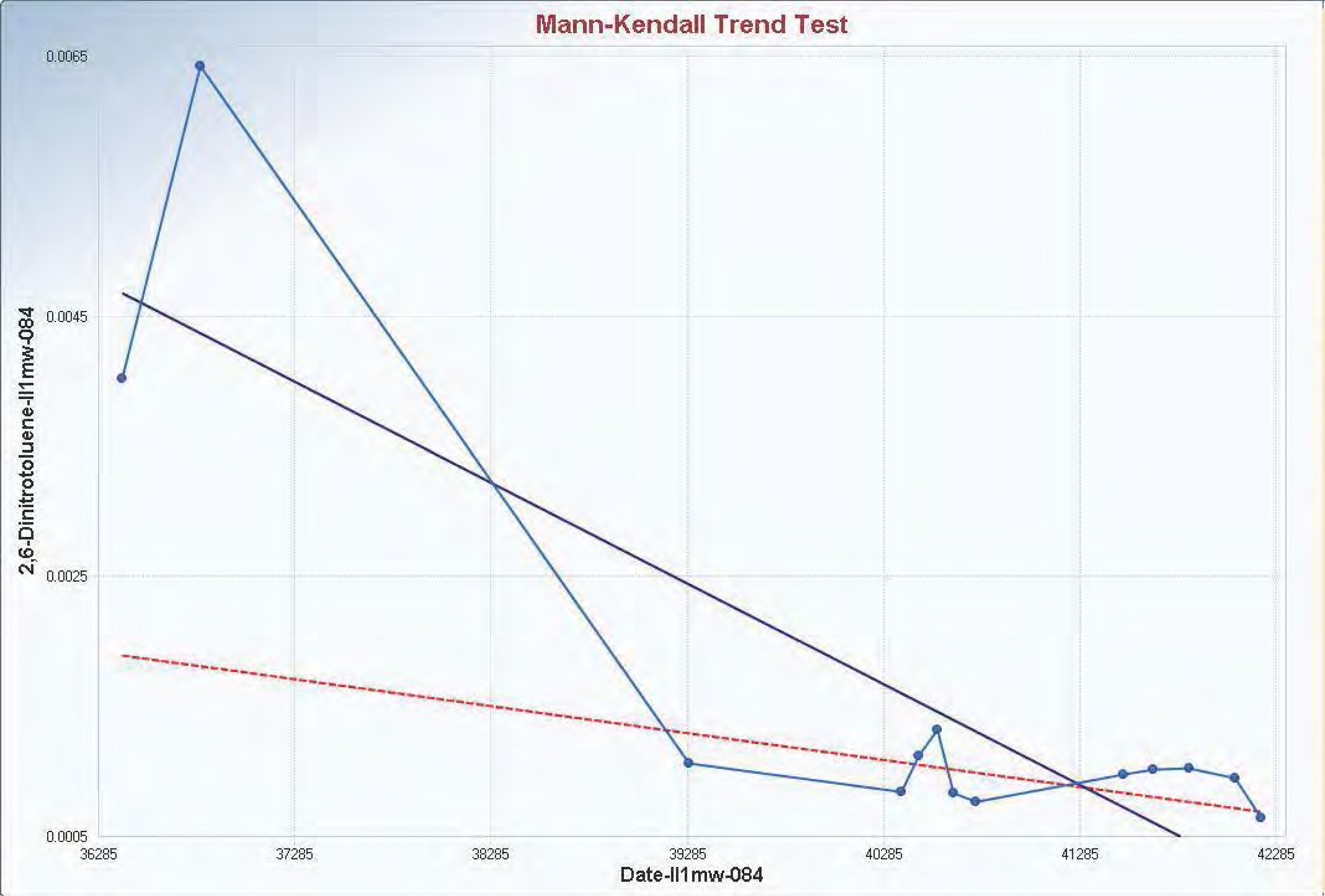
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0428

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0362

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	13
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.3911
Standardized Value of S	-2.1353
Test Value (S)	-36
Tabulated p-value	0.0150
Approximate p-value	0.0164

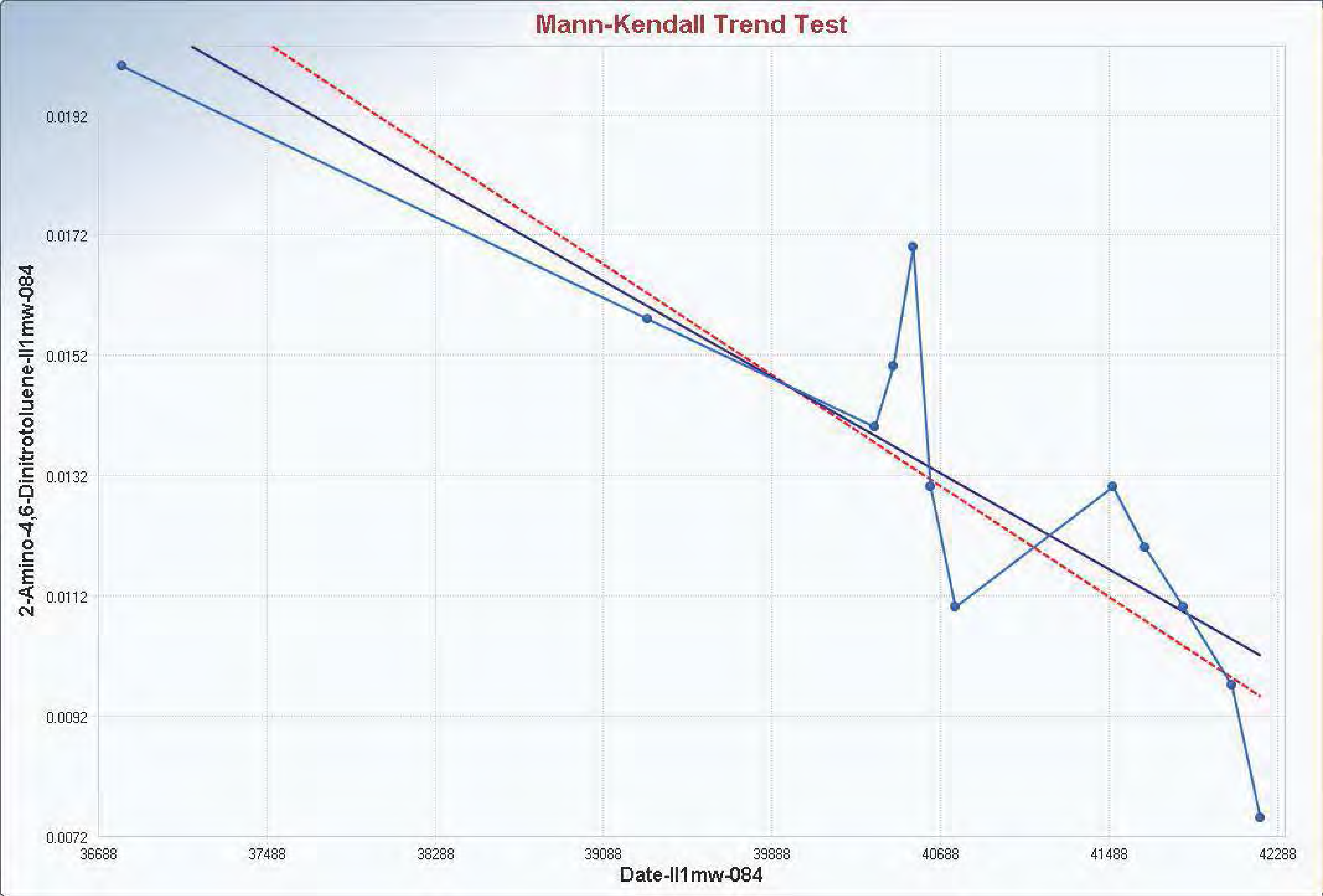
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0330

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0094

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.5144
Standardized Value of S	-3.5138
Test Value (S)	-52
Tabulated p-value	0.0000
Approximate p-value	0.0002

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0945

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.1069

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	13
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.0624
Standardized Value of S	-2.8016
Test Value (S)	-46
Tabulated p-value	0.0020
Approximate p-value	0.0025

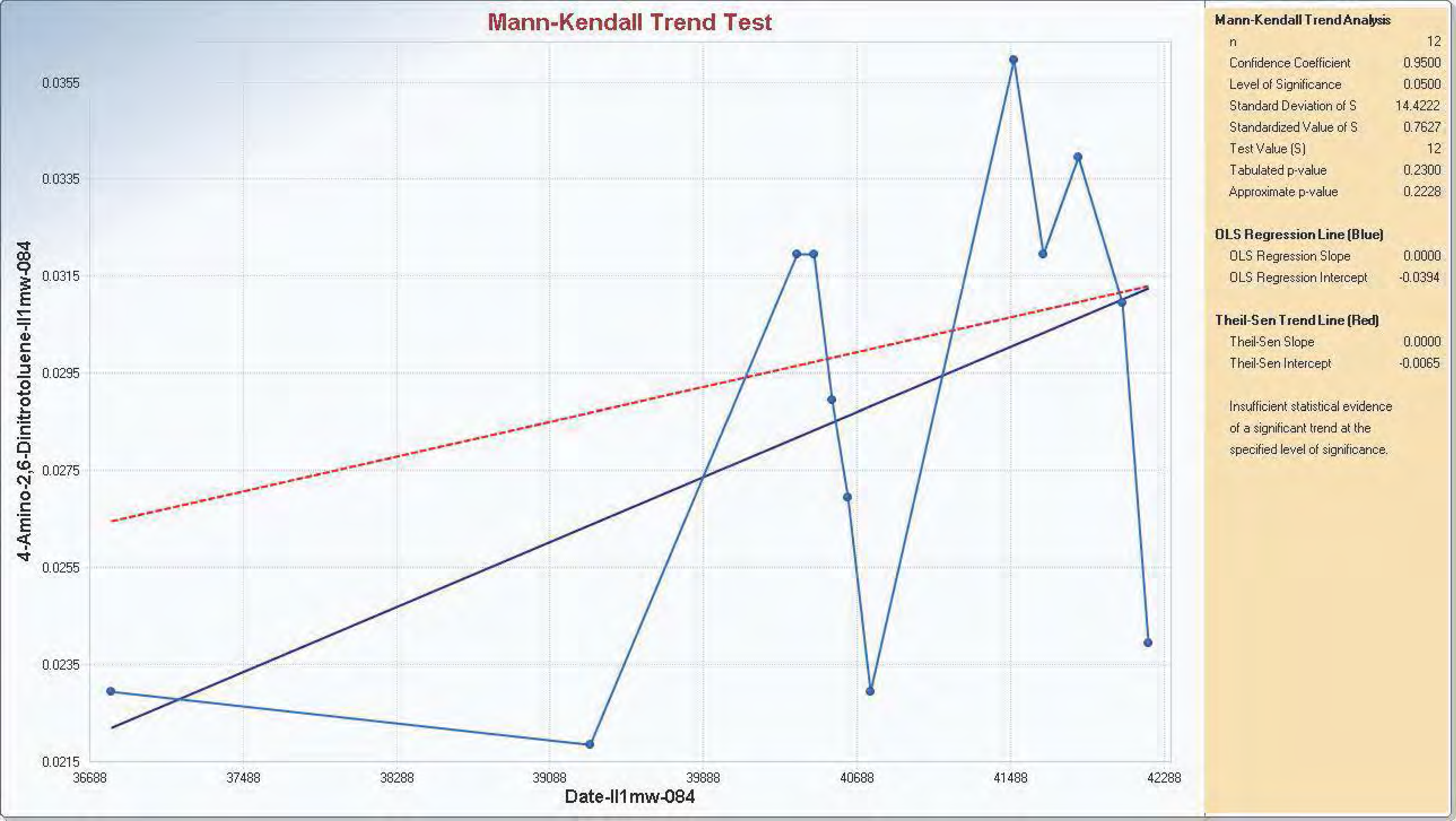
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0041

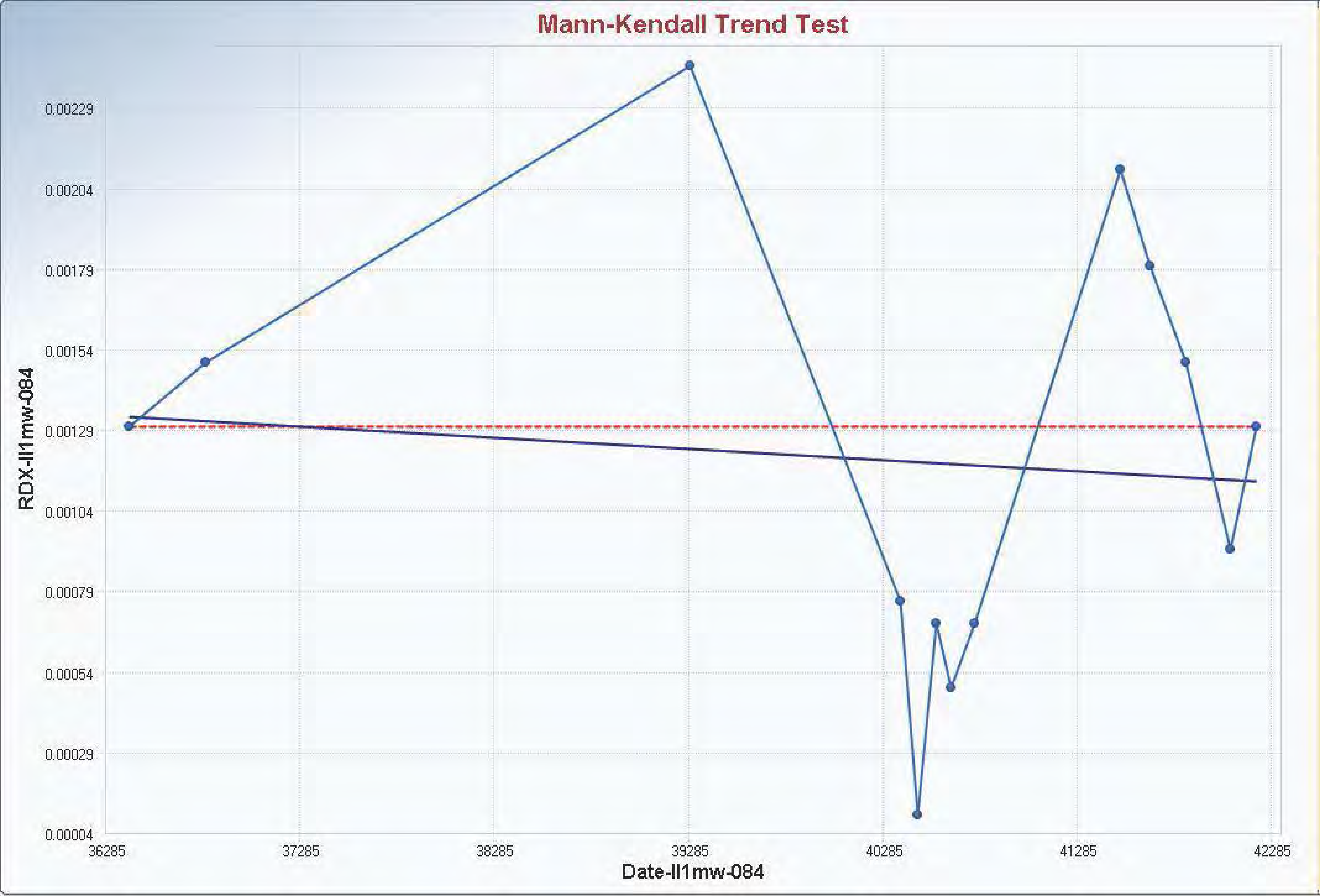
Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0064

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Test
4-Amino-2,6-Dinitrotoluene-Il1mw-084
0.0355
0.0335
0.0315
0.0295
0.0275
0.0255
0.0235
0.0215
36688
37488
38288
39088
39888
40688
41488
42288
Date-Il1mw-084
Mann-Kendall Trend Analysis
n 12
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 14.4222
Standardized Value of S 0.7627
Test Value (S) 12
Tabulated p-value 0.2300
Approximate p-value 0.2228
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept -0.0394
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept -0.0065
Insufficient statistical evidence
of a significant trend at the
specified level of significance.



Mann-Kendall Trend Analysis

n	13
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.2993
Standardized Value of S	0.0000
Test Value (S)	1
Tabulated p-value	0.5240
Approximate p-value	0.5000

OLS Regression Line (Blue)

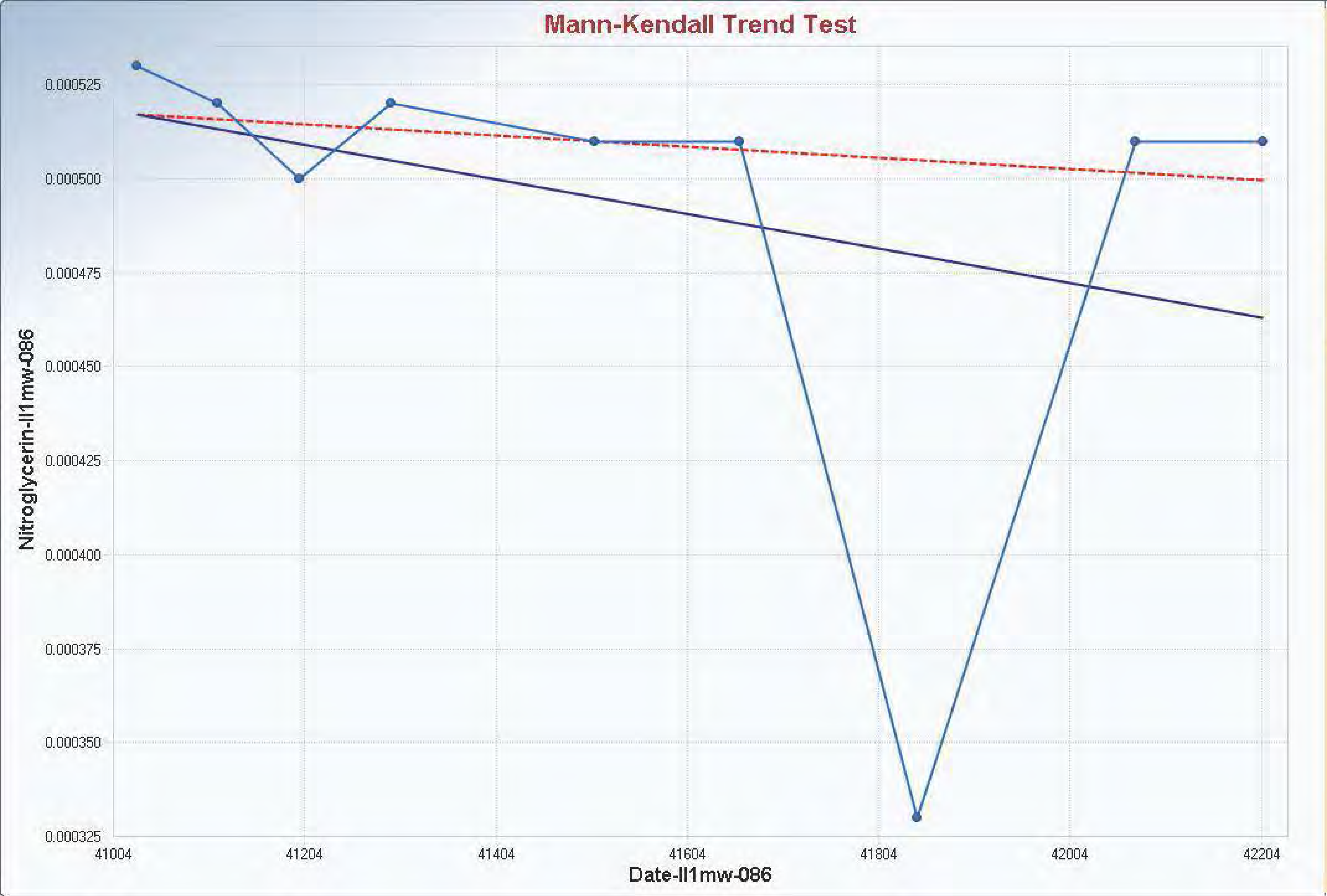
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0026

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0013

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Test
0.0155
0.0135
0.0115
0.0095
0.0075
0.0055
2,4,6-Trinitrotoluene-II1mw-084
36285
37285
38285
39285
40285
41285
42285
Date-II1mw-084
Mann-Kendall Trend Analysis
n 13
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 16.2481
Standardized Value of S -0.9232
Test Value (S) -16
Tabulated p-value 0.1840
Approximate p-value 0.1780
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0501
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0416
Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	9
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	9.0738
Standardized Value of S	-1.5429
Test Value (S)	-15
Tabulated p-value	0.0900
Approximate p-value	0.0614

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0024

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0011

Insufficient statistical evidence of a significant trend at the specified level of significance.

LOAD LINE 2 ProUCL OUTPUT

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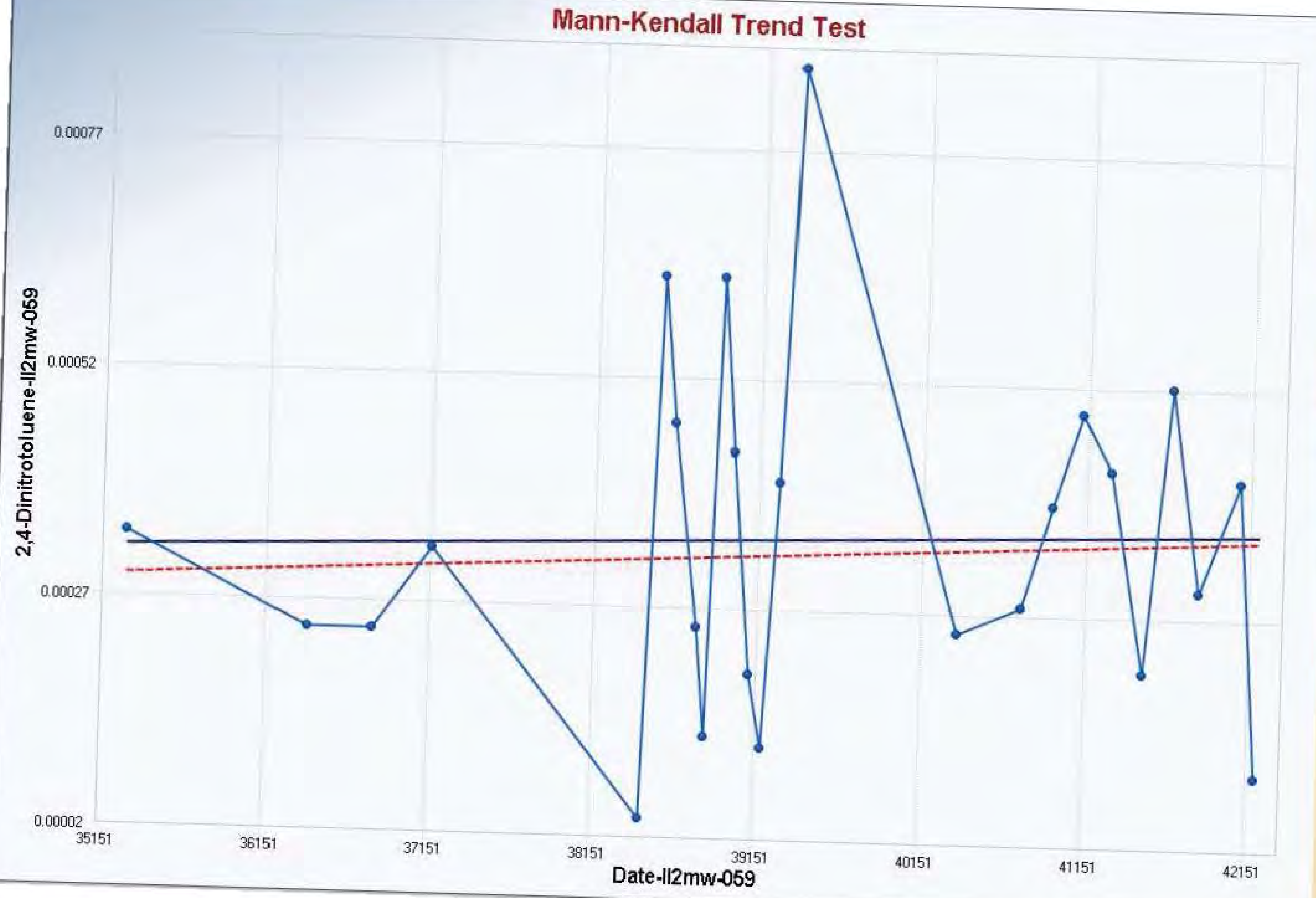


Mann-Kendall Trend Analysis

n	25
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	42.7824
Standardized Value of S	0.4207
Test Value (S)	19
Appx. Critical Value (0.05)	1.6449
Approximate p-value	0.3370

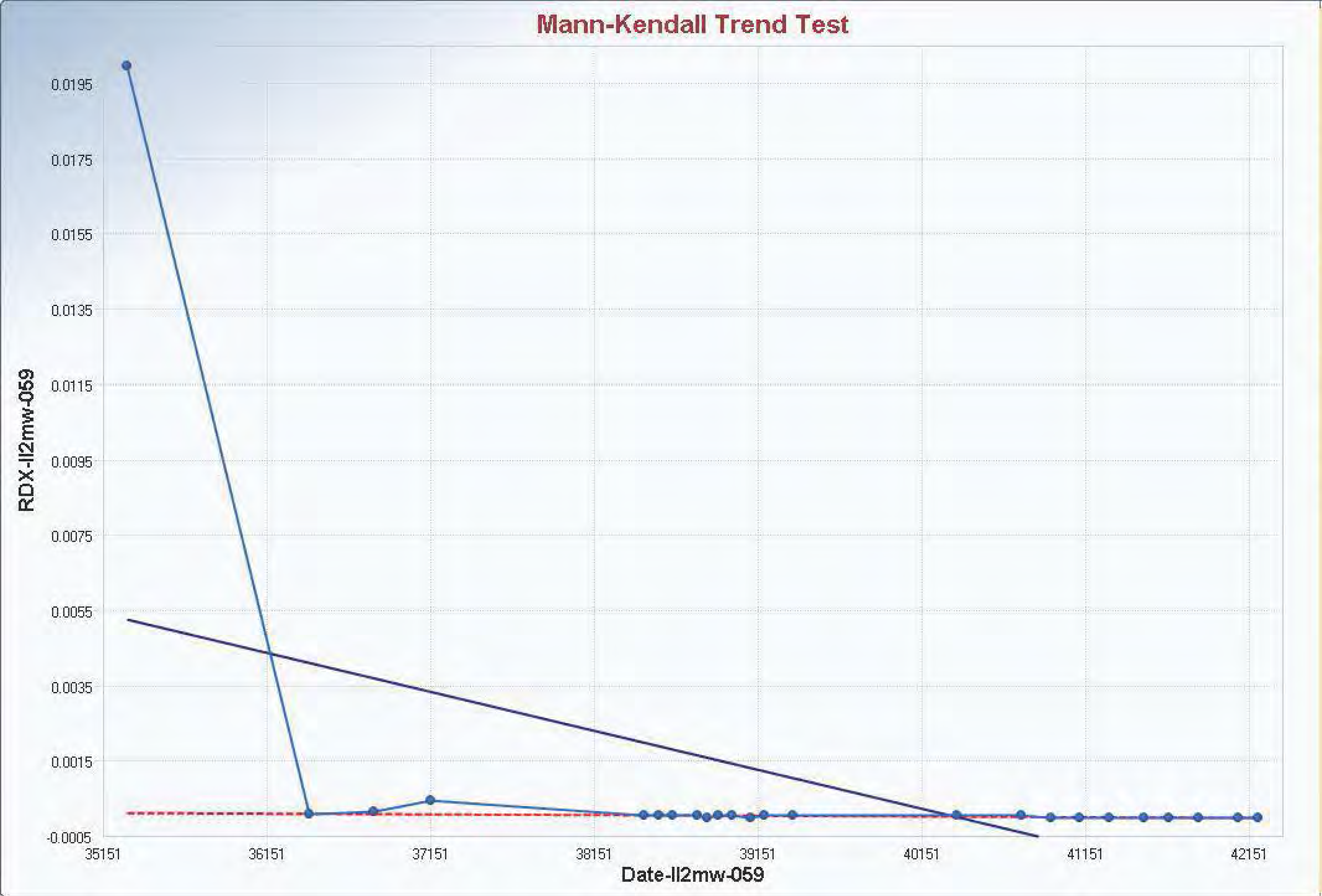
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0001

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0000

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	24
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	39.5390
Standardized Value of S	-3.6673
Test Value (S)	-146
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.0001

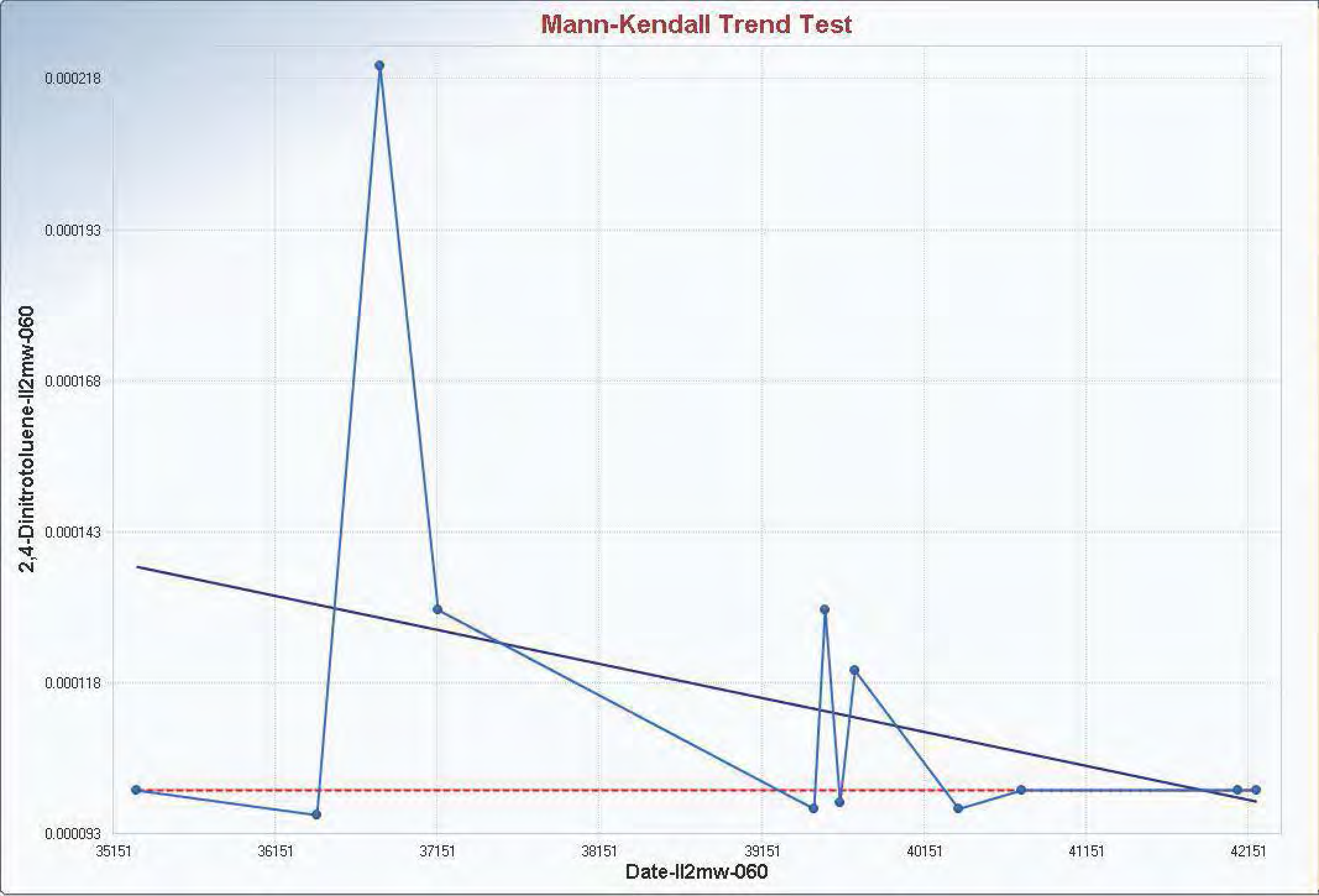
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0418

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0008

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	12
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	14.2127
Standardized Value of S	-0.2111
Test Value (S)	-4
Tabulated p-value	0.4200
Approximate p-value	0.4164

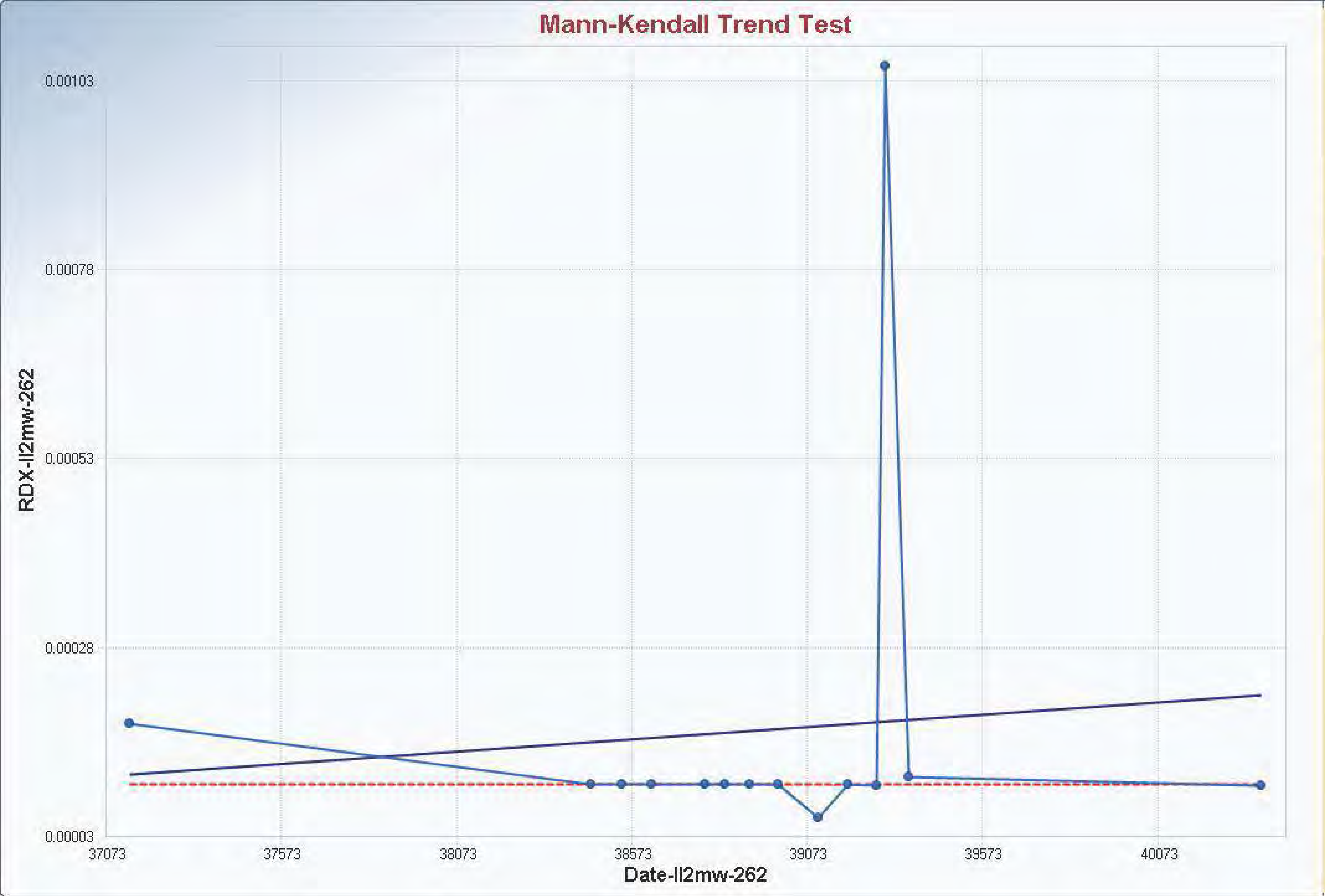
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0003

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.3809
Standardized Value of S	-0.8547
Test Value (S)	-15
Tabulated p-value	0.2250
Approximate p-value	0.1964

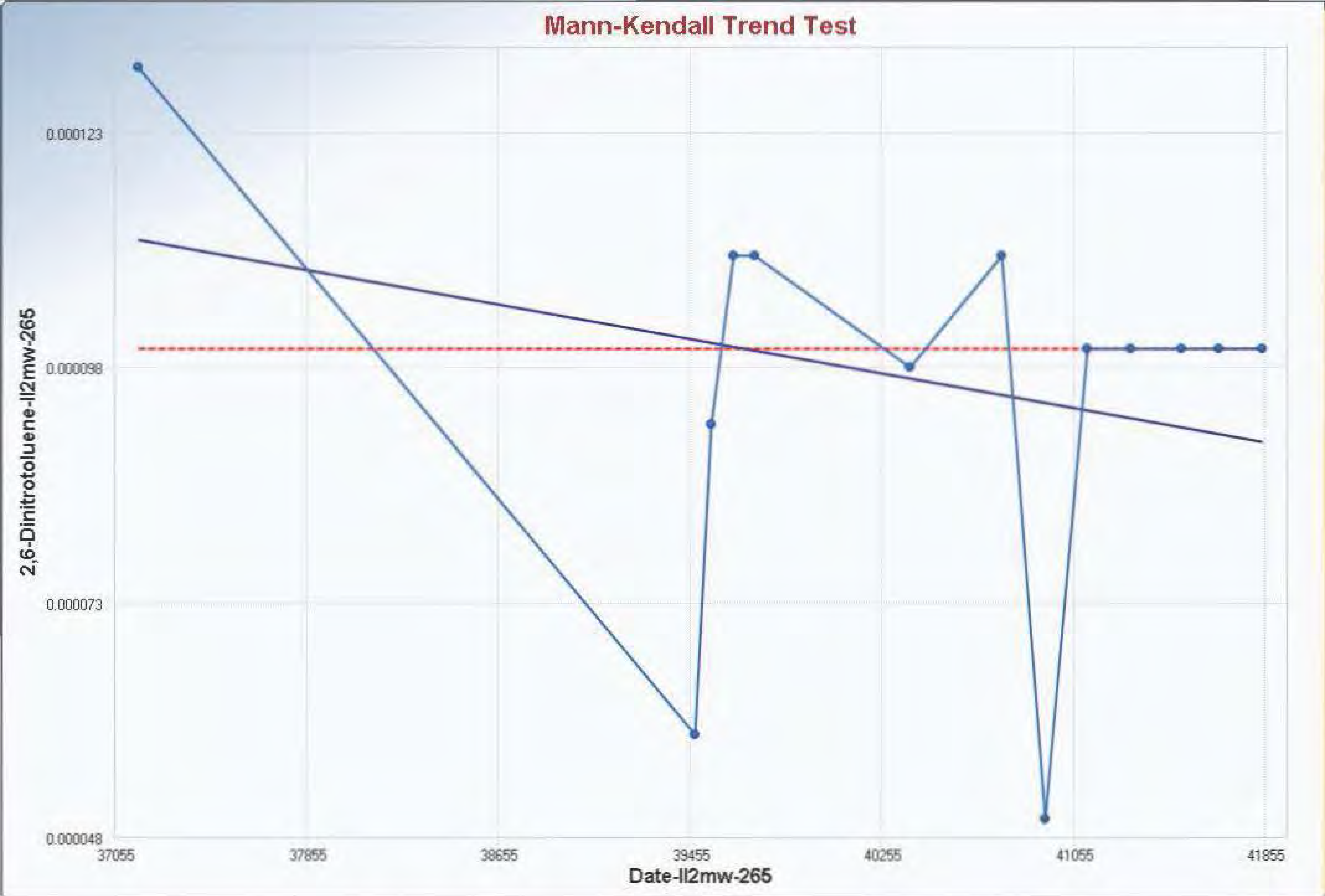
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0011

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	13
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	15.7586
Standardized Value of S	-0.2538
Test Value (S)	-5
Tabulated p-value	0.4290
Approximate p-value	0.3998

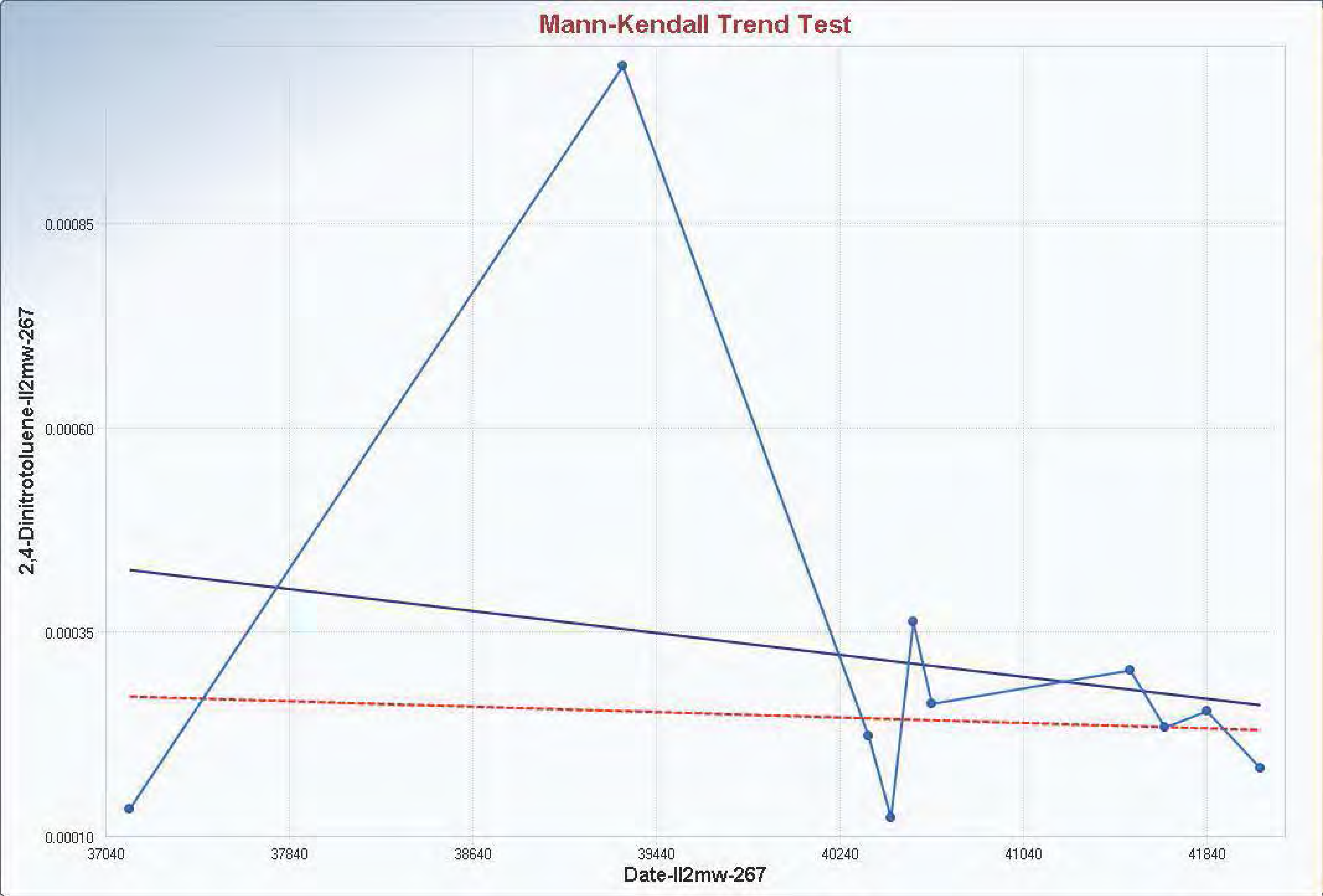
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0003

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	10
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	11.1803
Standardized Value of S	-0.1789
Test Value (S)	-3
Tabulated p-value	0.4310
Approximate p-value	0.4290

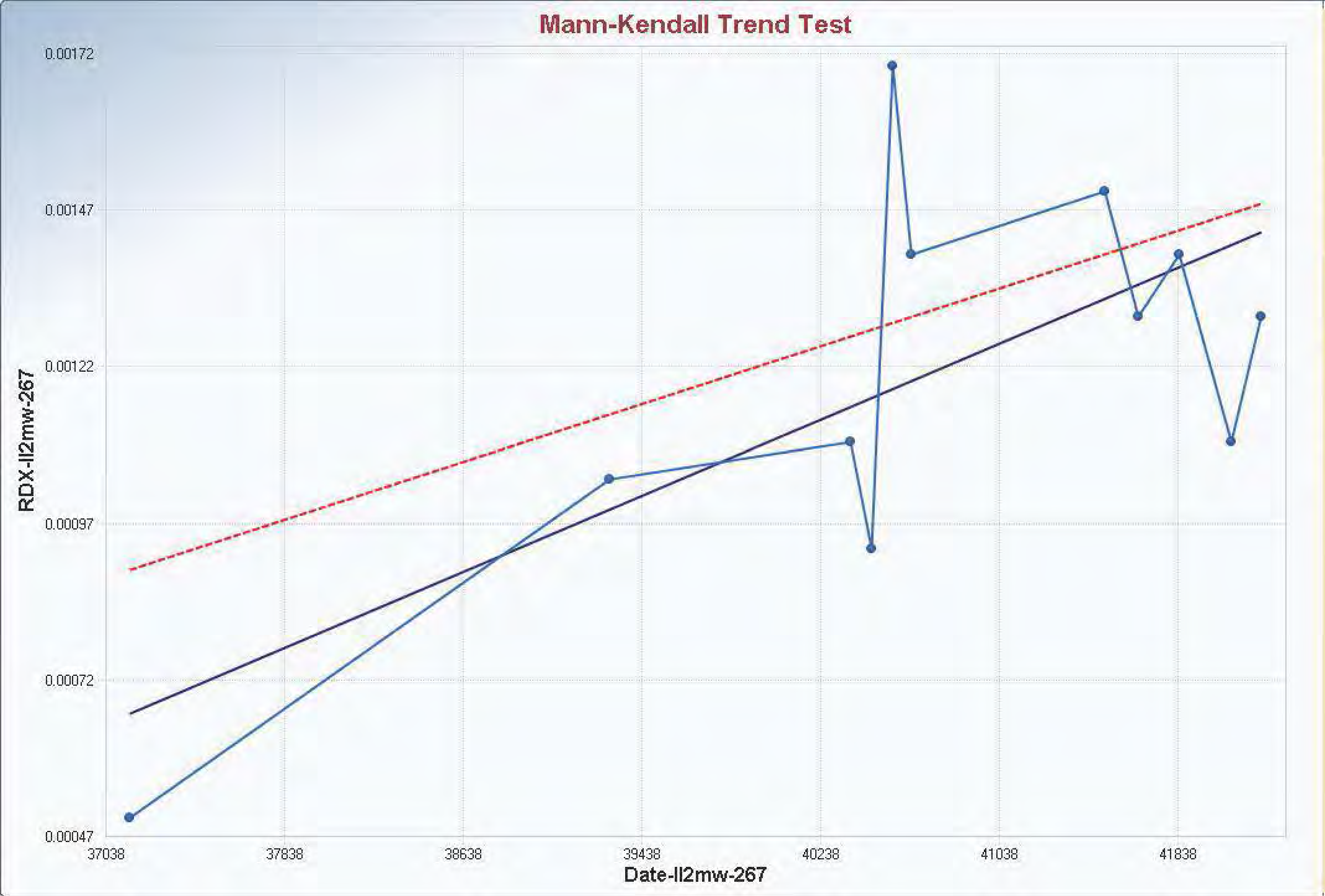
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0017

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0006

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	11
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	12.7279
Standardized Value of S	1.1785
Test Value (S)	16
Tabulated p-value	0.1090
Approximate p-value	0.1193

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0050

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0034

Insufficient statistical evidence of a significant trend at the specified level of significance.

LOAD LINE 3 ProUCL OUTPUT

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Mann-Kendall Trend Analysis

n	7
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	6.5064
Standardized Value of S	-1.8443
Test Value (S)	-13
Tabulated p-value	0.0350
Approximate p-value	0.0326

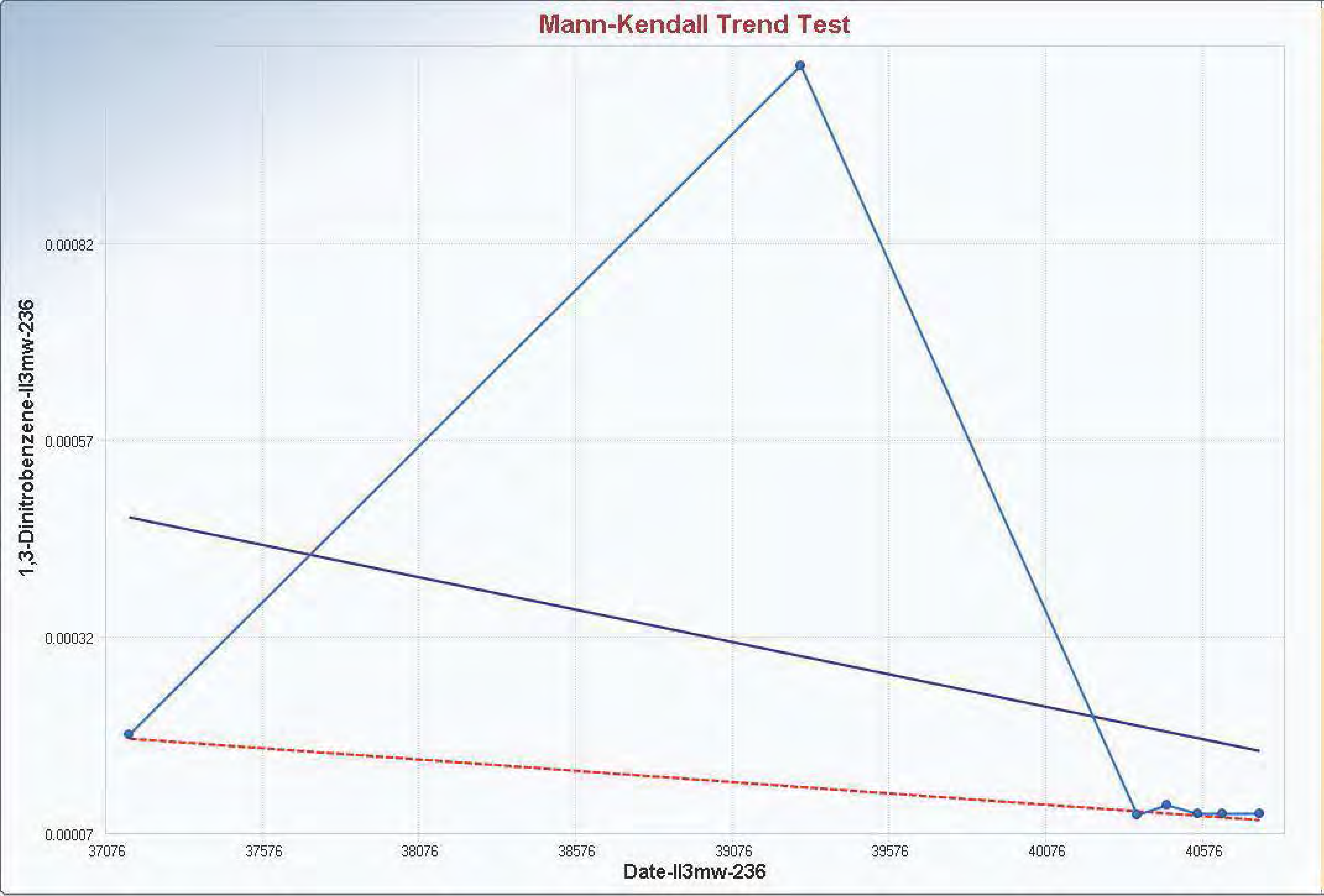
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0006

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0006

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	7
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	6.3770
Standardized Value of S	-1.0977
Test Value (S)	-8
Tabulated p-value	0.1190
Approximate p-value	0.1362

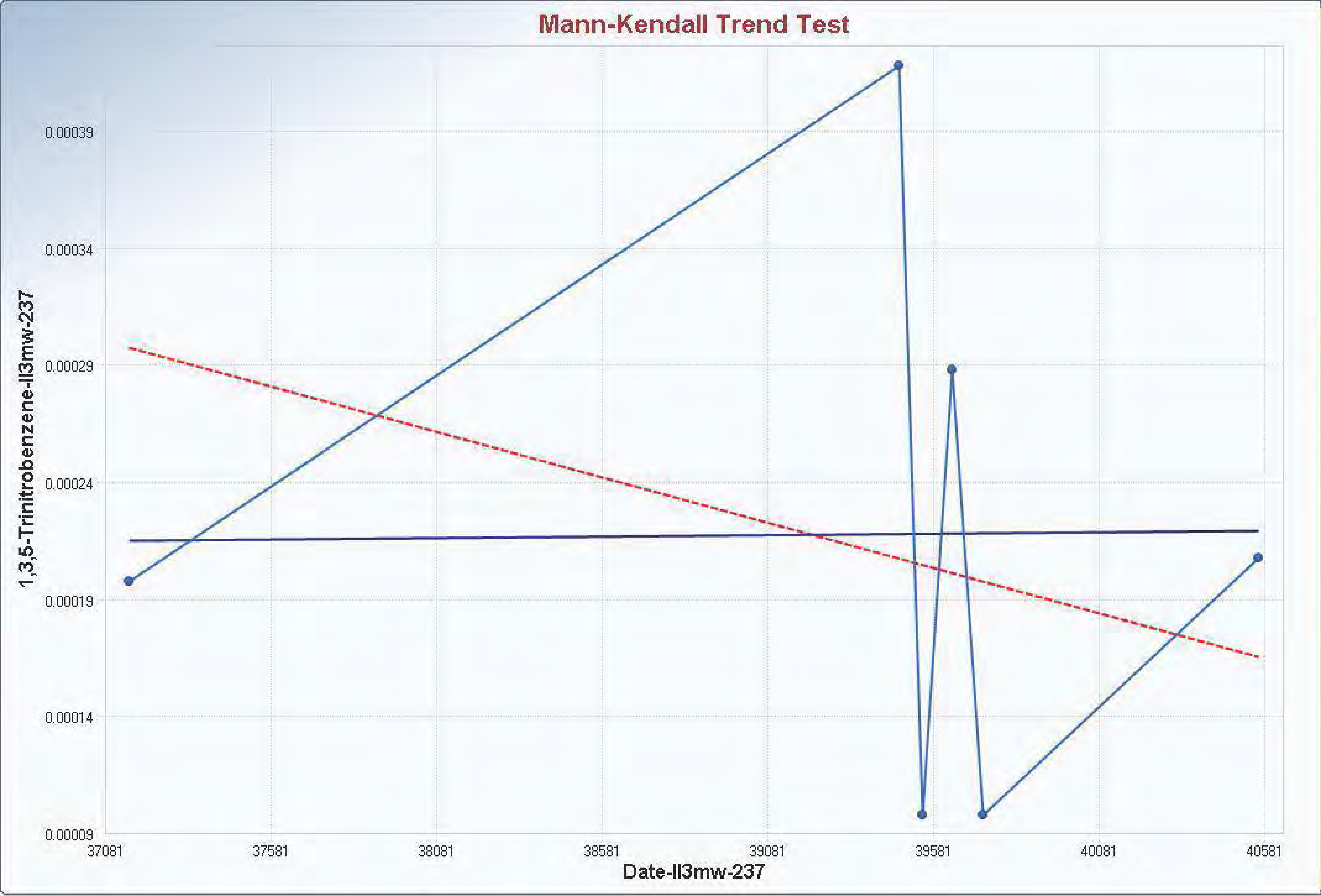
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0035

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0013

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.2281
Standardized Value of S	-0.1913
Test Value (S)	-2
Tabulated p-value	0.3600
Approximate p-value	0.4242

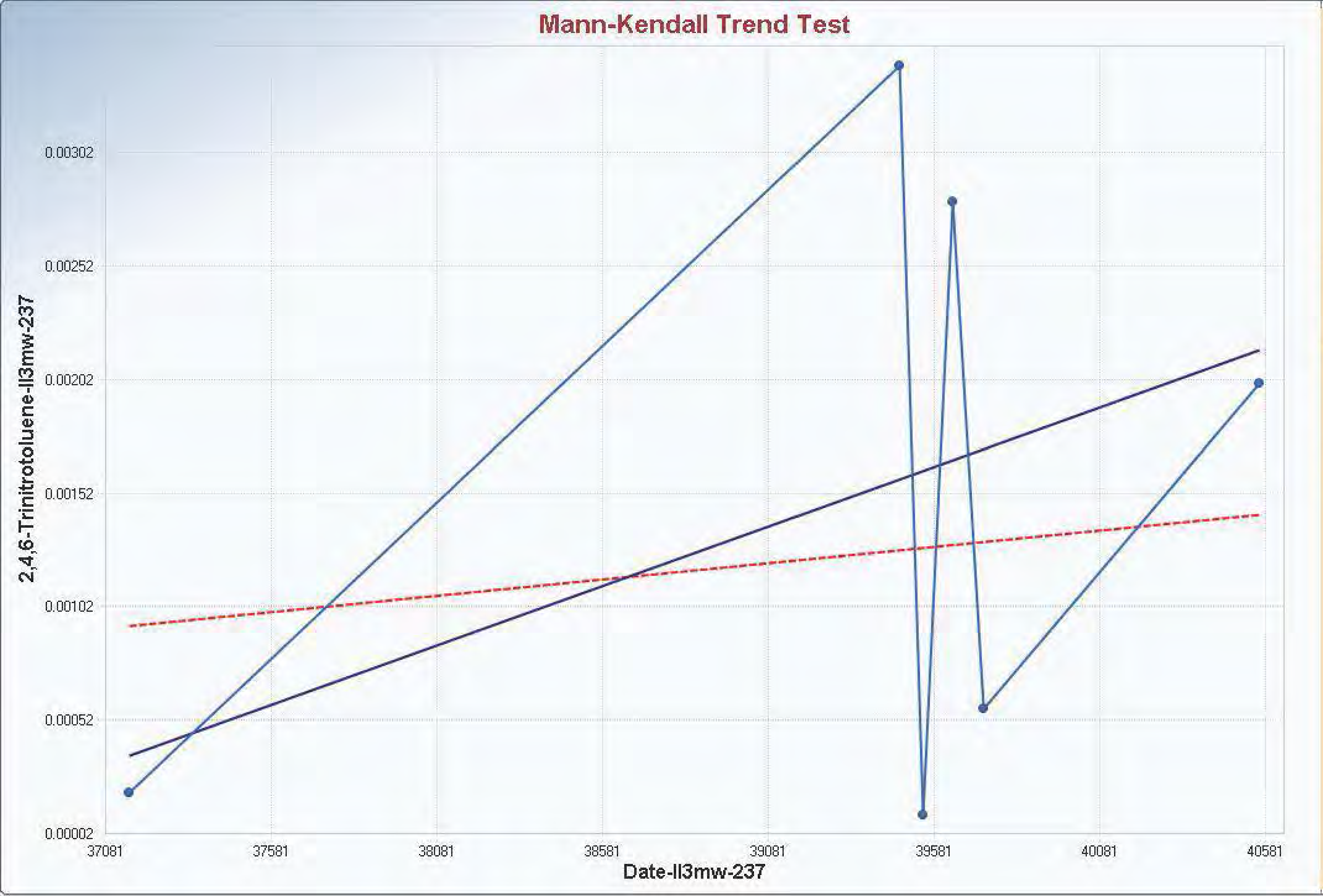
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0002

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0017

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.3229
Standardized Value of S	0.0000
Test Value (S)	1
Tabulated p-value	0.5000
Approximate p-value	0.5000

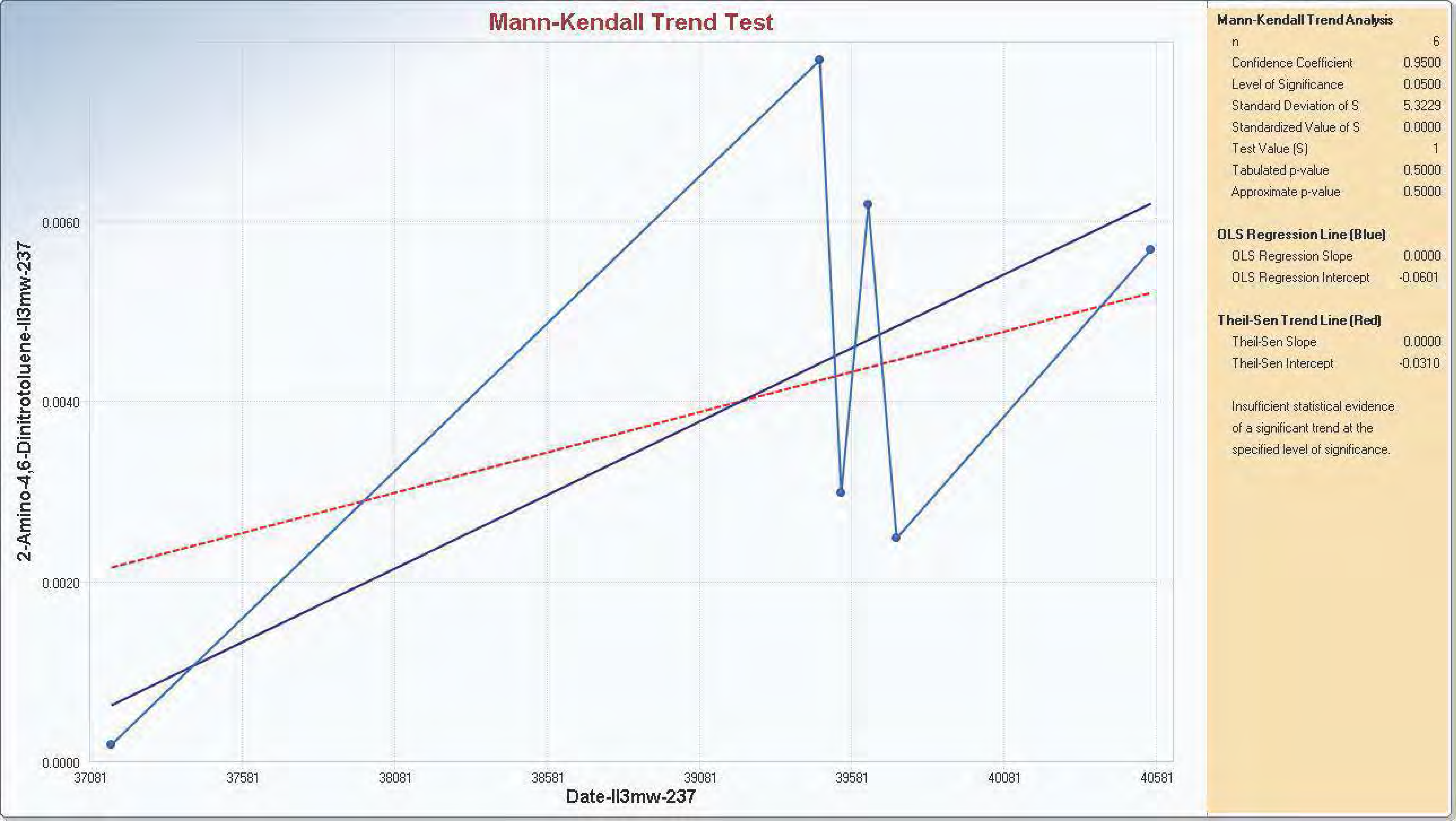
OLS Regression Line (Blue)

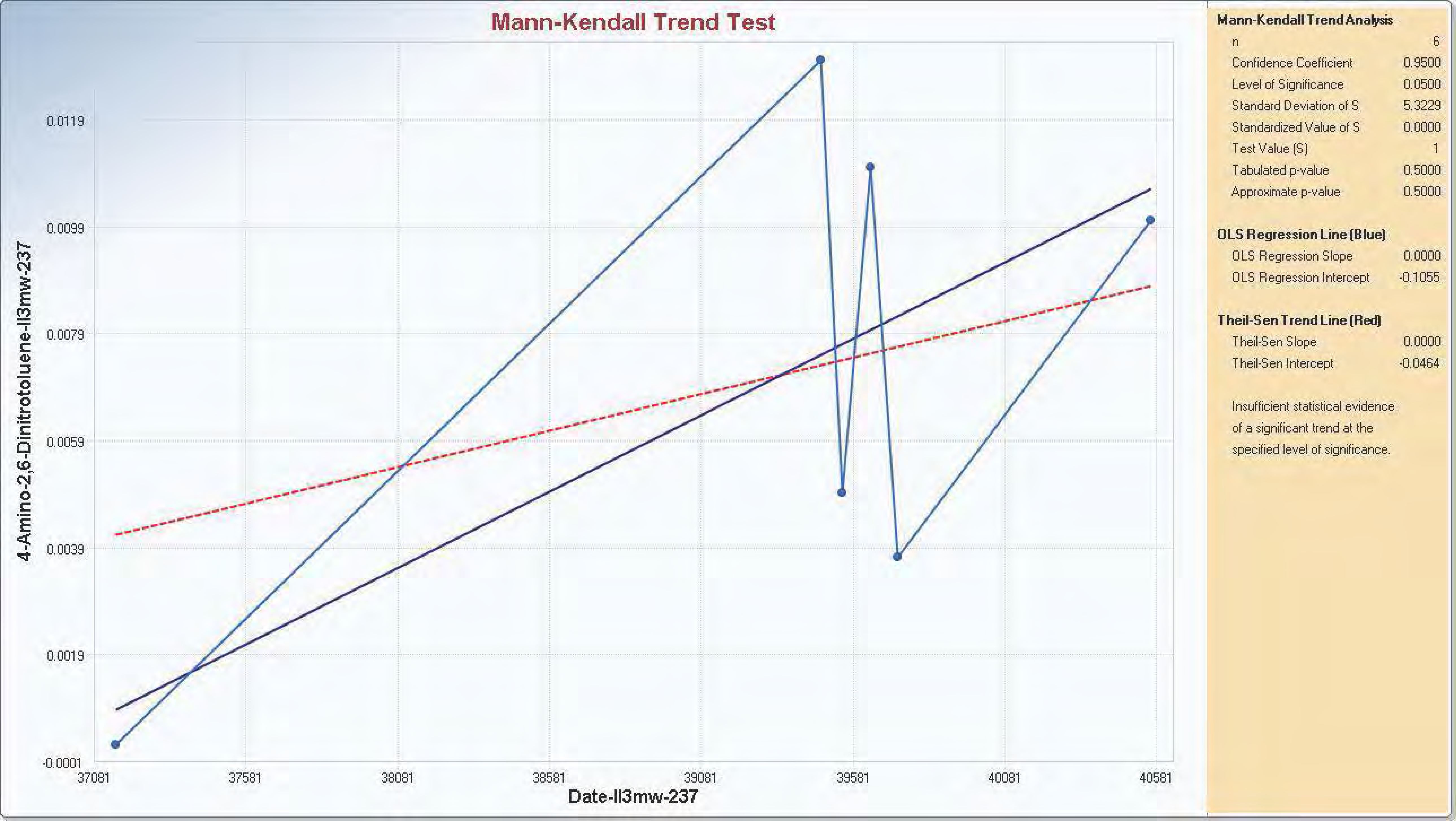
OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0191

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0044

Insufficient statistical evidence of a significant trend at the specified level of significance.


Mann-Kendall Trend Test
2-Amino-4,6-Dinitrotoluene-II3mw-237
Date-II3mw-237
0.0000
0.0020
0.0040
0.0060
37081
37581
38081
38581
39081
39581
40081
40581
Mann-Kendall Trend Analysis
n 6
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 5.3229
Standardized Value of S 0.0000
Test Value (S) 1
Tabulated p-value 0.5000
Approximate p-value 0.5000
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept -0.0601
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept -0.0310
Insufficient statistical evidence of a significant trend at the specified level of significance.


Mann-Kendall Trend Test
0.0119
0.0099
0.0079
0.0059
0.0039
0.0019
-0.0001
37081
37581
38081
38581
39081
39581
40081
40581
4-Amino-2,6-Dinitrotoluene-II3mw-237
Date-II3mw-237
Mann-Kendall Trend Analysis
n 6
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 5.3229
Standardized Value of S 0.0000
Test Value (S) 1
Tabulated p-value 0.5000
Approximate p-value 0.5000
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept -0.1055
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept -0.0464
Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.5307
Standardized Value of S	-3.2596
Test Value (S)	-94
Tabulated p-value	0.0000
Approximate p-value	0.0006

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.2524

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.2321

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	27.6043
Standardized Value of S	-1.2679
Test Value (S)	-36
Tabulated p-value	0.1050
Approximate p-value	0.1024

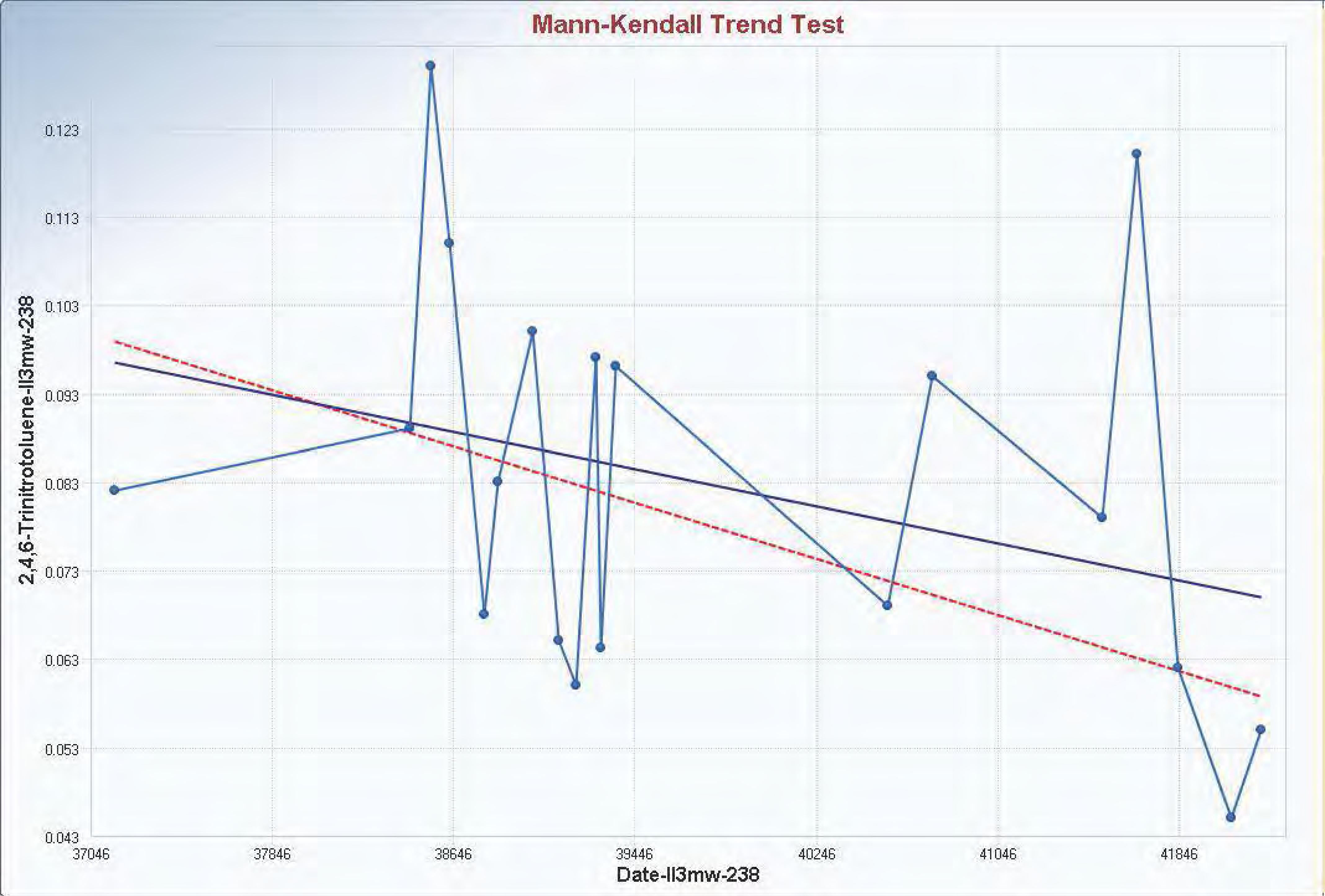
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0071

Theil-Sen Trend Line (Red)

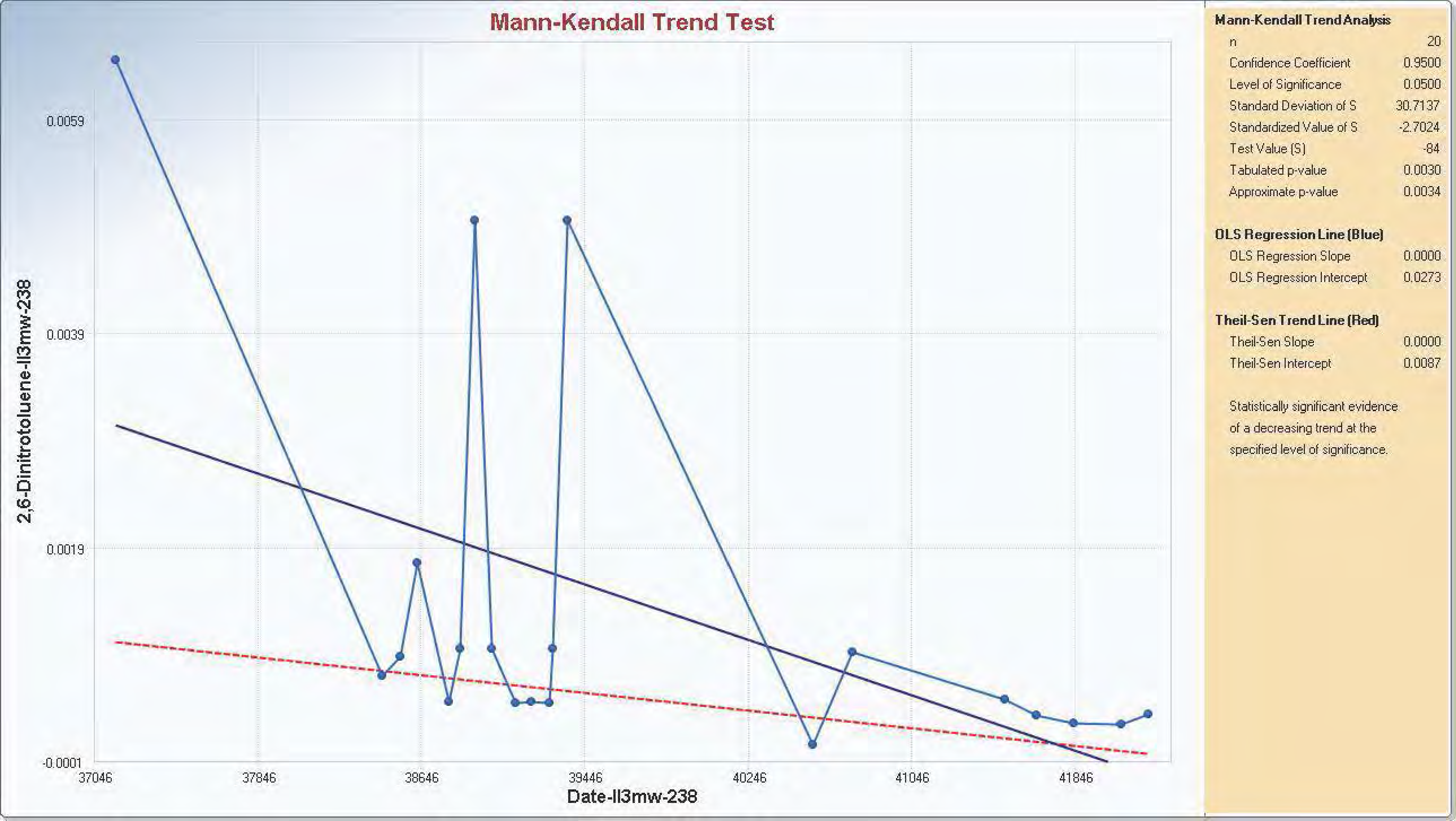
Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0013

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis	
n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.5832
Standardized Value of S	-1.8892
Test Value (S)	-55
Tabulated p-value	0.0290
Approximate p-value	0.0294
OLS Regression Line (Blue)	
OLS Regression Slope	0.0000
OLS Regression Intercept	0.2923
Theil-Sen Trend Line (Red)	
Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.3937

Statistically significant evidence of a decreasing trend at the specified level of significance.


Mann-Kendall Trend Test
2,6-Dinitrotoluene-II3mw-238
Date-II3mw-238
0.0059
0.0039
0.0019
-0.0001
37046
37846
38646
39446
40246
41046
41846
Mann-Kendall Trend Analysis
n 20
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 30.7137
Standardized Value of S -2.7024
Test Value (S) -84
Tabulated p-value 0.0030
Approximate p-value 0.0034
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0273
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0087
Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.4136
Standardized Value of S	-1.1614
Test Value (S)	-34
Tabulated p-value	0.1190
Approximate p-value	0.1227

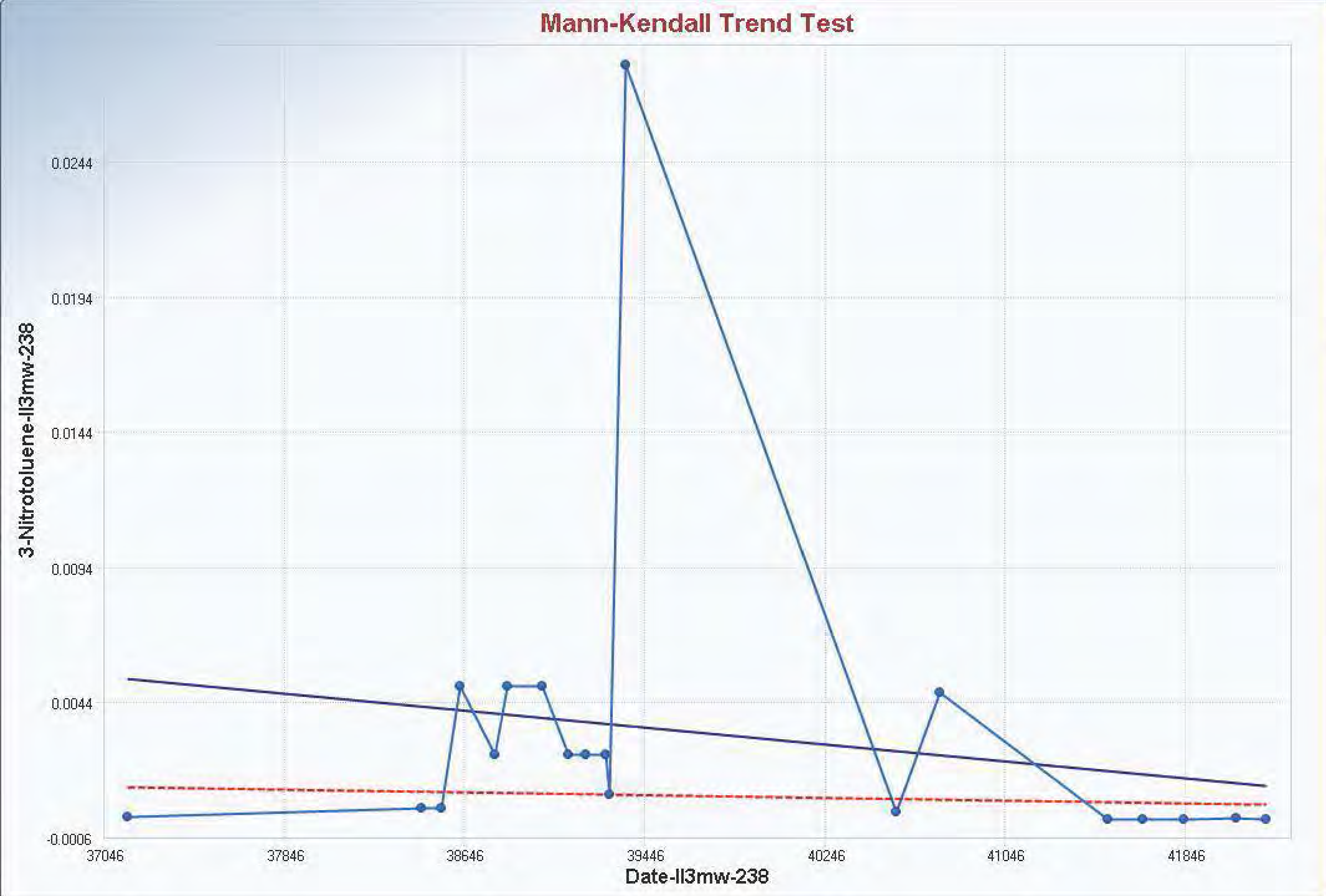
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0754

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0559

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.2843
Standardized Value of S	-1.8738
Test Value (S)	-54
Tabulated p-value	0.0290
Approximate p-value	0.0305

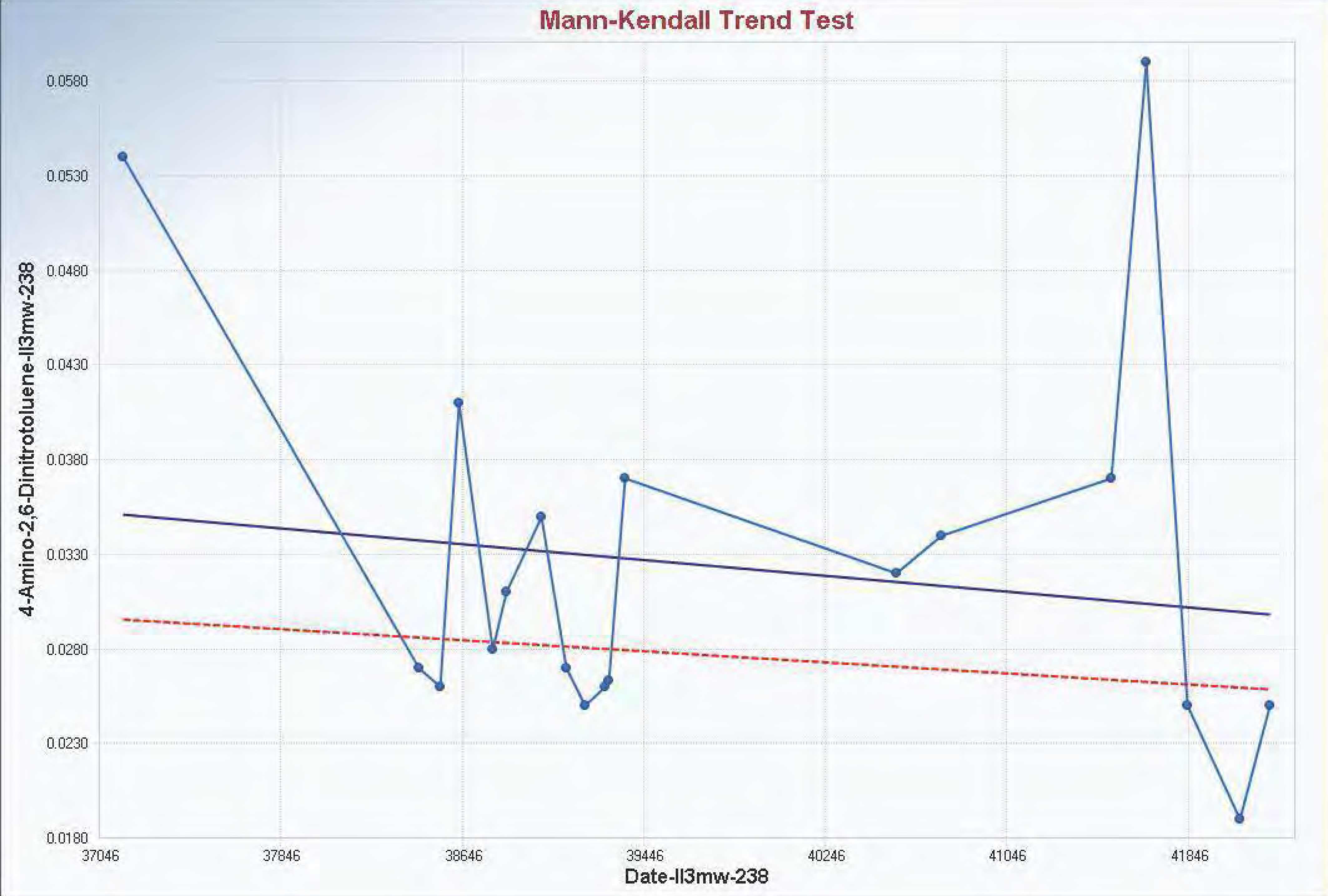
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0344

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0060

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.4664
Standardized Value of S	-0.9134
Test Value (S)	-27
Tabulated p-value	0.1840
Approximate p-value	0.1805

OLS Regression Line (Blue)

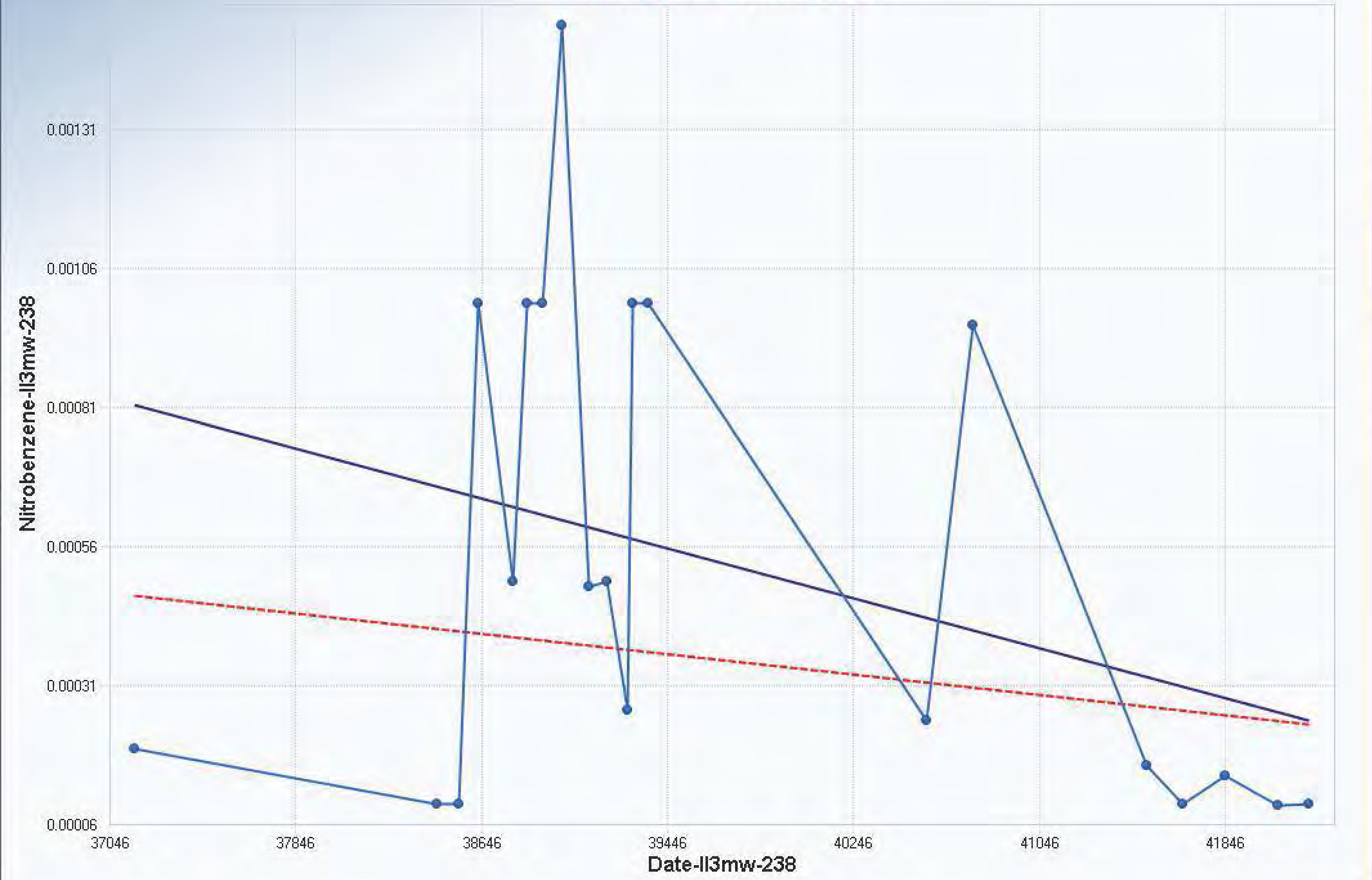
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0736

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0567

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	20
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	30.3919
Standardized Value of S	-1.5794
Test Value (S)	-49
Tabulated p-value	0.0640
Approximate p-value	0.0571

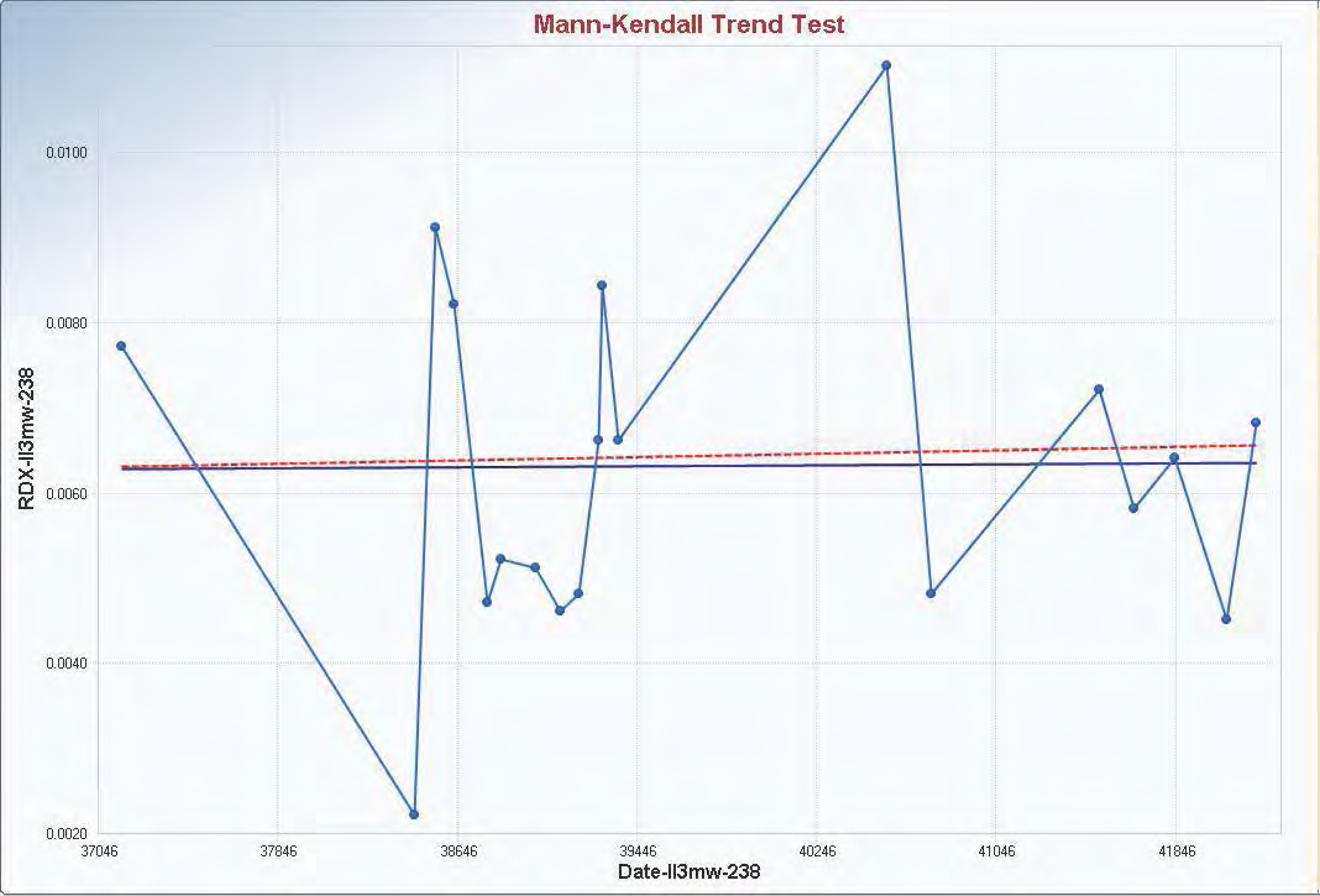
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0050

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0022

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	19
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	28.5482
Standardized Value of S	0.0701
Test Value (S)	3
Tabulated p-value	0.4730
Approximate p-value	0.4721

OLS Regression Line (Blue)

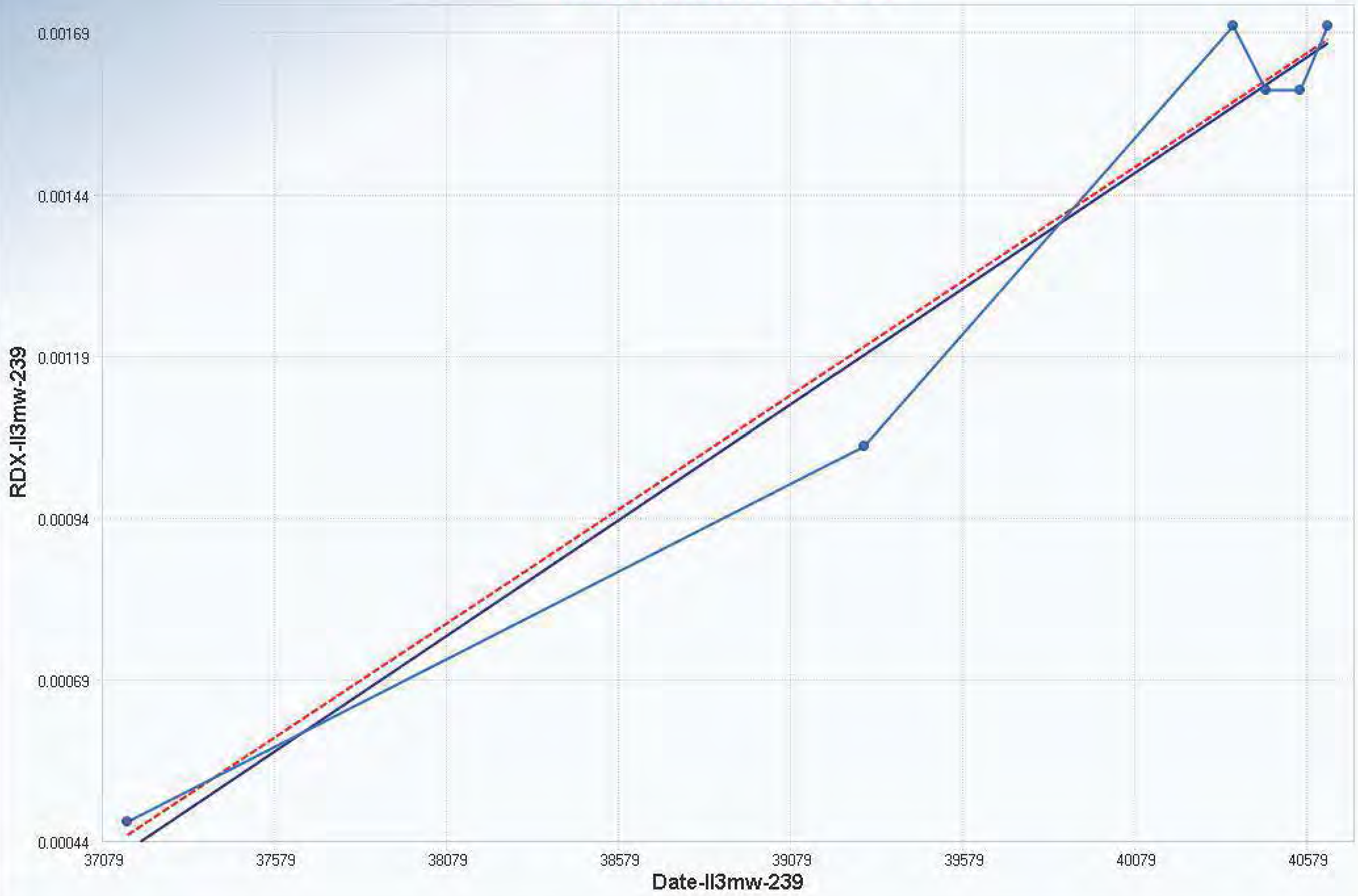
OLS Regression Slope	0.0000
OLS Regression Intercept	0.0058

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0044

Insufficient statistical evidence of a significant trend at the specified level of significance.

Mann-Kendall Trend Test



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.1316
Standardized Value of S	1.5590
Test Value (S)	9
Tabulated p-value	0.0680
Approximate p-value	0.0595

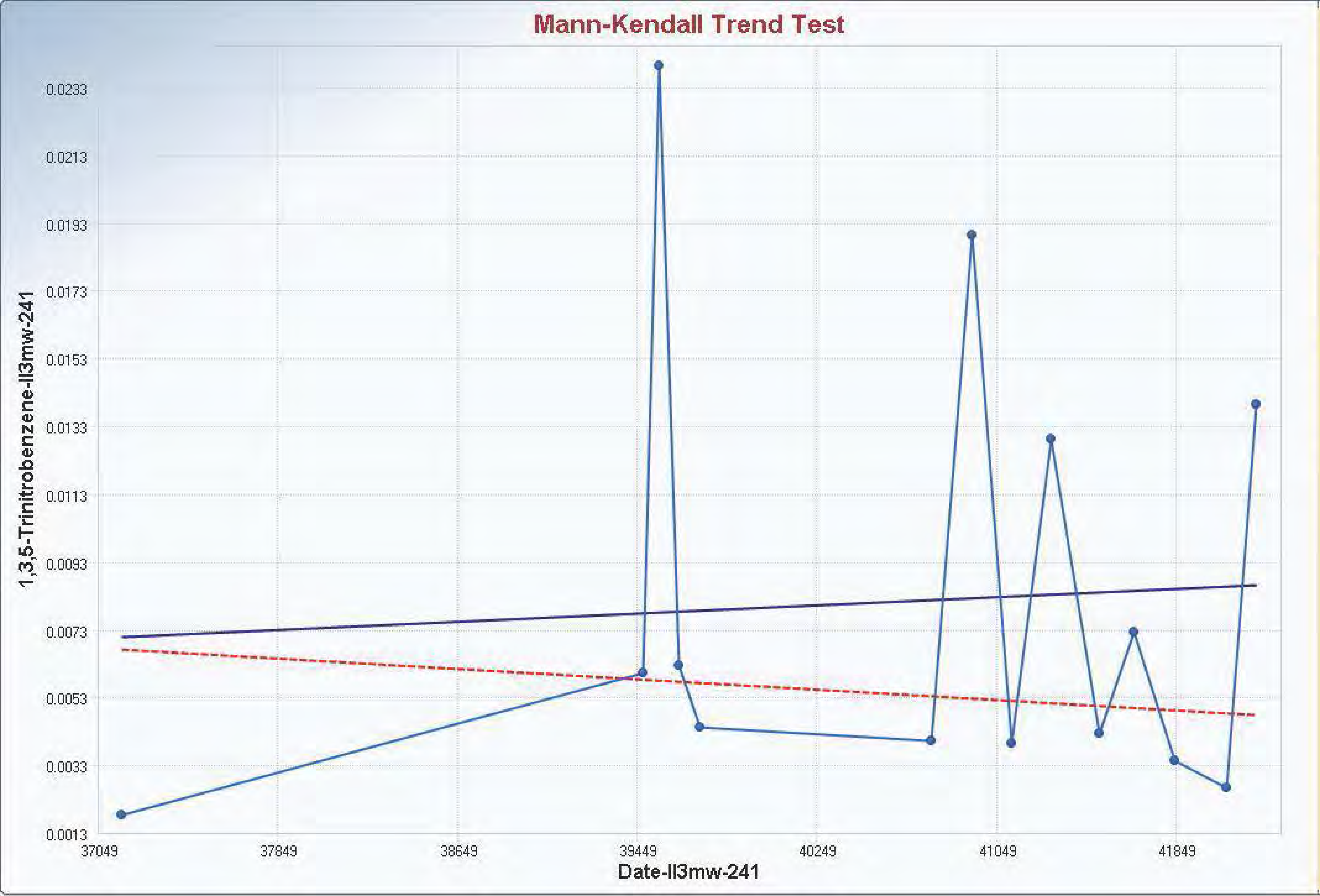
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0129

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	-0.0127

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.2665
Standardized Value of S	-0.3285
Test Value (S)	-7
Tabulated p-value	0.3740
Approximate p-value	0.3713

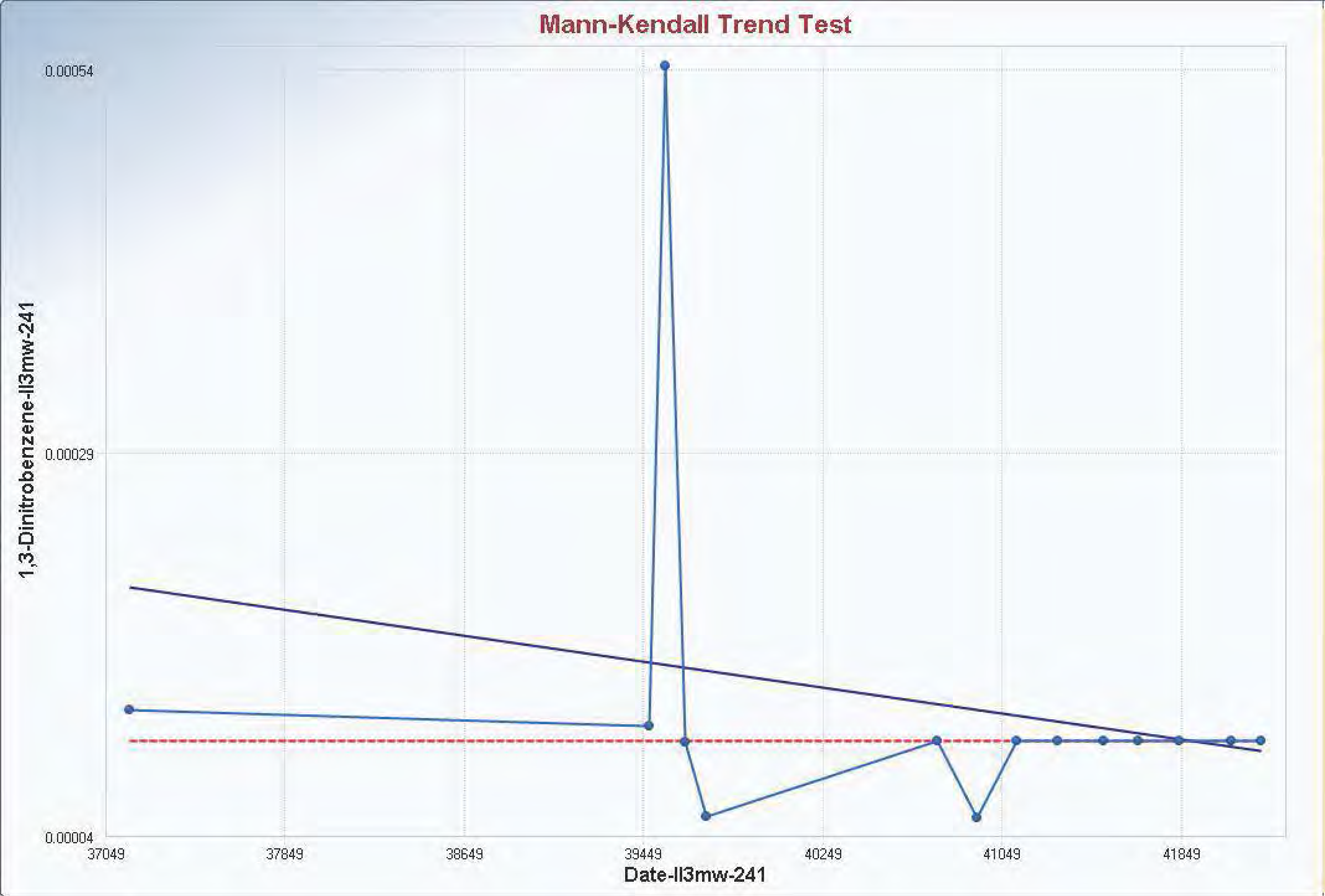
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	-0.0040

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0212

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	16.3809
Standardized Value of S	-0.7326
Test Value (S)	-13
Tabulated p-value	0.2590
Approximate p-value	0.2319

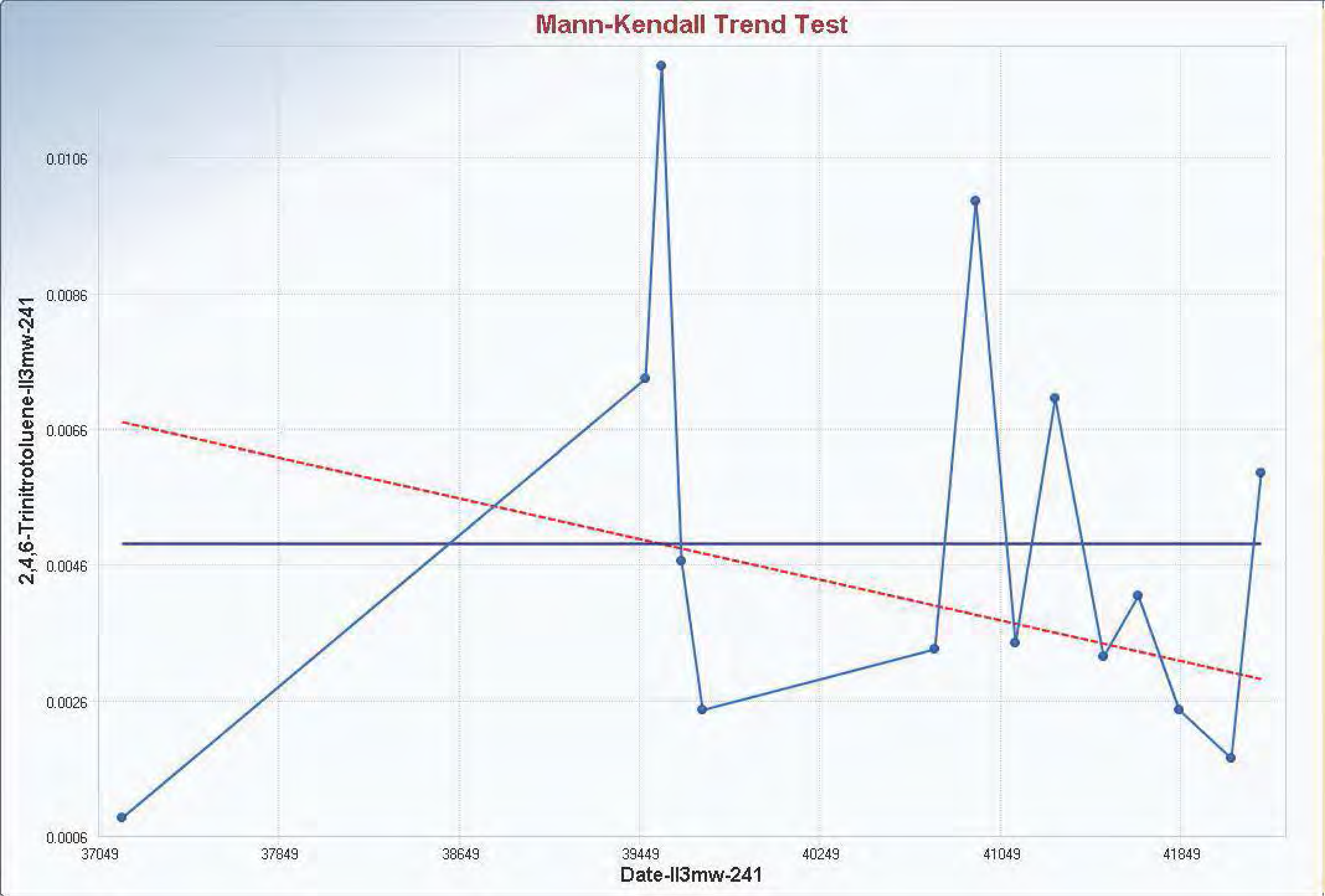
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0010

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.2392
Standardized Value of S	-0.7128
Test Value (S)	-14
Tabulated p-value	0.2250
Approximate p-value	0.2380

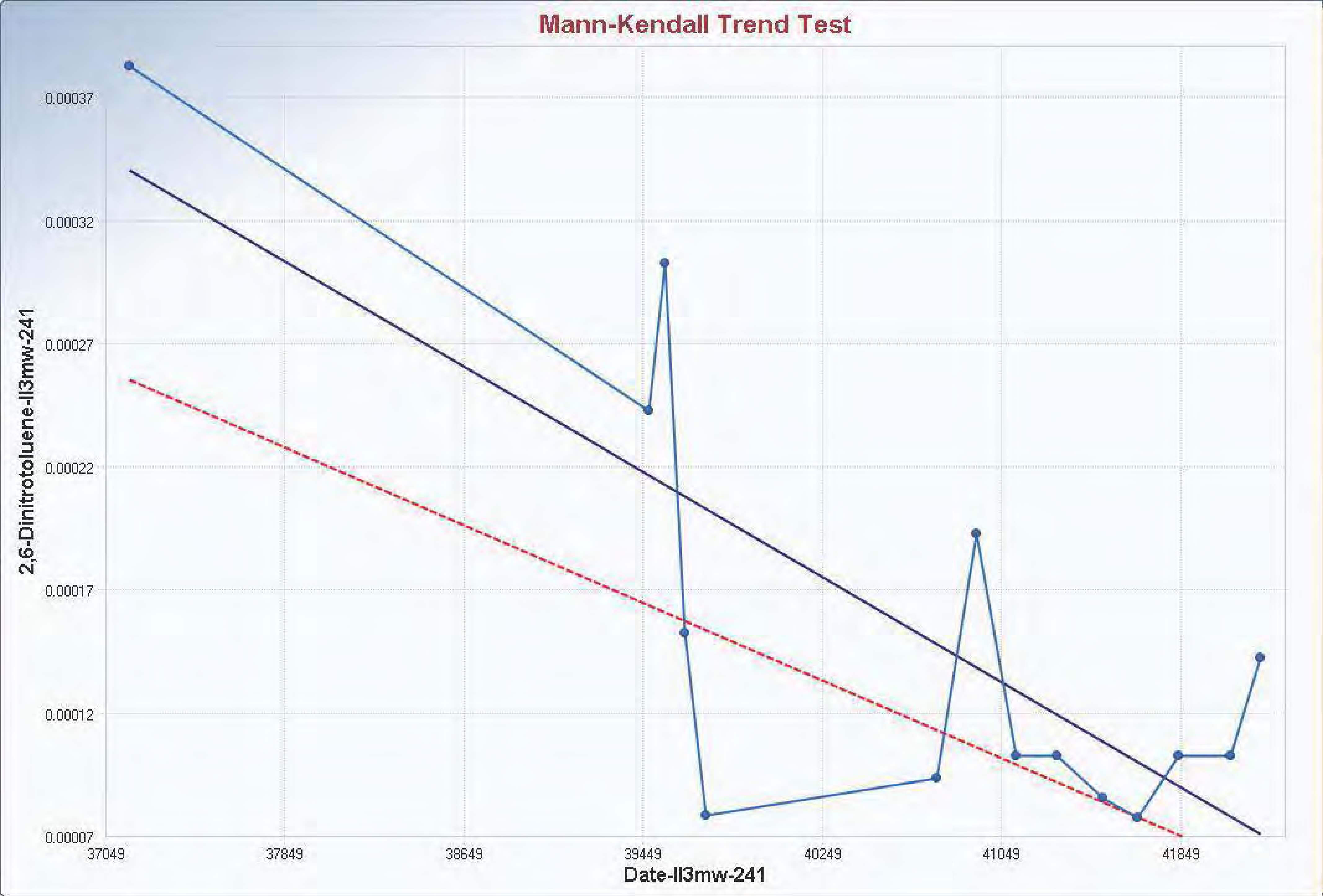
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0050

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0346

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.0278
Standardized Value of S	-1.7750
Test Value (S)	-33
Tabulated p-value	0.0400
Approximate p-value	0.0379

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0023

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0017

Statistically significant evidence of a decreasing trend at the specified level of significance.


Mann-Kendall Trend Test
2-Amino-4,6-Dinitrotoluene-II3mw-241
0.0053
0.0033
0.0013
37049
37849
38649
39449
40249
41049
41849
Date-II3mw-241
Mann-Kendall Trend Analysis
n 14
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 18.2117
Standardized Value of S -2.5258
Test Value (S) -47
Tabulated p-value 0.0050
Approximate p-value 0.0058
OLS Regression Line (Blue)
OLS Regression Slope 0.0000
OLS Regression Intercept 0.0159
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.0501
Statistically significant evidence
of a decreasing trend at the
specified level of significance.

Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.2392
Standardized Value of S	-1.9189
Test Value (S)	-36
Tabulated p-value	0.0240
Approximate p-value	0.0275

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0102

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0500

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	14
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	18.1108
Standardized Value of S	-3.3682
Test Value (S)	-62
Tabulated p-value	0.0000
Approximate p-value	0.0004

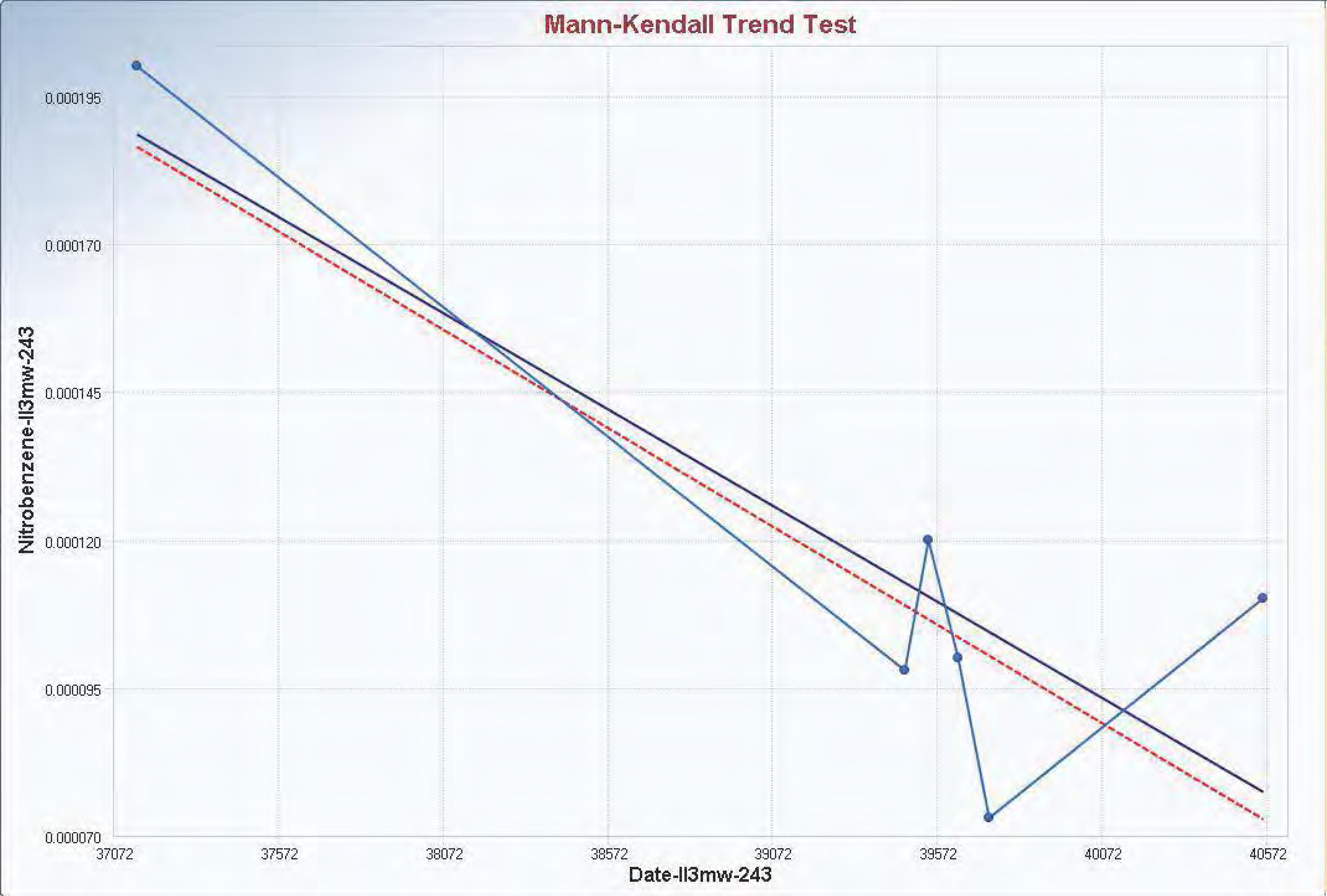
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0097

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0137

Statistically significant evidence of a decreasing trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	5.3229
Standardized Value of S	-0.7515
Test Value (S)	-5
Tabulated p-value	0.2350
Approximate p-value	0.2262

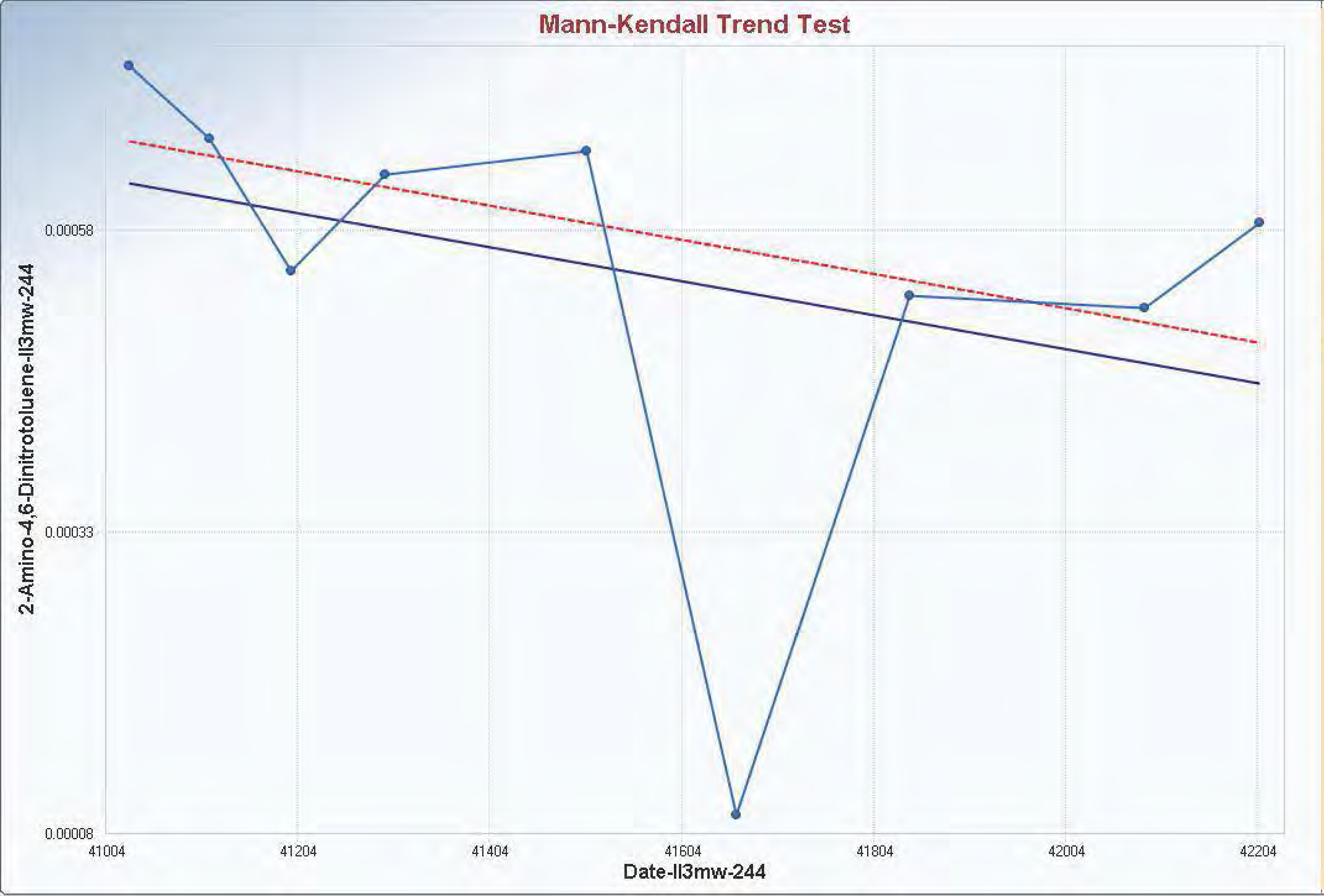
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0014

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0014

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	9
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	9.5917
Standardized Value of S	-1.7724
Test Value (S)	-18
Tabulated p-value	0.0380
Approximate p-value	0.0382

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0064

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0065

Statistically significant evidence of a decreasing trend at the specified level of significance.

Mann-Kendall Trend Analysis

n	9
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	9.5394
Standardized Value of S	-1.2579
Test Value (S)	-13
Tabulated p-value	0.1300
Approximate p-value	0.1042

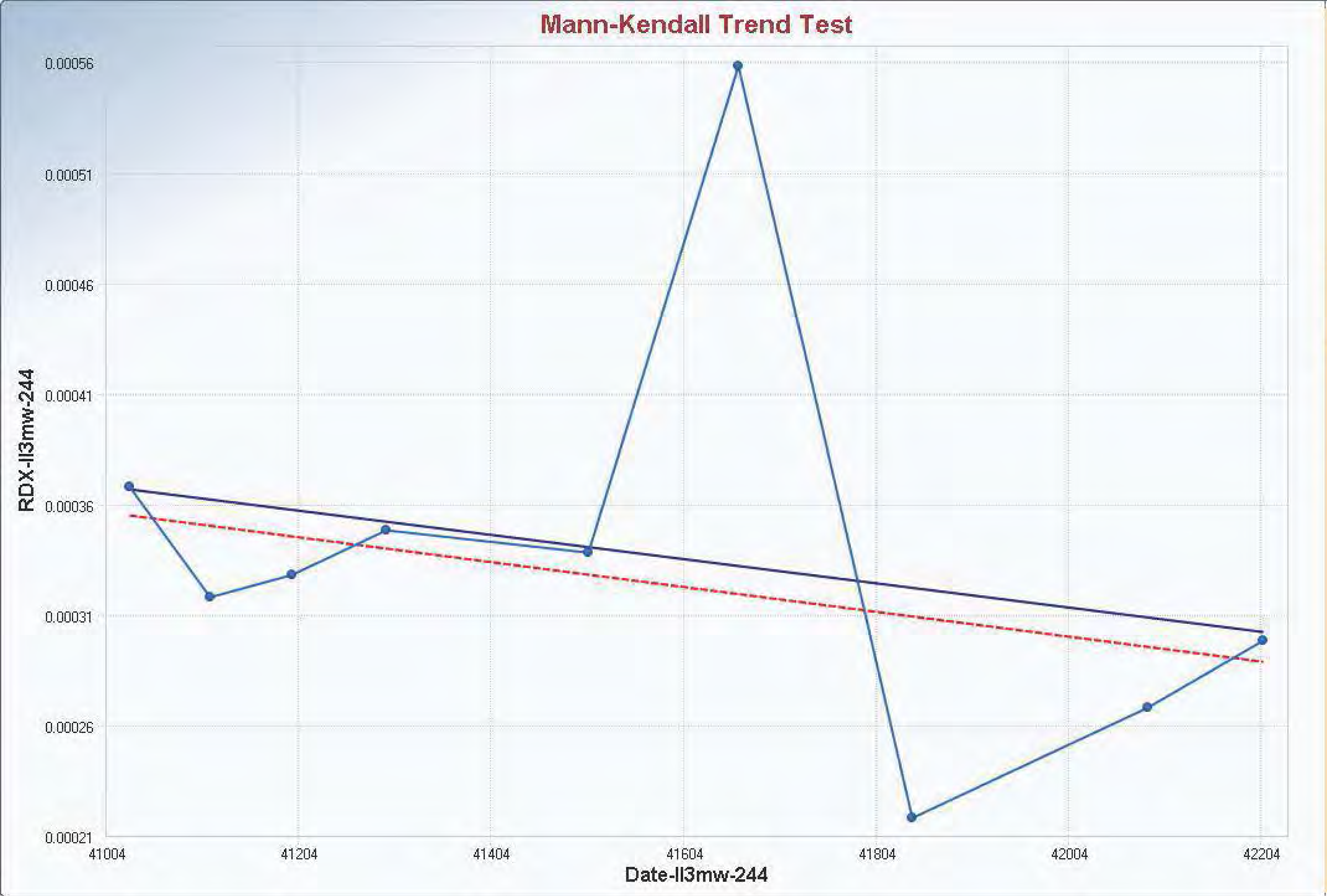
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0041

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0051

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	9
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	9.5917
Standardized Value of S	-0.9383
Test Value (S)	-10
Tabulated p-value	0.1790
Approximate p-value	0.1740

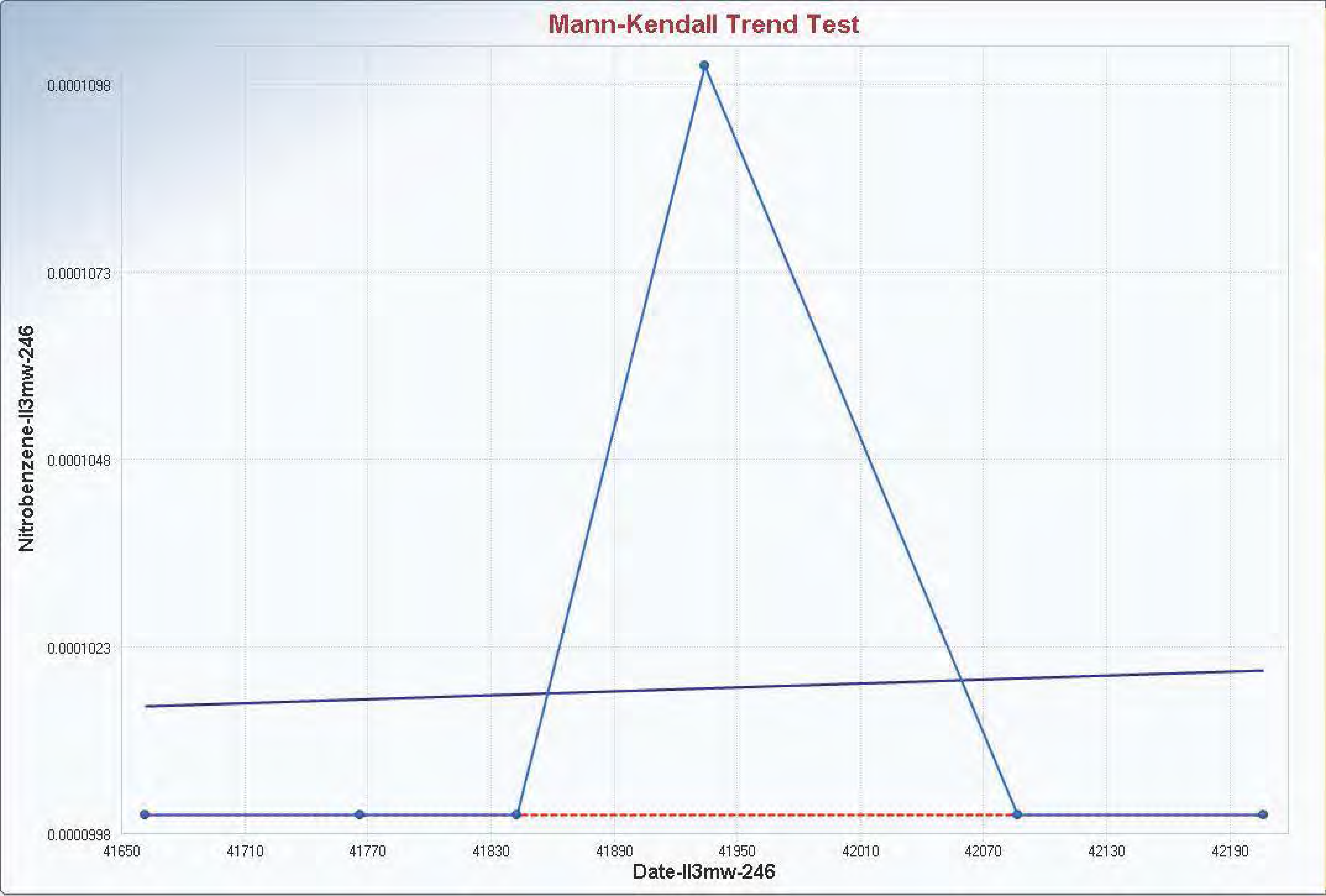
OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0026

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0027

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	6
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	3.4157
Standardized Value of S	0.0000
Test Value (S)	1
Tabulated p-value	0.5000
Approximate p-value	0.5000

OLS Regression Line (Blue)

OLS Regression Slope	0.0000
OLS Regression Intercept	0.0001

Theil-Sen Trend Line (Red)

Theil-Sen Slope	0.0000
Theil-Sen Intercept	0.0001

Insufficient statistical evidence of a significant trend at the specified level of significance.

APPENDIX D

MEC ANOMALY AVOIDANCE PLAN

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Final

Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater

Appendix D: MEC Anomaly Avoidance Plan

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

December 21, 2016

Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Prepared for:

National Guard Bureau
NGB-ZC-AQ
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

TEC-Weston Joint Venture
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903-4895

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
Camp Ravenna	Camp Ravenna Joint Military Training Center
DDESB	Department of Defense Explosives Safety Board
EM	Engineering Manual
Ft	foot
FWGW	Facility-Wide Groundwater
JV	Joint Venture
MEC	munitions and explosives of concern
MPPEH	material potentially presenting an explosive hazard
POC	point of contact
RI	remedial investigation
RVAAP	Former Ravenna Army Ammunition Plant
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance

1.0 INTRODUCTION

This project-specific plan for anomaly avoidance describes the techniques employed by unexploded ordnance (UXO)-qualified personnel at areas known or suspected to contain munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) at the RVAAP-66 Facility-Wide Groundwater (FWGW) Area of Concern (AOC), Former Ravenna Army Ammunition Plant (RVAAP); now known as Camp Ravenna Joint Military Training Center (Camp Ravenna) in Ravenna, Ohio. Operations requiring anomaly avoidance may include activities such as environmental sampling; monitoring well installation, development, and redevelopment; vegetation removal; surveying; site visits; and other equivalent site work where MEC and MPPEH may be encountered. The purpose of this plan is to provide the procedures necessary to avoid contact with potential surface or subsurface explosive hazards and to allow entry to the work sites for the performance of required FWGW remedial investigation (RI) field work.

Anomaly avoidance will be performed in accordance with the following references:

- United States Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-97, Explosives - Safety and Health Requirements Manual (Change 1, 2013).
- Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern – Related Activities (2015).

2.0 AREAS OF RESPONSIBILITY

The UXO escort (UXO-qualified personnel) has the following responsibilities:

- Conduct explosives safety briefings for all site personnel and visitors on a daily basis.
- Delineate MEC, MPPEH, and subsurface anomaly free zones for conducting site work.
- If MEC/MPPEH is encountered, initiate reporting procedures.
- The UXO escort will be a UXO Technician II or above in accordance with DDESB TP 18 and will be onsite during all site work.

Since the purpose is anomaly avoidance, the UXO escort is not tasked to perform MEC or MPPEH disposition. In the event that MEC or MPPEH is encountered that cannot be avoided, or, based on its fuzing or current condition, presents an immediate hazard requiring immediate attention, the UXO escort will notify the Camp Ravenna point of contact (POC). The POC will notify the appropriate authority of the MEC or MPPEH discovery and the UXO escort will safeguard the site pending arrival of the appropriate authority.

3.0 ON-SITE TRAINING

As part of the anomaly avoidance process, the TEC-Weston Joint Venture (JV) will perform site-specific explosives safety training for all field personnel. The purpose of this training is to ensure that all field personnel fully understand the explosives safety considerations for the work they are about to perform and how the anomaly avoidance process will be conducted. Any field personnel arriving at the site after this initial training session will have to complete the training before starting work. Explosives safety discussions will be performed each day at the tailgate safety briefing.

4.0 PROJECT EQUIPMENT

Project equipment for anomaly avoidance will be inspected to ensure completeness and operational readiness. Any equipment found damaged or defective will be repaired or returned for replacement. Geophysical equipment will be tested daily prior to the start of work using a small industry standard object to ensure the instrument is functioning properly. If an equipment check indicates that any piece of equipment is not operating correctly and field repair cannot immediately be accomplished, the equipment will be removed from service until it can be repaired. Alternately, the equipment may be replaced with an equivalent model.

A Schonstedt model GA-52Cx or equivalent metals detector will be used by the UXO escort during anomaly avoidance. If investigations or intrusive work such as monitoring well installation is deeper than the anticipated detection depth of the Schonstedt, a downhole Foerster FEREX (Mk26) locator will be used for anomaly detection.

5.0 PROCEDURE DETAILS

- The UXO escort must conduct a surface access survey and a subsurface survey for anomalies before any type of activities commence, including foot and vehicular traffic, approaching and leaving work areas. Typically, the access route will be as wide as the widest vehicle that will use the route.
- Personnel must be escorted by UXO-qualified personnel at all times in areas potentially containing MEC or MPPEH until the UXO escort has completed the access surveys and the anomaly free areas have been conspicuous marked (i.e. flagging). Escorted personnel will follow behind the UXO escort. If anomalies or MEC/MPPEH are detected, the UXO escort will halt escorted personnel in place, and select a course around the item.
- The UXO escort must also complete an access survey of an area around the proposed work site that is large enough to support all planned operations. The size of the surveyed area will be site-specific and will take into account, for example, maneuverability of required equipment (e.g., drill rigs, excavation equipment, etc.), parking of support vehicles, and establishment of decontamination stations.
- A Schondstedt GA-52Cx magnetometer or similar analog geophysical instrumentation capable of detecting ferrous MEC and MPPEH will be used to locate subsurface anomalies.
- During groundwater monitoring well installation or other invasive activities where the intrusive/ excavation depth is greater than the geophysical instrument's detection capabilities, downhole magnetometry using a downhole Foerster FEREX (Mk26) locator will be performed by the UXO escort.
- For monitoring well installation:
  - The first lift based on instrument detection depth, estimated to be 4 feet (ft) below ground surface, will be assessed using the Schonstedt during hand-auguring, post-hole digging, or initial drilling.
  - After the first lift of material has been removed, the next 4 ft interval will be assessed by the use of the Foerster FEREX. This process will be continued in similar increments until a depth is reached where MEC or MPPEH is unlikely to be encountered (estimated to 6 ft) or planned intrusive/ excavation depth is achieved.
  - If anomalies are detected, the intrusive/ excavation work will be relocated and reinitiated as close as possible to the initial or planned location.

- If anomalies or surface MEC or MPPEH are encountered, they will be marked with flagging and the work location will be relocated to an anomaly free area to avoid contact. The UXO escort will clearly mark the boundaries of the surveyed area using survey flagging and pin flags.
- No personnel will be allowed outside the surveyed areas.
- If anomalies are detected at a proposed work location or too many anomalies are detected in a general area of interest, the work/investigation area will be moved to an anomaly free location
- MEC and MPPEH will be described in the daily log. The description may include location, item type, size or other discernable features.

All work will be performed in accordance with the FWGW RIWP and its appendices.

6.0 REFERENCES

United States Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-97, Explosives - Safety and Health Requirements Manual (Change 1, 2013)

Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18, Minimum Qualifications for Personnel Conducting Munitions and Explosives of Concern – Related Activities (2015)

APPENDIX E

SIGNED DOCUMENTATION AND CORRESPONDENCE

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Meeting Summary

RVAAP-66 Kick-off Meeting

Meeting Details

> 22 September 2015

> Camp Ravenna FWGW Kick-off Meeting

> 1230 - 1500

Meeting Attendees *(see attached sign-in sheet; dial-in attendees listed below)*

Name	Organization	Phone Number	Email Address
Stacy MacKay	NGB-AQ		
Susan Klypchak	NGB-AQ		
Colonel Dernberger	OHARNG		
Justin Burke	OEPA		

Overview of Discussions

Welcome and Introductions:

- Meeting attendees provided personal introductions and their roles/responsibilities on the project.

Administrative/Contracting Remarks:

- Stacy MacKay, Contracting Officer, is the only individual that can authorize changes on the Task Order (TO).
- Mark Leeper has been assigned as the Contracting Officer Representative (COR).Susan Klypchak is the Contract Specialist assigned to this TO.
- The COR assignment letter will be sent by Stacy.
- A Certificate of Insurance (COI) for the TEC-Weston JV must be kept current to allow work in the field.
- Base access should be coordinated directly with onsite OHARNG personnel.

Project Overview:

- Notice to Proceed (NTP) was received 8/18/15.
- Overall TO Goals and Objectives – Complete RI, FS, and ROD for Facility-Wide Groundwater (FWGW) remedy.
- Near-term milestones:
  - PMP/QCP
  - RI Work Plan (RIWP) components:
    - Conceptual Site Model (CSM)
    - Groundwater Model
    - FSP
    - QAPP

  - Existing Monitor Well Evaluation
  - Background (upgradient) Well Evaluation
- Archaeological Survey Work Plan
- 2015 Annual FWGW Report

Project Goals and Objectives:

- The TEC-Weston JV Team requested input from the multiple project Stakeholders as to what each Stakeholder views as hot buttons and critical issues/concerns to ensure a successful project outcome. The JV Team's objective is to integrate and exceed Stakeholder expectations and achieve an overall Exceptional Performance rating upon project completion.

- OEPA Input:
  - Look at each AOC individually, including contaminant source histories, facility mission/operations, etc.
  - Map AOCs by area/groups in RIWP; include soil boring data and groundwater concentrations.
  - Tie current FWGW holistic work to historical AOC work/knowledge.
  - Check location and relevance of existing FWGW monitoring wells.
  - Good maps are critical in the RIWP.
  - Key is a complete CSM, including understanding of inter-relation between multiple aquifers.
  - Project has taken a long time and has involved multiple contractors and change in personnel; ROD milestone is approaching (2018).
  - FWGW characterizations have been disconnected from AOCs.
  - Want the FWGW RI conducted similar to a conventional Phase II.

- ARNG/OHARNG Input:
  - Need an accurate and complete CSM; one that makes sense and tells the story from beginning to end.
  - Meeting the schedule is crucial due to 2018 ROD deadline in Army/OEPA Director's Final Findings and Orders (DFFO).
  - Need a fresh look at FWGW with a new contractor with technical expertise.
  - Concern is GW quality on site, pertaining to future land uses by end-users (OHARNG and other trainees); where can/can't GW be used in the future; where are GW use restrictions needed.
  - Concern is what contaminants are migrating offsite.
  - Need to protect facility users (troops) for long-term use of property

Project Schedule Discussion:

- Bob Guthrie of Management Solutions LLC coordinates all environmental restoration contractor schedules on behalf of ARNG.

- Readjustment of project schedule based on actual NTP versus what was assumed in TEC-Weston JV's proposal is ongoing.
- Bob Guthrie reviewed key schedule aspects of the DFFO:
  - 45 calendar day OEPA review time for comments on draft and final deliverables.
  - 30 calendar day ARNG review time on all deliverables.
  - 30 days to respond to OEPA with RTCs or deliverable revisions.
  - 45 calendar day OEPA review if RTCs submitted.
  - Can ask for clarification meeting if requested within 15 days of receipt of OEPA comments; clarification calls/meetings are preferred.
  - Everything pertaining to SOW and schedule adjustments/clarification should be made via letter (no emails).
  - Internal/interim email is ok – end result documented in formal letter format.
  - Annual Groundwater Report: 15 December deadline; no flexibility to change.
  - 15 day advance fieldwork notifications.
- There are contractor schedule status and review meetings/teleconferences every other Tuesday @ 1330 EST; approximately 1 hour.
- A 1-week look ahead schedule is emailed from Bob in advance; shows items that are to be briefed during the call.
- OHARNG reports to OEPA the 10th of every month.
- JV Team will submit MSR to ARNG by the 5th of each month; to include monthly IDW data.
- OHARNG has a MSR template to follow.
- Need to show review times on the project schedule for all reports – pre-draft, draft, final.
- Annually, milestones/objectives are reset halfway through the year; 1-year milestones, 2-year targets.
- Open dialogue and cooperation within project team is critical; have meetings and phone calls to minimize RTCs.

<u>Open Discussion on Project Scope/Technical Approach:</u>

- OEPA looked at the draft PWS but not the JV Team's proposal/technical approach submitted to ARNG. Mark Leeper (ARNG) was the only person at the meeting to review the JV Team's proposal.
- Gale Harris (not present at meeting) is the document archivist and can help with document distribution.
- Kevin Sedlak indicated that streamlined documents are preferred, especially semi-annual/final reports; JV Team to create new report TOCs accordingly.
- OEPA indicated that report outlines are based on previous agreements; JV Team to consider during new TOC development.
- Technical meetings are "key" to avoiding delays and RTCs cycles.

- The JV Team proposes to combine AOCs into Plume Groups to establish exposure point concentrations and facilitate FWGW characterization in accordance with 2014 USEPA. CERCLA guidance; acknowledged uncertainties in scoping during the proposal phase.
- Proposed background well approach used existing database to query turbidity plus chemistry.
- Kevin Sedlak will organize the native files for JV Team use for the 2015 Annual Report.
- OEPA had numerous review comments on historical EQM documents; need to focus on quality and accuracy over quantity of content.
- OEPA may have potential concerns with a Plume Group approach – are wells close enough to hot spots to define/delineate? Understanding AOCs is crucial including localized clarifications. Historically AOC investigations were conducted without focus on good science.
- Monitor wells should be evaluated with regard to contaminant sources, including missing/unknown sources.
- Paul Bartz indicated the PWS did not include source characterization/delineation as part of this FWGW RI.
- OEPA asked if there will be monitor wells installed at every AOC. Paul Bartz indicated that is not planned.
- Clarifications to Meeting Agenda Items pertaining to PWS requirements, per Kevin Sedlak:
    - No CAC required.
    - Gov't issued IDs and vehicle information are required to enter RVAAP; provide 48-hr advance notice.
    - 40 & 8 hour HAZWOPER required; copies of field personnel training certificates to be provided.
    - PWS 1.4.6.3: AT Level 1 Training online required ~1 hour.
    - PWS 1.4.6.5: disregard for now – can't access.
    - PWS 1.4.6.6: OPSEC Training required.
    - Data management and database access: JV Team/Kevin Sedlak to set up conference call with Leidos.
    - Photographs are permitted.
    - Must coordinate activities with Range Control.
- JV Team to assess components in the Plexus final Work Plan for well abandonment. Leave newly grouted wells open for 24 hours – check for grout subsidence.
- For planned wells in ODOT ROW, ODOT Permits will be completed and signed by OHARNG. Need to map each location (Lat/Long). Must coordinate fieldwork in ODOT ROWs.
- IDW Reports should be attached to each Semi-Annual and Annual FWGW Report.
- RAB Meetings: The next one is November 18th. Each is approximately 90 minutes. JV Team to provide high-level overview of FWGW scope/schedule at November meeting.
- VISTA is the Contractor supporting OHARNG with onsite facility operations.
- History of Ravenna-Portage County (from Historical Society) is a good resource and available on REIMS. USGS's report is also a good background reference.
- An Initial Project Scoping Meeting @ Northeast OEPA's Twinsburg, OH office will be scheduled for 10/14/15.
- Tree cutting is only allowed 1 October – 31 March.

- The Phase I Archaeology Work Plan and RIWP are currently being drafted, as separate deliverables. No OEPA review of Archaeological WP is required as area has already been designated.
- As clarification to OEPA question regarding the number of planned new monitor wells, the JV Team proposal included 7 new background wells and 21 new RI wells.
- Prior environmental reports were data dumps, some with no recommendations or conclusions.
- Groundwater sample turbidity and metals have been key technical issue with existing wells due to old methods/practices. No dedicated sampling pumps were used previously.
- All Stakeholders prefer more meetings to facilitate document finalizations, with fewer RTCs. Issues can often be addressed with a phone call.
- For Section 508 documentation protocols, Gail Harris is the best contact.

Summary of Open and Closed Action Items (*if applicable*)

Number	Responsible Party	Status	Action Item
Open Action Items			
1.	Stacy MacKay	Open	NGB-AQ to issue COR letter
2.	JV Team	Open	Review the DFFO for schedule details/requirements and incorporate into revised project schedule
3.	JV Team	Open	Review the DFFO for schedule details/requirements and incorporate into project schedule
4.	JV Team	Open	Prepare a brief summary of the proposed technical approach for distribution as a read-ahead for discussion during 10/14/15 Initial Scoping Meeting
5.	JV Team	Open	Create new tables of contents for Groundwater Reports
6.	Kevin Sedlak	Open	Provide native files for JV Team use on 2015 Annual FWGW Report
Closed Action Items			
1.	JV Team	Closed 9/23/15	Provide Bob Guthrie more recent draft project schedule; draft RIWP milestones for 1Q 2016 to be identified
2.	Kevin Sedlak	Closed 9/22/15	Provide Monthly Status Report template to JV Team
3.	Kevin Sedlak/JV Team	Closed 9/25/15	Hold conference call with Leidos on database management and access
4.			
5.			

Summary of Consensus Items (*if applicable*)

Date	Consensus Item
10/14/15	Initial Scoping Meeting to be held at NE Ohio OEPA offices

Meeting/Training Roster			
Meeting/Training Topic: Groundwater Kick Off Meeting			
Meeting/Training Date and Time: 9/22/15 1226			
Training Given By:			
Name	**Unit/Organization**	**Phone Number**	**Email**
Kevin Sedlak	OHNG	614 3364000 2057	Kevin.m.sedlak.ctr@mail.mil
David G. Wazny	Weston-TEC	440-781-2467	david.wazny@cardno.com
Paul Bartz	" "	517-381-5933	paul.bartz@westonsolutions.com
ERIC STAHL	" "	610.324.1988	eric.stahl@westonsolutions.com
Katie Tait	OHARNG ENV	614-336-6136	kathryn.s.tait.nfg@mail.mil
Mark Leeper	ARNG	703.607.7955	mark.s.leeper.civ@mail.mil
Joe Davis	JD2-TM, LLC	615-791-1139	jdavis@jdtwo.com
Robert Guthrie	MSLLC	865.805-1365	BGUTHRIE@MANAGEMENTSOLUTIONSLLC.com
Bob Princic	Ohio EPA	330 963-1230	Bob.princic@epa.ohio.gov
Rod Beals	Ohio EPA	330-963.1218	rodney.beals@epa.ohio.gov
Al Muller	OHIO EPA	330-963-1211	albert.muller@epa.ohio.gov
Kevin Palombo	Ohio EPA	330 963 1292	Kevin.Palombo@epa.ohio.gov

ON Phone:

COL Dernberger

Draft Meeting Summary

Groundwater Scoping Technical Meeting

Date of Meeting: 14 October 2015
Time of Meeting: 0900-1400hrs.
Prepared By: Rebecca Haney, Vista Sciences Corporation

Participants:

Name	Organization	Phone:	Email:
Bob Princic	Ohio EPA DERR/NEDO	330-963-1230	Bob.princic@epa.ohio.gov
Rod Beals	Ohio EPA DERR/NEDO	330-963-1218	Rod.beals@epa.ohio.gov
Paul Bartz	Weston Solutions	517-381-5933	Paul.bartz@westonsolutions.com
David G. Wanzy	Cordno TEC	440-781-2467	David.wazny@cordno.com
Mike Chapa	Weston Solutions	210-380-2570	Mike.chapa@westonsolutions.com
Katie Tait	OHARNG	614-336-6136	kathryn.s.tait@us.army.mil
Kevin Sedlak	ARNG	614-336-6000 ext. 2054	kevin.m.sedlak.ctr@mail.mil
Eric Stahl	Weston Solutions	610-324-1988	Eric.stahl@westonsolutions.com
Joe Davis	JD2-IM, LLC	615-791-1139	jdavis@jdtwo.com
Mark Leeper	ARNG	703-607-7955	Mark.s.leeper.civ@mail.mil
Kevin Palombo	Ohio EPA DERR/NEDO	330-963-1292	Kevin.palombo@epa.ohio.gov
Al Muller	Ohio EPA DERR/NEDO	330-963-1211	albert.muller@epa.ohio.gov

Participated via Phone:

Carrie Rasik	Ohio EPA – CO		Carrie.rasik@epa.ohio.gov
Justin Burke	Ohio EPA – CO	614-644-2902	justin.burke@epa.ohio.gov

A technical meeting to discuss the Ravenna Army Ammunition Plant (RVAAP) Restoration Program Facility-Wide Groundwater Scoping and path forward was held on Wednesday 17 October 2015. Meeting participants are indicated above. The following items were discussed along with development of any corresponding decisions and/or action items.

General Meeting Objectives:

- Identify stakeholder issues and end goals
- Identify high priority objectives for stakeholders
- Describe/establish specification of successful outcomes
- Discuss thought process and development of technical approach
- Review document submission and sampling schedule
- Risk assessment approach
- Other items not included above

Scheduling and Document Clarification:

➢ **DFFO FY15 Milestone Extension Request**

- The Army submitted an extension request for the FY15 DFFO Milestone for RVAAP-66 Remedial Investigation/Feasibility Study Work Plan due to a change in contractor.
- There was some confusion about the proposed extension date of 28 March 2016.
- The project schedule was reviewed. The Preliminary Draft document is scheduled for submission 19-20 November 2015. There were some discrepancies in required review times that were noted and corrected. With the timeframe as it stands the Draft document would be expected at the end of January 2016 and the Final document to follow in Mid-April.
- In the proposed schedule the first sampling event should be held in March and covers 179 wells. The approval for the Draft RI Work Plan may not be received in sufficient time to achieve the March sampling event.
- If needed the sampling plan can be approved separately from the work plan.
- The Draft Work Plan will be submitted for Ohio EPA review by 1 February 2016.

➢ **Annual Groundwater Monitoring Report and Semiannual Groundwater Addendum**

- The DFFO requires the Semiannual Groundwater Addendum be submitted as a separate item, not included in the submission of The Annual Groundwater Annual Report (typically in March).
- The Semiannual Groundwater Addendum allows stakeholders a yearly chance to review the status of GW Monitoring and regroup accordingly.
- It was decided that for 2016 the Work Plan will also serve as the Addendum. The letter of transmittal for the 2016 Work Plan will state that it also serves as the Addendum. In 2017 and subsequent years the Addendum will be submitted under separate cover.

Technical Approach:

- **Mike Chapa of Weston TEC gave a review of the rationale behind the Technical Approach that was submitted for contract bid.**
  - The first step was to try to evaluate the previous RVAAP GW data, which is very challenging due to the amount of data.
  - The technical approach was developed using guidance from the US EPA published in February 2014. The goal was to get to a holistic RI with individual AOC's and a mix of COPCs and COCs. Weston tried to develop an approach that took a practical aspect, based on the whole installation and what has been characterized historically at the AOC's.
  - The first stage of the approach begins with looking at the installation boundaries, turbidity, inorganics (even at low levels) and if anything is getting off site. A high priority is getting a better idea of what is migrating off site.
  - Weston analyzed technical data available on REIMS and in RI reports to look at what had been characterized in groundwater at localized AOC's. Then this was correlated to what was characterized in the soil at those AOC's. There many AOC's were constituents were present in GW or soil, but not in both. This was not an exhaustive analysis and hasn't been looked at in great detail but did factor in the scoping process.
  - Plume groups were identified to better manage the vast amount of data. Available groundwater data and directional flow data was accessed in developing the size and extent of each plume. Due to co-mingling of COCs and COPCs, differences in COCs and COPCs present at AOC's, and different layers where COCs and COPCs were found, there are instances of overlapping plume groups in various locations.
  - With these variations in mind it made more sense to address the installation as a consolidated mass. This approach allows the team to identify and zero in on problem/high priority areas or COC/COPCs. This approach will also tease out problems at the individual AOC level.
  - Weston and the Army believe this approach is more economical and efficient than addressing all AOC's on an individual basis.

Remedial Investigation Work Plan:

- **Discussion to determine the best methodology in developing the Work Plan.**
  - When looking at the Groundwater Program there are many issues such as identifying boundaries, placeholders, interior areas that have not characterized to date, and time lapse between samples. The decision process looked at data sets as plume groups, establish to assess if/which wells needs to be reviewed.
  - How can all this be addressed and managed into a document that is reviewable in a couple of months. Plume Groups make this more feasible, but also require reassessment as the program evolves. The AOC specific well data needed for

the Ohio EPA can and will be addressed as the area included in the plumes is focalized.

- The vast amount of data produces time constraints in getting it to a point where informative decisions can be made.
- The Ohio EPA believes Groundwater is Facility-Wide because the AOC's. Each AOC specific document states that groundwater will be addressed under the Facility-Wide Groundwater Monitoring Program. Each AOC needs to be evaluated to ensure groundwater has been adequately addressed. This can only be accomplished by assessing COCs and COPCs present (if any) at the site, their location, if there are enough wells, and the proximity of those wells in relation to the hits. There are some sites were existing wells adequately address COCs and COPCs present, other sites were additional wells are needed, and some sites that have not been evaluated at this level. This is the only opportunity to ensure that wells are in the right place and address COCs and COPCs found at each AOC.
- This model will address each current AOC and COC/COPC characterized. It will also evaluate what has not been addressed in the past and address it under the current project. Any data gaps the Ohio EPA is aware of will be helpful in addressing those issues as timely as possible.
- The bottom line is there are multiple objectives for this project. Understanding the hierarchy of those objectives will focus the work and give a better concept of the path forward. The RI will define the objectives and rationale for prioritization.
- A high priority objective of the project is to establish accurate background wells. Once this is done many of the questionable wells and COPCs will no longer be considered a concern. It is not practical or efficient to assess these issues until accurate backgrounds are established (some metals for example).
- Addressing data gaps on site and plume levels are also high priority objectives.
- The Ohio EPA prefers that current groundwater data to be assessed on an AOC-specific basis.

<u>Groundwater Modeling:</u>

- **Mike Chapa of Weston TEC gave a review of the methodology in the Groundwater Modeling.**
  - The starting point for the model was an installation base map. Then historical cross sections were imported. The projections were based on the limited number of wells at certain depths and contacts to develop the current model lithology. It's important to have historical data cross checked with current data.
  - The Preliminary model – consists of surface topography and upper bedrock surface elevations. Then projection of contours overlapping Sharon conglomerate and upper contact levels. The next level was the Sharon conglomerate with RVAAP wells installed.
  - As work progresses the model will evolve and be more usable.

- There are static map discrepancies that affect the modeling images that need to be evaluated and corrected.
- An AOC-specific overlay needs to be added to evaluate plumes and if each AOC is adequately addressed.
- The Ohio EPA wants to make sure leaching potential from soil to groundwater is considered in the RI.
- State and public information will be used to correlate and better understand soil types present at the facility.

End of Meeting Summary:

- It would be very beneficial to the project if stakeholders could develop a list of AOC's where they believe there are groundwater concerns.
- The project is up against tough time constraints and development of an AOC list may create delays in that schedule.
- If there are no high or elevated contaminated soil areas there is nothing to drive the installation of a new well.
- Tabulate data that shows a roadmap to logic will be included in the work plan.
- Regardless, the Ohio EPA is going to ask and wants to see the information used to eliminate areas and focus on other areas.
- In this groundwater project more wells will be sampled using better sampling methods. The team might want to wait until some of this data comes back. There will be a lot more data that is more accurate than what is currently available and this will change things.
- There is also some outstanding soil data which will affect the direction of the project. The work plan is meant to communicate the logic proposed.
- Some new wells are a given, for example new background wells and some to fill already identified data gaps. Drilling of these wells needs to proceed as planned in the current project schedule. The placement of the remaining new wells need to be handled through another meeting once background data is established.
- The overall goal is to craft a RI that is as specific as possible but can be adapted as additional data is collected.
- The Ohio EPA prefers a tabular document that states each AOC was evaluated.
- This is a Facility-Wide project, but future or current AOCs with no RI in place will not be addressed. A list is needed of AOCs that constitute the scope of this project as it stands now.
- The team discussed having a project status meeting in about a month from this meeting, but no concurrence or date was established.

Ohio Environmental Protection Agency

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

November 9, 2015

Re: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859036

Mr. Mark Leeper
Army National Guard Bureau
Environmental Programs Division
ARNG-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Subject: FFY'15 Milestone Extension for the RVAAP-66 Facility-Wide Groundwater Draft RI/FS Work Plan and Annual Submittal Date Revision for the Draft Facility-Wide Groundwater Report, Project ID # 267-000859-036.

Dear Mr. Leeper:

The purpose of this correspondence is to respond to your September 29, 2015 request, to extend the Facility-Wide Groundwater AOC, RVAAP-66 *Draft Remedial Investigation/ Feasibility Study (RI/FS) Work Plan* milestone date and your October 6, 2015 request, to change the *Draft Annual Facility-Wide Groundwater (FWGW) Report* milestone submittal date. These topics were further discussed during the October 14, 2015 meeting at Ohio EPA's Northeast District Office.

The September 30, 2015, FFY'15 RVAAP-66 Draft RI/FS Work Plan milestone date was missed due to a change in contractors and related contracting procedures. The National Guard Bureau (NGB) raised the potential of project delays in our January 29, 2015 Installation Action Plan (IAP) meeting and Ohio EPA has been provided project updates since. Ohio EPA is pleased that a new contractor has been selected and that work is proceeding expeditiously on this project. The September 29, 2015 request proposed a revised milestone date of March 28, 2016. This date was changed to February 1, 2016, during our October 14, 2015 meeting. Pursuant to Section X, paragraph 22 of the June 10, 2004 Director's Final Findings and Orders (DFFOs), Ohio EPA concurs that there is good cause for the requested extension and approves your request. The new milestone date for the Draft RI/FS Work Plan is February 1, 2016.

The annual submittal date for the Draft FWGW report is December 15th. This milestone date was first documented in the December 2003 *Final Conceptual Plan for a Facility-Wide Groundwater Monitoring Program Plan (FWGMP), Section 4.2,* which was attached as Appendix F of the 2004 DFFOs and has been used since as an annual milestone. The NGB has pointed out that the December 15th submittal date raises scheduling and logistical issues related to the semi-annual sample collection and analysis, and has proposed that the Draft FWGW Report be submitted in the first quarter of the following year, in order to assure appropriate data and report QA/QC. This topic was discussed at the October 14, 2015 meeting and an alternative submittal date of February 15th was agreed upon by both Agencies. Thus, Ohio EPA concurs with the request to change the milestone date for the annual submittal of the Draft FWGW Report to February 15th.

Section 4.3 of the FWGMP also requires the submittal of an annual review, as part of the annual reporting process. This review evaluates the applicability and effectiveness of the FWGMP and describes any proposed modifications to the plan. Since the ground water sampling that will be conducted during the next year will be detailed within the FWGW RI/FS Work Plan, Ohio EPA and NGB agreed during the October 14, 2015 meeting that the annual review is not needed for the next year. Annual review submittals will resume in calendar year 2017, as an attachment to the Draft FWGW report.

Please update the FFY'16 Milestones to reflect the approved extension for the RVAAP-66 Draft RI/FS Work Plan and the revised milestone submittal date for the Annual FWGW Reports. Please do not hesitate to contact me at (330)963-1218 or rodney.beals@epa.ohio.state, if you have any questions.

Sincerely,

Rod Beals
Manager
Division of Environmental Response and Revitalization

RB/nvr

ec: Bob Princic, DERR, NEDO
Kevin Palombo, DERR, NEDO
Justin Burke, CO, NEDO
Katie Tait, OHARNG RTLS
Kevin Sedlak, OHARNG RTLS
Gregory F. Moore, USACE
Rebecca Haney/Gail Harris, VISTA Sciences Corp.

APPENDIX F

COMMENT RESPONSE TABLE

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NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE, AH2
ARLINGTON VA 22204-1373

17 June 2016

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Kevin Palombo
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Response to Comments - Draft Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater, and Semiannual Facility-Wide Groundwater Monitoring Addendum for 2016
Camp Ravenna, Portage and Trumbull Counties, Ohio
Ohio EPA ID # 267-000859-036
Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Dear Mr. Kevin Palombo:

The Army National Guard is pleased to submit the enclosed Response to Comments on the Draft Remedial Investigation Work Plan (RIWP) for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater for your review. This deliverable is in response to Ohio EPA comments dated 31 March, 2016. This deliverable consists of one hardcopy and one electronic copy containing a single pdf of the submission.

The ARNG is requesting a resolution meeting within three weeks to finalize the responses and prepare to submit the Final RIWP. Please contact the undersigned at 703-607-7955 or mark.s.leeper.civ@mail.mil if you would like to discuss this submission.

Sincerely,

Mark Leeper, P.G., MBA
RVAAP Restoration Program Manager
Army National Guard Directorate

CC:

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE, AH2
ARLINGTON VA 22204-1373

Rod Beals, Ohio EPA, DERR-NEDO
Al Muller, Ohio EPA, DERR-NEDO
Bob Princic, Ohio EPA, DERR-NEDO
Justin Burke, Ohio EPA, CO
Kevin Sedlak, ARNG, Camp Ravenna
Katie Tait, OHARNG, Camp Ravenna
Gail Harris, Vista Sciences Corporation
Brent Ferry, JV Project Manager

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 4 April 2016

Cmt No.	Page or Sheet	Comment	Response
1	General	Ohio EPA understood from numerous meetings with the National Guard Bureau and the U.S. Army Corps of Engineers that evaluation of ground water would be conducted at all applicable areas of concern (AOC). We want to be assured that those areas identified in historical studies of specific AOCs, where the evaluation of the ground water was to be included in the Facility-Wide Groundwater Remedial Investigation (FWGW RI) are included in this Work Plan. A review of Appendix C, titled AOC-Specific Evaluations provides a Status Summary table. It was noted that the Status Summary table identifies several sites (AOCs/MRS/CRS) where ground water needs or may need additional evaluation. The current Work Plan also identifies certain "data gap" areas. However, for some of these sites and/or data gap areas, additional monitoring wells are proposed, while in others, no additional data collection (new wells or borings) is proposed. Examples of sites/areas where it is identified that a data gap exists yet no additional data is proposed to be collected include Load line 1, Load line 2, Atlas Scrap Yard, and many others (see Comment 6).	Additional clarification text and tabulated data has been added to the Work Plan to explain the basis for determining "data gap areas" (DGAs) and the rationale for selecting the proposed assessment approach. The following text has been added to Section 1.8.6 CSM Summary: *AOC-specific data gap areas (DGAs) discussed in Table 1-3 are based on areal and temporal gaps in the facility-wide groundwater monitoring program that need to be resolved in order to: (1) complete a baseline risk assessment (BRA); (2) characterize potential vertical migration of COPCs between water bearing units at Camp Ravenna; and (3) ensure downgradient delineation of site related contaminants to below analytical laboratory method detection limits (MDLs). In general, DGAs that were not proposed to include installation of new monitoring wells were identified to require an assessment of current COPC conditions in historically characterized source areas to support development of exposure point concentrations (EPCs) for the BRA (e.g., historically impacted monitoring wells that have not been sampled within 3-5 years of the current date). In other cases, the need for additional characterization of groundwater through sampling of currently existing monitoring wells located within DGAs will be based on sampling results for other wells currently selected for sampling and listed in Table 2-1 or new wells proposed for installation on Table 3-1.* *Groundwater contaminant concentration trends have been evaluated at a limited subset of AOCs using the USEPA ProUCL software, Version 5.0.00, to support a determination of RI sampling requirements. Individual well concentration trends will be evaluated for the remaining Camp Ravenna AOCs utilizing the updated RI sampling dataset. Primary outputs of the ProUCL contaminant trend analysis are provided in Appendix E.*

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 4 April 2016

Cmt No.	Page or Sheet	Comment	Response
			In addition, the content of Table 1-3 has been expanded to include: • key site history information for AOCs/MRSs/CRSs • discussion of groundwater conditions for individual aquifers monitored at each site • assignment of DGA identification numbers that aid in tracking content to supporting maps • description of specific CSM issues associated with each DGA
2	General	It was noted in recent publications that the Defense Department was currently evaluating numerous sites across the country where crash training and fire training activities took place, to determine if firefighting foams containing perfluorinated compounds had impacted soils or ground water. Ohio EPA wants to be assured that areas such as the RVAAP 38 NACA, or RVAAP 03 ODA1, RVAAP-05 Winklepeck Burning Grounds, RVAAP-002-R-01 Erie Burning Grounds, RVAAP-01 Ramsdell Quarry or others, if appropriate, will be evaluated for this group of chemicals, or evidence will be provided that will eliminate the need for this evaluation.	Based on review of historical assessment documents for RVAAP-38 NACA Test Area, aircraft crash testing and associated firefighting responses were conducted from 1947 through 1953. According to the Phase I RI (SAIC, December 2001), the site was used for “training and parking” after 1969. As PFCs were not used in firefighting foam products prior to 1970, assessment of these compounds is not warranted at the NACA Test Area. As discussed, potential for PFCs will be investigated as part of a separate contract being issued for CC RVAAP-69 Building 1048 Fire Station. No other Camp Ravenna sites are suspected to have potentially been subject to use of PFC containing firefighting products. Applicable tables regarding CSM inputs (Table 1-3) and site investigation summary information (Appendix C) have been updated with the above information. No other changes to the RI Work Plan have been made in response to this comment.
3	General	Reviewers found the Draft RI Work Plan somewhat difficult to review. No narrative was provided in the text of the RI Work Plan that explains the rationale for the specific number and location of proposed monitoring wells. Although the maps and figures were well done, pretty much all information must be deduced from data on maps provided without a lot of narrative, which left the reviewer with many questions. More written	In addition to revisions to Section 1.8.6 and Table 1-3 discussed above, the following clarifying text has been added to Section 2.2.2 with related content additions to Table 2-1: *AOC-specific RI activities outlined in Table 2-1 have been structured to provide:*

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
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Date: 4 April 2016

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		descriptions would be helpful in our review of the maps.	• *Identification of specific constituents and individual wells to be sampled during the RI (based on historical data evaluations summarized by AOC maps and Data Tables provided in Appendix C)* • *Summary of currently existing wells to be sampled and new wells to be installed broken down by DGA* • *Listing of FWGWMP wells that are associated with or collocated with AOCs, with an indication of which of these wells will also be sampled for the purposes of the RI* • *A description of site evaluation activities other than well sampling/new well installations that will be conducted as part of the RI*
4	General	Figure C-16 in the Volume 2 shows an unusual topographic feature (depression) in the Block D area. It is located at the southeast corner of the intersection of Smalley Road and Road 6D. It does not seem to match air photographs available from REIMS or Google Maps, which do not depict this depression. Can you provide some interpretation of this feature? Also, this area lacks any ground water or significant soil data. The only soil data provided shows data with site chemicals of potential concern (COPCs) detected, yet no further evaluation is anticipated. Provide the rationale for this decision.	Recent field observations by OHARNG/ARNG personnel indicate the depression feature on the referenced map is not visible at the site. The map contours have been revised for inclusion in the Final RI Work Plan. Historical assessment of the Block D Igloo site indicates residual contamination is not present at levels indicating unacceptable risk to human and ecological receptors.
5	General	Add the acronym RTLS to the List of Acronyms on page vii.	Comment has been addressed as requested.
6	General	Page 1-35, Section 1.8.6, last paragraph, states, "The preliminary CSM for the Draft RIWP has been structured to provide a summary of key site-specific…described in Subsection 1.6.5." There is no Section 1.6.5, please make this correction.	Comment has been addressed as requested.
7	General	It was noted on Table 2-1 (Map ID C-13) that it states, "…Unconsolidated Aquifer monitoring wells will be installed in the motor pool area during site specific investigations planned to be conducted by ARNG/OARNG during 2016 under other contracts." Ohio EPA was unaware that any ground water investigations were being planned outside the Facility-	The following text has been added to Table 2-1: *Continued monitoring of groundwater wells installed during the investigation with confirmed contamination levels requiring additional assessment/monitoring will be incorporated into the FWGWM Program after four quarters of initial characterization sampling have been completed.*

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		wide Groundwater RI Work Plan. We anticipated that the rate and extent of ground water contamination was being conducted under this contract. Please clarify.	
SPECIFIC COMMENTS			
Specific portions of the Draft RI Work Plan (i.e., the location of proposed four background monitoring wells, the location of five proposed extent monitoring wells, and the first semi-annual ground water sampling event for 2016) were previously reviewed and approved by Ohio EPA in order to facilitate field work at Camp Ravenna. For clarity, those portions of the Draft RI Work Plan previously approved by Ohio EPA in its March 2, 2016 letter to the National Guard Bureau are summarized below:			
1	**Previously Approved Portions of the *Draft RI Work Plan***	On March 2, 2016, Ohio EPA approved the four proposed background monitoring well locations as indicated in Table 1-4 and Figure 1-18 of the *Draft RI Work Plan*. The four approved background well locations include two wells to be installed in the Homewood Sandstone (FWBKG-HSS1 and FWBKG-HSS2) and two wells to be installed in the Basal Sharon Sandstone (FWBKG-SCON1 and FWBKG-SCON2). **Note**: Ohio EPA's March 2, 2016 letter incorrectly indicated that proposed wells FWBKG-SCON1 and FWBKG-SCON2 are to be installed in the "Upper Sharon Aquifer" instead of the Basal Sharon Conglomerate.	Comment acknowledged.
2	**Previously Approved Portions of the *Draft RI Work Plan***	On March 2, 2016, Ohio EPA approved the five proposed "extent" monitoring wells to be installed in areas located down-gradient of AOCs and near the Camp Ravenna boundaries. The five wells include three in Upper Sharon Aquifer (FWG-SS/C3, FWG-SS/C4, and FWG-SS/C8) and two in the Basal Sharon Aquifer (FWG-SCON3 and FWG-SCON4). The locations of the five wells that Comment acknowledged. Ohio EPA approved are shown on Figure 3-1 of the *Draft RI Work Plan*.	Comment acknowledged.
3	**Previously Approved Portions of the *Draft RI Work Plan***	On March 2, 2016, Ohio EPA approved the schedule of wells to be sampled and associated laboratory analytical parameters for the Spring 2016 semi-annual sampling event at Camp Ravenna, as summarized in Table 3-3 of the Draft RI Work Plan.	Comment acknowledged.
4	**New Ground Water**	Section 1.4.3 (Hydrogeology) of the plan does not provide hydrogeologic information needed to adequately support the	The following text has been added to Section 1.4.2, Site Geology: *The RI will provide formation-specific lithology descriptions*

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	Comments	Remedial Investigation and Conceptual Site Model (CSM). Section 1.4.3 provides a very general summary of the ground water hydrogeology beneath Camp Ravenna that focuses mainly on the Unconsolidated Aquifer and the Basal Sharon Conglomerate Aquifer. The Homewood Sandstone and Upper Sharon Sandstone are the other hydrostratigraphic units currently monitored at Camp Ravenna. Geologic cross-sections show that the Mercer and Massillon Sandstone Members of the Pottsville Group are present beneath the western portion of Camp Ravenna. The Mercer and Massillon Sandstone Members lie between the uppermost (Unconsolidated Aquifer) and lowermost (Basal Sharon Conglomerate Aquifer) hydrostratigraphic units monitored beneath Camp Ravenna. The Homewood Sandstone uncomformably overlies the Mercer Member. The Massillon Member stratigraphically underlies the Mercer Member and unconformably overlies the Sharon Shale. USGS Professional Paper 551, Geology and Ground Water Resources of Portage County (Winslow and White, 1966) and ODNR's 1990 Ground Water Pollution Potential of Portage County indicate that the Mercer and Massillon Members are known hydrostratigraphic units in Portage County. Ground water quality in the Mercer and Massillon Sandstone may be impacted by historic activities in AOCs; therefore, the hydrogeology of these units also needs to be understood. Upon review of the Potentiometric Surface Map of the Homewood Sandstone Aquifer (Figure 1-8) it was noted that 60 percent of the wells used to monitor that hydrostratigraphic unit are installed in the Mercer Member. It is not clear that it is appropriate for the Homewood and Mercer Members to be treated as a single hydrostratigraphic unit, as shown in Figure 1-8. There are no wells at Camp Ravenna monitoring the Massillon Member. The hydrogeologic characteristics of the	*based on monitoring well and soil boring logs for historically characterized locations on post, with an emphasis on characteristics affecting contaminant fate and transport (e.g., texture/grain-size for unconsolidated materials, relative permeability and porosity for bedrock).* The following text additions to Section 1.4.3 of the RI Work Plan have been made to address the requested updates to the hydrogeologic CSM: After second paragraph, line 14: *Review of local geology literature references (i.e., Winslow and White, 1966) with respect to upper contact bedrock formations at Camp Ravenna indicates a number of wells identified in historically prepared Camp Ravenna assessment documents as being installed within the Homewood Sandstone aquifer may actually be screened within other stratigraphic units (e.g., the Mercer or Massillon Member of the Pottsville Group, see Figure 1-8). Figure 1-11 presents a 3-dimensional view of critical hydrogeology characteristics in the area of the Fuze and Booster Quarry Landfill/Ponds site and Load Lines 5 through 10, where these monitored formation discrepancies are primarily suspected to have occurred. Lithologic units, in descending order, include the Homewood Sandstone Member, the Mercer Member, the Massillon Sandstone Member, the Sharon Member Shale and the Sharon Member Sandstone/Conglomerate of the Pottsville Group. Generally, these lithologic units are not exposed at the ground surface but rather are overlain by thin soil horizons or by glacial till composed of sand, silt, clay and gravel. Variations in the uppermost lithologic unit subcrop in this portion of Camp Ravenna are related to erosional processes, ostensibly allowing the bedrock units to transition in sequence laterally following the ground surface topography downslope. Groundwater is indicated to flow in the direction of ground surface topography, through the basal unconsolidated material matrix and through the upper-*

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		Homewood, Mercer, and Massillon Members are not described/discussed in Section 1.4.3 of the plan, and need to be. To ensure that information supporting the hydrogeologic site conceptual model is accurate, and that ground water at the facility is appropriately monitored, the National Guard needs to demonstrate a more thorough and detailed understanding of the hydrogeology of the facility in Section 1.4.3 of the RI Work Plan.	*reach weathered sandstones of the Homewood, Mercer and Massillon members. Groundwater elevations determined from historical gauging measurements indicate semi-confined conditions associated with overlying, low-permeability till material may be present in some areas. Potential aquitards within and underlying the bedrock units include discontinuous shale lenses in the Mercer Member and shale layers of the Sharon Member. As a result of these lower confining unit conditions, groundwater may be discharged along the edge of the formations topographic boundary as surface seeps or may flow downslope and migrate through the till/weather bedrock interface zone to enter a lower lithologic unit. In instances where the shales are discontinuous, vertical migration through different sandstone units may occur.* *Historically prepared monitoring well logs for this portion of Camp Ravenna generally provide insufficient lithologic description details to make definitive delineations of the various bedrock upper contact areal extents (and, therefore, limit confidence in identification of individual well monitored formations). However, the current understanding of the site hydrogeology characteristics discussed above indicates that, regardless of actual formation, groundwater within the upper contact bedrock reaches in this portion of Camp Ravenna may nevertheless be hydraulically connected as has been historically assumed in mapping of "Homewood Sandstone" potentiometric surface elevation contours. The RI will include installation of new groundwater monitoring wells in the Upper Sharon Sandstone and Basal Sharon Conglomerate that will support a more detailed evaluation of the overlying bedrock stratigraphy, the hydraulic relationships between these uppermost water bearing intervals, and the resulting effects on groundwater contaminant fate and transport. Spatial variation in stratigraphy within the study area and localized hydrogeology will be provided graphically in the RI through illustrations of*

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			'release scenarios' with supporting text for Camp Ravenna areas representing primary hydrogeologic regimes affected by historical releases of contaminants. The release scenario illustrations will be categorized by the following water bearing units/aquifers: • *Homewood Sandstone and other upper contact water bearing units in the area of the FBQ and LL5 through LL10.* • *Unconsolidated Aquifer: NACA Test Area* • *Upper Sharon Sandstone and Basal Sharon Conglomerate: LL1 and LL2* *The release scenarios illustrations will provide discussion of aquifer permeability and localized physical influences (e.g., surface water, ground surface and upper geologic contact topography, wetlands) on contaminant fate and transport. Analysis will include review of seasonal variation in the hydrologic regime.* *A tabulated summary of key hydrogeology parameters for each AOC currently monitored at Camp Ravenna will be provided in the RI report, to include:* 1. *Thickness of water bearing units, lithologic composition and presence/thickness of confining units (based on site-specific logs)* 2. *Depth to water table aquifer/potentiometric surface elevations for each WBU monitored with seasonal variation* 3. *Hydraulic conductivities and transmissivities for each water bearing unit* 4. *Calculated gradients within and between formations.* 5. *Monitored interval depths/elevations/formation descriptions, with a correlation to current identification of monitored formation: emphasis on review of wells currently mapped in the Mercer that have been historically identified as Homewood wells*

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5	**New Ground Water Comments**	Neither Section 1.6.3 (Monitoring Well Network Data Gaps) of the plan, or the Project Schedule (Figure 8-1), clearly indicates when data gaps in the facility's monitoring system will be evaluated/addressed so that the rate, extent, and concentration of metals COPCs in ground water can be determined. Section 1.6.3 indicates that the National Guard is deferring the evaluation of data gaps in the adequacy of the monitoring system to determine the rate, extent, and concentration of metals in ground water until it has completed its background study. According to Section 1.7 (Background Well Study) of the plan, completion of the background well study will require the installation and sampling of four new monitoring wells over one-year period. Based on the Project Schedule, the fourth sampling event for new wells would not occur until January 2017. Data from the fourth event will not be reviewed and approved by the National Guard until April 2017. The plan does not clearly indicate when the National Guard plans on evaluating/addressing the data gaps in the facility's monitoring system to determine the rate, extent, and concentration of metals COPCs in ground water. This issue needs to be addressed.	The following clarifying text has been added to Section 1.6.3, lines 28-29 (inserted text underlined and in italics: …evaluation of the current nature and extent of metals has been deferred pending Ohio EPA approval of the background study for those constituents *[see Section 1.7.4 for details on submittal of the background study results for stakeholder review]*). The following text has been added following the last paragraph of Section 1.7.4 Background Well Study, Presentation of Results, Page 1-25: *The background study report will be provided either as an appendix to a FWGW RI Work Plan Addendum, or as an appendix to the FWGW RI report. A FWGW RI Work Plan Addendum will be prepared in the event the results of the background study indicate additional sampling of currently existing wells or installation of new monitoring wells is required to characterize the nature and extent of metals constituents in groundwater for the RI. The currently anticipated schedule for submittal of the RI Work Plan Addendum (if required) and of the RI Report is provided in Figure 8-1.* A revised Project Schedule addressing these issues has been provided as Figure 8-1.
6	**New Ground Water Comments**	Review of Section 3.5.1, Table 3-1, and various figures in the plan indicate that an insufficient number of new monitoring wells are proposed to address the 24 non-metal/inorganic COPCs Data Gap areas in Camp Ravenna ground water monitoring system identified in the plan. Appendix C contains the Evaluations of 53 AOCs, 17 Munitions Response Site (MRSs) and 14 Compliance Restoration Sites (CRSs) for non-metals COPC data gaps in the facility's ground water monitoring system. Figures 3-1 through	Additional details regarding the selection of groundwater constituents and individual monitoring wells for characterization during the FWGW RI have been added to AOC-specific data summary tables provided in Appendix C. **Site-specific Summary of Groundwater COPCs with Results Statistics,** added columns indicating selection of individual compounds as SRCs and the rationale for these selections. Generally, historical results indicating the presence of common laboratory contaminants (e.g.,

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		3-3 (main text) and Figures C-1 through C-25 (Appendix C) show a total 24 potential horizontal and vertical non-metal COPC ground water Data Gap Areas. However, only 11 extent wells are proposed in the plan to address those data gap areas. Of these 11 wells, only 7 are installed within a Data Gap Area, and 4 are installed down-gradient of Data Gap Areas. No extent wells are shown in 19 of the 24 Data Gap Areas. The 19 Data Gap Areas with no proposed monitoring wells are provided below along with Ohio EPA's recommendations to provide additional information:	DEHP and methylene chloride) or pesticides at levels not consistent with a regulated release of site related compounds (SRCs) were not considered for additional assessment during the RI. Although not currently planned for characterization for purposes of the RI, historically documented concentrations for certain pesticides constituents will be considered in determinations of residual risk where applicable. **Site-Specific Monitoring Wells Summary of Historical Maximum Groundwater COPC Results (Top 3 Rankings)** and **Site-Specific Monitoring Well Summary of 2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)**, added columns providing the following information. • A calculated "COPC Risk Ratio" for each well based on maximum detected constituent concentrations, the Risk Ratio values were determined by dividing maximum detected concentrations by USEPA screening levels. Risk-driver COPCs will generally be characterized for current conditions at each of the top 3 historical/current concentration wells. COPCs with lower-risk ratios will generally be characterized for current conditions at a minimum of the maximum historical/current concentration well.
			A "yes" or "no" selection indicating whether each well is planned for sampling during the RI. • Individual well COPC Concentration Trend. Analysis information, including results for a statistics-based review for certain AOCs, an indication of wells/constituents that were not required for sampling during the RI based on datasets with four or more sampling events with non-detect results after the last detected concentration, or an indication that a concentration trend analysis will be conducted after receiving results from the pending RI sampling. In addition to Appendix C data table content, the AOC-specific historical data summary maps (C-1 through C-25) have been revised to

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			• Present DGA identifying labels correlating to text descriptions provided in Tables 1-3 and 2-1 of the main text • Annotate individual monitoring wells that will be sampled for the RI, for the FWGW Monitoring Program, or for both purposes. A tabulated summary of wells that have been added to the planned RI characterization effort as requested by Ohio EPA and wells that were proposed in the Draft FWGW RI Work Plan but that have been dropped based on additional evaluation of their respective data sets is provided as an attachment to this RTC.
		• **Erie Burning (Two Data Gap Areas) (Figure C-1)** a. Include EBGmw-127 in the 2016 Facility-Wide Ground Water (FWGW) Monitoring Program sampling, because one or more non-metal COPC was detected above a screening level and it was the location of one or more site COPC maximum results (top three ranking). • **Load Line 1/Ore Storage/Ramsdell Quarry (Two Data Gap Areas) (Figures C-2 and C-3)** a. Install well(s) down-gradient of LL1mw-084, or relocate proposed well FWG-SS/C1 (Table 3-1 and Figure 3-1) closer to LL1, to monitor the movement of explosives detected above screening levels at the AOC; b. Include wells LL1mw-079, LL1mw-063, and LL1mw-081 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because the well is identified as having one or more non-metal COPCs above screening levels and one or more site COPC	• **Erie Burning Ground** a. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. • **Load Line 1/Ore Storage/Ramsdell Quarry** a. FWG-SS/C1 has been relocated to be closer to LL1 as requested (see revised Figures 3-1 through 3-3). b. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. Monitoring wells LL1mw-063 and LL1mw-081 have been added to the RI sampling plan. c. LL1mw-080 will be sampled as requested; d. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. RQLmw-014 has been added to the RI sampling plan. e. Dioxins are not suspected to be present at the RQL based on review of the indicated historical site use as part of the

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		maximum results; c. Resample LL1mw-080 to evaluate the potential for COPC migration from LL 2; d. Include RQLmw-014 in the 2016 FWGW Monitoring Program sampling, because the well is identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results, or provide justification explaining why they can be excluded from the sampling effort; and **e.** Provide some rationale why PCBs or dioxins should, or should not be added to the analyte list based on the reports of burning thousands of 500 pound bombs in this area.	FWGW RI Work Plan for Sediment and Surface Water. The following text has been added to Table 1-3: *Dioxins and furans are not suspected to be present at the RQL site as a result of the historical napalm open burn activities (NGB, 2016).* Although not suspected to be present due to the referenced bomb burning activities, additional data review conducted since the submittal of the Draft FWGW RI Work Plan indicates PCBs have been detected in groundwater at levels exceeding EPA screening levels. Wells with historical SL exceedances (RQLmw-015 and RQLmw-017) will be sampled for PCBs during the RI.
		• **Load Line 2/Electrical Substation-East (Figure C-4)** a. Include LL2mw-269 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because the well is identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results; b. Include LL2mw-263, LL2mw-264, and LL2mw-268 in the 2016 FWGW Monitoring Program sampling to evaluate the potential migration of COPCs; c. The 2016 FWGW Monitoring Program sampling could include LL22mw-271 instead of installing FWG-SS/C8, as there appear to be an adequate amount of Sharon aquifer wells in the proposed new well installation area; and **d.** The LL1-4 FFS (May 2005) Seasonal Soil Compartment Model (SESOIL) modeling indicated antimony, arsenic, cadmium, chromium, mercury, and	• **Load Line 2/Electrical Substation-East** a. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. LL2mw-269 has been added to the RI sampling plan. b. LL2mw-268 has been added to the RI sampling plan based on a statistics based review of the historical groundwater sampling dataset for all LL2 wells with SL exceedances. c. FWG-SS/C8 has been proposed for installation based on the presence of perchlorate in LL2mw-271 below current USEPA screening levels but above analytical method detection limits. d. Metals have been historically characterized in groundwater at LL2. Review of historical results to support determination of which metals are present in groundwater at levels requiring additional assessment will be conducted upon Ohio EPA approval of the pending metals background study.

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		royal demolition explosive (RDX) were predicted to exceed screening criteria in the ground water beneath the source area, thus metals should be included as ground water COPC analytes (Table 3-3).	
		• **Sand Creek Landfill/Dump (Figure C-9)**	• **Sand Creek Landfill/Dump** See response to General Comment No. 4 above.
		• **Atlas Scrap Yard Storage Area and Load-Line 4 (Two Data Gap Areas) (Figures C-10 and C-11)** a. Add hexavalent chromium to the analytical testing suite (Table 3-3); b. Include all wells in the 2016 FWGW Monitoring Program sampling that were identified as still having one or more non-metal COPCs above screening levels or provide justification explaining why they can be excluded from the sampling effort; c. The LL1-4 FFS (May 2005) SESOIL modeling indicated chromium and selenium were predicted to exceed screening criteria in the ground water beneath the source area, so metals should be included as ground water COPC analytes (Table 3-3); d. Include wells LL4mw-197 and LL4mw-198 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because these wells are identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results; e. Install well(s) down-gradient of LL4mw-197 to evaluate the potential migration of COPCs; and f. Add the vapor intrusion pathway as a key CSM input	• **Atlas Scrap Yard Storage Area and Load-Line 4** a. Cr(VI+) will be added to the analytical testing suite as recommended. Assessment of metals concentrations for the RI will be deferred until obtaining Ohio EPA concurrence on the pending background study. b. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. c. See response for LL2, Comment d., above. d. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. LL4mw-197 has been added to the RI sampling plan. e. Based on groundwater contours for the unconsolidated aquifer in the area of LL4, direction of flow is towards the surface water feature to the south. Delineation of groundwater constituents in the unconsolidated aquifer is provided by LL4mw-199 and LL4mw-200 in this direction. f. The vapor intrusion pathway has been included for all sites with currently existing surface structures potentially impacted by VOCs in groundwater and for locations with surface structures potentially impacted in the future from plume migration or through new construction.

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		(Table 1-3) because the sampling effort includes VOCs.	
		• **Winklepeck Burning Grounds (Two Data Gap Areas) (Figure C-12)** a. Include all wells in the 2016 FWGW Monitoring Program sampling that were identified as still having one or more non-metal COPCs above screening levels or provide justification explaining why they can be excluded from the sampling effort. • **Motor Pool Area (Figure C-13)** a. No wells are proposed at the Motor Pool Area. Table 1-3: Key CSM Inputs for Each AOC/MRS/CRS Site states, "Groundwater has not been characterized to determine potential impact from historical site use associated with AOC and CRS sites in the motor pool area." If other investigations indicated suspected or confirmed releases, ground water should be characterized. For example, the sampling completed for the Draft Remedial Investigation Report CC-RVAAP-74 Building 1034 Motor Pool Hydraulic Lift (March 6th, 2015) detected Site Related Contaminants b. (SRCs) in the subsurface soil, which is a valid reason to evaluate ground water at the area. • **Load-Line 8 (Figure C-21)** a. Include well LL8mw-003 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because these wells are identified as having one or more non-metal COPCs above screening	• **Winklepeck Burning Grounds** a. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. • **Motor Pool Area** a. See response to General Comment No. 7 above. b. See response to General Comment No. 7 above. • **Load-Line 8** a . See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. LL8mw-003 has not been added to the RI sampling plan.

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		levels and one or more site COPC maximum results.	
		• **Load-Line 11 (Figure-18)** a. Install well(s) down-gradient of LL11mw-006 and LL11mw-008 to evaluate the potential migration of COPCs toward Sand Creek (if ground water is in communication with surface water); b. Install well(s) down-gradient of LL11mw-002 to evaluate the potential migration of COPCs off the AOC; c. Include LL8mw-001, LL8mw-008, LL8mw-009, and LL8mw-010 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because these wells are identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results; d. Update the CSM to include the vapor intrusion pathway (TCE detected in ground water) and the ecological receptors (Sand Creek; if ground water is in communication with surface water). • **Load-Line 7 (Figure C-19)** a. Install well(s) down-gradient of LL7mw-001 to confirm 1,1-dichloroethane and 1,1-dichloroethene detections have naturally attenuated rather than	• **Load-Line 11** a. and b. Based on the low hydraulic conductivity of glacial till materials comprising the unconsolidated aquifer matrix and the relatively low levels of contaminant mass present in groundwater at LL11, migration of SRCs is anticipated to be limited in areal extent. Historical results for LL11mw-007 provide downgradient delineation of SRCs at LL11mw-008. It is recommended that the need for installation of additional delineation wells downgradient of LL11mw-002 and LL11mw-006 be reviewed after groundwater conditions at these two wells have been updated by sampling during the RI. The relative stability of the groundwater plume (and the potential need for additional delineation wells) will be evaluated based on a statistical concentration trend analysis of the comprehensive data set for these wells, including results for sampled collected during the RI. c. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions (our current response assumes this is a typographical error and the corresponding wells at LL11 are being requested for potential addition to the RI sampling). LL11mw-10 has been added to the RI sampling plan. d. The CSM will be updated to include the vapor intrusion and ecological exposure pathways as requested. • **Load-Line 7** a. 1,1-dichloroethane and 1,1-dichloroethene have not been historically detected in downgradient monitoring wells located in LL5 and LL6. VOCs will be added to the testing suite for LL5mw-002 and LL5mw-006, LL6mw-003 will be

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		migrated; and b. The RI/FS report identifies silver, TNT, 3-nitrotoluene, and naphthalene as predicted to exceed screening criteria in ground water beneath the source area, and 2,6-DNT, nitroglycerin and RDX predicted to exceed screening criteria in ground water beneath source area and at the down-gradient receptor location; therefore, include semi-volatile organic compounds (SVOCs) in the analyte testing suite for all wells (Table 3-3) to evaluate naphthalene and ensure wells (current or new) are appropriately placed in relation to the source area (s) identified in the RI/FS.	added to the RI sampling and characterized for VOCs to evaluate potential downgradient migration of these constituents in the Homewood aquifer. The need for installation of a new well downgradient of LL7mw-001 will be evaluated based on VOC results for the LL5 and LL6 wells. b. Historical characterization of SVOCs in groundwater at LL7 has not indicated the presence of naphthalene above current SLs. Review of the currently existing wells with respect to adequately characterizing groundwater underlying the presumed source of naphthalene at LL7 indicates the wells are adequately located to have previously determined the presence of the constituent at levels requiring additional assessment. SVOCs are not planned for sampling at LL7 during the RI. .
		• **Fuse and Booster Quarry/40 MM Firing Range/Water Works (Two Data Gap Areas) (Figure C-20)** a. Install well(s) down-gradient of FBQmw-166, FBQmw-176, and FBQmw-167 to evaluate the potential migration of COPCs; b. Include FBQmw-169 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because the well was identified as having one or more non-metal COPCs above screening level, and wells FBQmw-170, -171, -172, -173 and -175 to “confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant migration to the north and west” (Table 1-3); and Include SVOCs in the analytical testing suite for all wells (Table 3-3) based on historical sample results (Appendix C Site-Specific Summary of Groundwater COPCs with Statistical	• **Fuse and Booster Quarry (FBQ)/40 MM Firing Range/Water Works** a. Based on the age of the presumed initial release of contaminants at the FBQ and localized groundwater gradients in the Unconsolidated and Homewood Aquifers in the area, the historical data sets for these wells are considered adequate to have established delineation of contaminants in this direction from the FBQ source area. It is recommended that the need for installation of additional delineation wells downgradient of these wells be reviewed after groundwater conditions have been updated by sampling during the RI. The relative stability of the groundwater plume (and the potential need for additional delineation wells) will be evaluated based on a statistical concentration trend analysis of the comprehensive data set for these wells, including results for samples collected during the RI. b. FBQmw-171, FQBmw-172, FBQmw-173 and FBQmw-175 have been added to the RI sampling plan. c. Bis(2-ethylhexyl)phthalate (DEHP) is the only SVOC

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		Results).	historically reported above current SLs at the FBQ site. Based on the reported concentrations, the presence of DEHP is likely due to laboratory cross-contamination; however, the three top historical maximum constituent concentration wells for DEHP (FBQmw-166, -167, and -176) will be tested for this constituent to evaluate current conditions during the RI.
		• **NACA Test Area (Figure C-24)** a. Include wells NTAmw-114, NTAmw-115, NTAmw-117, and NTAmw-118 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because the well was identified as having one or more non-metal COPCs above screening level; and b. Evaluate placement of wells to ensure down-gradient migration from the area is being sampled and install new wells, as necessary.	• **NACA Test Area** a. See general response above pertaining to review of historical monitoring well sampling data for recommended well additions. NTAmw-115, NTAmw-117 and NTAmw-118 have been added to the RI sampling plan. b. Based on the low hydraulic conductivity of glacial till materials comprising the Unconsolidated Aquifer matrix and the relatively low levels of contaminant mass present in groundwater at the NACA Test Area site, migration of SRCs is anticipated to be limited in areal extent. The need for installation of additional delineation wells in the Unconsolidated Aquifer downgradient of the site will be reviewed after groundwater conditions have been updated by sampling at selected wells during the RI. The relative stability of the groundwater plume in the unconsolidated aquifer (and the potential need for additional delineation wells) will be evaluated based on a statistical concentration trend analysis of the comprehensive data set for these wells, including results for sampled collected during the RI. Characterization of area-wide conditions in the Upper Sharon Aquifer potentially impacted by vertically downward and horizontally downgradient migration of SRCs in the NACA Test Area will be provided by installation of FWG-SS/C7 to the east. Review of previously prepared cross-sections for the NACA Test Area provided in the Final Characterization of 14 AOCs at Ravenna Army Ammunition Plant, dated March 2007, was conducted to facilitate an evaluation of the historically characterized vertical distribution of site COPCs at the site. Based on this review, *the*

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			*NACA Test Area overlies a buried glacial valley feature in the upper contact of the Sharon Member Sandstone/Conglomerate Unit (see **Figure 1-11**). Preferential flow paths associated with coarse-grained alluvial deposits present at the site tending to direct water table groundwater flow toward surface water features and the thickness of low-permeability glacial till material underlying the site effectively limit the extent of downward contaminant migration at the site. The relatively low levels of contaminant concentrations reported at the site, which have continued to attenuate over time, further limit the potential for downward migration of contaminants.* Installation of a vertical delineation well at depth within the glacial till materials underlying the NACA test area is not warranted. Italicized text above has been added to the Table 1-3 inputs for the NACA Test Area.
		• **Mustard Gas Burial Site-South (Figure C-24)** • **C-Block Quarry (Figure C-25)** It is not clear how non-metal ground water data gaps in these 19 areas of the facility are going to be addressed. This needs to be explained.	• **Mustard Gas Burial Site-South** Additional rationale for the basis for designation of the DGA for the Mustard Gas Burial Site will be provided as discussed in the response to General Comment No. 1 above. • **C-Block Quarry** See response to General Comment No. 4 above.
7	**New Ground Water Comments**	It is not clear why four of the proposed extent wells (FWG-SS/C1, FWG-SS/C6, FWG-SS/C7, and FWG-SCON5) are not located within non-metal data gap areas in the facility's monitoring system; but are located down-gradient of those areas. The location of these four proposed monitoring wells are shown on Figures 3-1 and 3-2.	In each of these cases, the new well installations are intended to provide an <u>*area wide*</u> evaluation for the presence of downgradient migration of SRCs in groundwater. In the case of FWG-SS/C6 and FWG-SS/C7, the new well installations are intended to characterize potential downward migration of SRCs from the Unconsolidated and Homewood Aquifers to the Upper Sharon Sandstone formation, and subsequent downgradient migration

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			within the Upper Sharon Sandstone Aquifer. See response to LL1, Comment No. a., above regarding revised placement of FWG-SS/C1. The location of FWG-SCON5 has been revised to be collocated with FWG-SS/C5 directly underling the area between LL9 and LL10. *The need for additional characterization of potential vertical migration of contaminants underlying AOC-specific source areas will be based on relative localized gradients determined between the aquifers and on sample results obtained from the planned new well installations.* Italicized text above has been added to Section 2.2.1 and Table 2-1 entries for the NACA Test Area and the FBQ.
8	**New Ground Water Comments**	As shown on Figure 3-1, a "Sharon Sandstone/Sharon Conglomerate" (a.k.a. Upper Sharon Sandstone Aquifer) well FWGSS/C1 is proposed to be located down-gradient of the Load-Line #1 Data Gap Area, but that proposed well is over a half-mile (about 3,000 feet) down gradient of the existing two Upper Sharon Sandstone monitoring wells (LL1mw-083 and LL1mw-084) located within the Load-Line 1 Data Gap Area. LL1mw-083 and LL1 mw-084 are impacted by various explosive COPCs above screening levels (refer to Appendix C). It is unclear that the proposed well, FWGSS/C1, is appropriately located to accurately determine the rate, extent, and concentration of non-metal COPCs in ground water beneath the Load Line 1 Data Gap Area. It is unclear why proposed well FWGSS/C1 is not to be located within the Load Line 1 Data Gap Area. As shown on Figure 3-2, a Basal Sharon Conglomerate well FWG-SCON5 is proposed to be located over 500 feet down-gradient of the Load-Lines 5, 9, and 10 delineation gap areas. There is no Basal Sharon Conglomerate well located within the	See response to LL1, Comment a., above regarding revised placement of FWG-SS/C1. See New Groundwater Comment No. 7 regarding currently proposed placement of FWG-SS/C6, FWG-SS/C7 and FWG-SCON5. Current references in the RI Work Plan to the Sharon Sandstone/Sharon Conglomerate will be revised to refer to the Upper Sharon Sandstone Aquifer.

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		Load Lines 5, 9, and 10 Data Gap Area. It is unclear if proposed well FWG-SCON5 is appropriately located in order to accurately determine the rate, extent, and concentration of non-metal COPCs in ground water beneath the Load Line 5, 9, 10 Data Gap Area. It is also unclear why proposed well FWG-SCON5 is not to be located within Lines 5, 9, and 10 Data Gap Area. As shown on Figure 3-2, a "Sharon Sandstone/Sharon Conglomerate" (a.k.a. Upper Sharon Sandstone Aquifer) well FWG-SS/C6 is proposed to be located approximately 250 down-gradient of the triangular Fuse and Booster Quarry/40 MM Firing Range/Water Works Data Gap Area. There are no Upper Sharon Sandstone wells located within the aforementioned Data Gap Area. It is unclear if proposed well FWG-SS/C6 is appropriately located in order to accurately determine the rate, extent, and concentration of non-metal COCs in ground water beneath the triangular Fuse and Booster Quarry/40 MM Firing Range/Water Works Data Gap Area. It is unclear why well FWG-SS/C6 is not to be located within the triangular Fuse and Booster Quarry/ 40 MM Firing Range/Water Works Data Gap Area. As shown on Figure 3-2, a "Sharon Sandstone/Sharon Conglomerate" (a.k.a. Upper Sharon Sandstone) well FWG-SS/C7 is proposed to be located over one-third of a mile (about 2,000 feet) south of the rectangular Fuse and Booster Quarry/ 40 MM Firing Range/Water Works Data Gap Area. There is no Upper Sharon Sandstone monitoring wells in the aforementioned data gap area. It is unclear if proposed well FWG-SS/C7 is appropriately located in order to accurately determine the rate, extent, and concentration of non-metal COPCs in ground water beneath the rectangular Fuse and Booster Quarry/40 MM Firing Range/ Water Works Delineation Gap Area. It is unclear why well FWG-SS/C7 is not located within the rectangular Fuse and Booster Quarry/40 MM Firing Range/Water Works Delineation Gap Area.	

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		Note: It is confusing that on Figure 3-2 the Upper Sharon Sandstone is referred to as the "Sharon Sandstone/Sharon Conglomerate" (see Comment #16). It needs to be explained how the four above referenced proposed monitoring wells adequately address non-metal data gaps in the facility's monitoring system.	
9	**New Ground Water Comments**	Review of Section 1.6.3 (Monitoring Well Network Data Gaps) and Appendix C (AOC-Specific Evaluations) of the plan indicates that at least two additional monitoring wells are needed to address non-metal data gaps in the facility's monitoring well system in the vicinities of Load Line 2 and Load Line 12. Ohio EPA agrees with the proposed location of "Sharon Sandstone/Sharon Conglomerate" (a.k.a. Upper Sharon Sandstone Aquifer) well FW-SS/C2, located in the southern triangular Load Line 2 Data Gap Area near the Camp Ravenna property boundary. However, as shown on Figure 3-1, that proposed location is over a half-mile (about 3,000 feet) down-gradient of the closest up-gradient monitoring well (LL2mw-267) in the Upper Sharon Aquifer in the vicinity of the Load Line 2 Data Gap Area. LL2mw-267 is impacted by COPCs including the explosives 2, 4-dinitrotoluene and RDX above screening levels (refer to Appendix C). It appears that at least another Upper Sharon Sandstone well located closer to well LL2mw-267 may be needed in order to adequately determine the rate, extent, and concentration of explosive COPCs in ground water in the southern triangular Load Line 2 Data Gap Area. Ohio EPA previously approved the location of "Sharon Sandstone/Sharon Conglomerate" (a.k.a. Upper Sharon Sandstone Aquifer) well FWG-SS/C3 (refer to Ohio EPA letter dated March 2, 2016). As shown on Figure 3-1, proposed well FWG-SS/C3 is to be located in the southern portion of the triangular Load Line 12 Delineation Gap Area	FW-SS/C2 will be moved to be closer to LL2mw-267 in order to better characterize downgradient migration of contaminants. *The potential need for installation of an additional delineation well down-gradient of the proposed location of FWG-SS/C2 will be evaluated following obtaining sample results for the new well.* *A statistics-based evaluation of historical COPC concentration trends for LL3mw-238 and LL3mw-241 indicates stable to declining COPC concentrations with a low potential for contamination to have migrated downgradient such that current concentrations between these wells and the proposed location of FWG-SS/C3 are at levels higher than at LL3mw-241.* Italicized text above has been added to the Table 2-1 and Table 1-3 entries for LL2 and LL3, respectively.

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		and near the Camp Ravenna property boundary. According to Table 3-1, FWG-SS/C3 was to be installed to determine the potential for various non-metal/inorganic COPCs off the Camp Ravenna property. However, the proposed location of well FWG-SS/C3 is over 3 quarters of a mile (about 4,000 feet) south of well LL3mw-241, which is closest up-gradient Upper Sharon Sandstone monitoring well in the vicinity of Load Line 12. Well LL3mw-241 is impacted by COPC, including various explosives and pesticides above screening levels. It appears that another Upper Sharon Sandstone well may be needed in the triangular Load Line 12 Data Gap Area in order to adequately determine the rate extent, and concentration of explosives and pesticides COPCs in ground water in that area.	
10	**New Ground Water Comments**	The table entitled: *Status Summary for Compliance Restoration Sites* in Appendix C of the *RI Work Plan* is part of the facility's analyses for the monitoring network for data gaps (Section 1.6.3). Review of the aforementioned table indicates a Compliance Restoration Site, Electrical Substations (CC RVAAP-68) that represents ground water data gap areas that are not addressed by *the RI Work Plan*. The table in Appendix C indicates naphthalene was the only COPC identified as a "potential contaminant migration COPC" for ground water for CC RVAAP-68. The conclusion of the April 2, 2014 *Army's Draft Remedial Investigation Report CC RVAAP-68 Electrical Substations (East, West, No.3)* is that naphthalene impact in the vicinity of Substation No. 3 would be further investigated as part of RVAAP-66 Facility Wide Ground Water. In Ohio EPA's letter dated June 2015, Ohio EPA concurred with that conclusion. In a letter dated July 6, 2015, the National Guard Bureau indicated that naphthalene impact in the vicinity of substation No. 3 would be investigated as part of RVAAP-66 Facility Wide Ground Water. The *RI*	Table 1-3, Item C-14, discussion for the Unconsolidated Aquifer has been updated with the following text: *The potential for naphthalene identified in soil to have impacted groundwater underlying CC-RVAAP-68 Electrical Substation No. 3 will be evaluated during the RI.* Table 2-1, Item C-14, has been updated with the following text:. *Based on coordination with OEPA during a preliminary RTC review meeting on 26 April 2016, three temporary monitoring wells will be installed at the CC-RVAAP-68 Electrical Substation No. 3 to sample groundwater in the Unconsolidated Aquifer for naphthalene. The temporary wells will be installed at the approximate location of the maximum naphthalene concentrations identified in soil during the Soil RI (ECC, 2105) and to enable a triangulation of well gauging points to determine groundwater flow direction. The temporary wells will be plugged and abandoned immediately after gauging and sampling. The need for additional characterization of naphthalene in*

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		Work Plan does not indicate that any Unconsolidated ground water monitoring wells are to be installed down-gradient of RVAAP-68 Electrical Substation No. 3. Therefore, a ground water data gap exists in the vicinity of Electrical Substation No. 3, which is part of the Electrical Substations RVAAP-68 CRS.	*groundwater (e.g., the installation of permanent wells) will be based on the temporary well sampling results.* Approximate locations of the wells have been added to Figure 3-2. The temporary wells have been added to Table 3-1 with an indication of their purpose to evaluate potential leaching of naphthalene from soil into groundwater.
11	**New Ground Water Comments**	Neither Section 1.63 (Monitoring Well Network Data Gaps) nor Appendix C of the plan contains a clear narrative explanation of the process by which the 24 non-metal Data Gap Areas (Figures 3-1 through 3-3 and Figures C-1 through C-25) and their boundaries were determined. Table 1-3 does provide a summary of key conceptual site model inputs for each of the AOC/CRS/MRS sites, but the plan does not provide a clear explanation of how the non-metal data gap areas in the ground water monitoring system were determined, and needs to.	See response to General Comment No. 1 above.
12	**New Ground Water Comments**	It is not clear that Section 1.6.3 (Monitoring Well Network Data Gaps) of the plan addresses potential data gaps in the facility's ground water monitoring network that may exist in the Massillon and Mercer Members beneath Camp Ravenna (refer to Comment 4). The Massillon and Mercer units beneath Camp Ravenna are currently not monitored as discrete hydrostratigraphic units. Ground water quality in the Mercer and Massillon Sandstone may be impacted by historic activities in AOCs. If the National Guard determines that the Mercer and/or Massillon Members are discrete hydrostratigraphic units beneath Camp Ravenna, they will need to evaluate the monitoring well network for data gaps in those units.	See response to New Groundwater Comment No. 4 above.
13	**New Ground Water Comments**	Section 1.7 (Background Well Study) of the plan indicates that a background study is to be conducted to determine the background level of metals and "…other inorganic/indicator parameters as needed". It is unclear for which "other" inorganic/indicator parameters the National Guard anticipates determining background concentrations. This needs to be	Section 1.7, Page 1-19, Line 11 text has been revised as follows (new text in italics): …other inorganic/indicator parameters as needed *to support the preparation of Piper Diagrams to correlate groundwater quality between monitoring wells as previously requested by Ohio EPA*)

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14	**New Ground Water Comments**	Section 1.7.3 (Statistical Evaluation of Data) of the plan does not indicate how/when additional data (if needed) would be added to a background data set after the initial establishment of the data set. Chapter 5 of U.S. EPA Unified Guidance (2009) gives recommendations on how/when a background data set should be updated. The plan needs to address how/when background data sets will be updated.	The following text has been added to the last paragraph of Section 1.7.3 Statistical Evaluation of Data: *As appropriate, the background dataset will be updated following methods recommended in Chapter 5 of the U.S. EPA (2009) Unified Guidance. Updating would occur when 4 to 8 new measurements are available. A test of means (or medians in the case of non-normal data) will be conducted to ensure that no statistical differences are detected between the new data and the current background data.*
15	**New Ground Water Comments**	Section 1.7.3.1.2 (Pooling Well Data) of the plan indicates that Piper diagrams will be utilized to compare ground water chemistry of a data set for a given hydrostartigraphic zone to determine if it is representative. The plan does not indicate that background samples will be analyzed for alkalinity. Ohio EPA's Division of Drinking and Ground Waters (DDAGW) recommends that background samples be analyzed for alkalinity so that data is available to properly construct Piper diagrams.	The following text has been added to Section 1.7.3.1.2, Page 1-22, Line 10 (new text in italics): …the major constituent ground water cations and anions, *as well as alkalinity*, will be used as recommended by Ohio EPA
16	**New Ground Water Comments**	Section 3.5.1 (Monitoring Well Installations) of the plan refers to Table 3-1, which summarizes the purpose of the 11 proposed non-metals/inorganic extent wells and 4 proposed background wells. Table 3-1 identifies the purpose for determining the vertical and horizontal extent of "various non-metal COPCs" for 7 of the proposed extent wells (FWG-SCON4, FWG-SCON5, FWG-SS/C1, FWG-SS/C3, FWG-SS/C5, FWG-SS/C6, and FWG-SS/C7). For the aforementioned 7 wells, the purposes listed in the table are vague and need to be clarified. The purpose needs to identify specific non-metal COPCs.	Table 3-1 has been revised as requested to identify specific non-metals COPCs to be characterized by each new monitoring well installation, as applicable.
17	**New Ground**	Table 1-4, Table 3-1, and Table 3-2 in the plan categorize	References in the RI Work Plan to the Sharon Sandstone/Sharon

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	Water Comments	Sharon Sandstone Member wells (existing and proposed) as either being installed in the Basal Sharon Conglomerate or "Sharon Sandstone/Conglomerate" hydrostratigraphic zones. The Basal Sharon Conglomerate and massive Upper Sharon Sandstone have historically been monitored as discrete hydrostratigraphic zones beneath Camp Ravenna. The designation "Sharon Sandstone/Conglomerate" in describing a discrete hydrostratigraphic zone is confusing. Ohio EPA believes that the National Guard is using the term "Sharon Sandstone/Conglomerate" to refer to the Upper Sharon Aquifer. This needs to be clarified. The National Guard needs to be consistent in its nomenclature for the various hydrostratigraphic units.	Conglomerate have been revised to refer to the Upper Sharon Sandstone Aquifer.
18	**New Ground Water Comments**	The Sampling and Analyses Plan (SAP) [Volume 2, Appendix A, page 4-10] proposes that the filter pack in new monitoring wells will extend from the bottom of the borehole to 3 to 5 feet over the top of the well screen. DDAGW believes that installation of a filter pack extending over 3 feet is unwarranted at this facility unless it can be demonstrated that special circumstances exist to justify installation of a longer sand pack. Chapter 7 (revised 2008) of Ohio EPA's Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring (TGM) recommends that the sand pack extend at least three feet above the top of the screen. The reason for extending the sand pack above the top of the screen is to prevent the infiltration of the bentonite annular seal into the screen sealing a portion of the screen and/or affecting water quality. The sand pack should be thick enough to account for settlement particularly in deeper wells (i.e., > 200 feet deep) in which the sand pack may not initially compress. Ohio EPA's *TGM* only provides general guidance, and the guidance must be used with consideration of a facility's unique characteristics and professional judgment. Only one of the existing wells at Camp Ravenna is over 200 feet deep	The filter pack length has been revised. In Section 4.3.2.4 Filter Pack Placement, the text, "The filter pack will extend from the bottom of the borehole to 0.9 to 1.5 m (3.0 to 5.0 ft) above the top of the well screen" has been corrected to "The filter pack will extend from the bottom of the borehole to 0.9 m (3.0 ft) above the top of the well screen" (FAP, page 4-11).

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		(SCFmw-001), and most of the existing wells at the facility are well under 100 feet deep. The *TGM* also recommends that the extension of the sand pack not be excessive, because it enlarges the zone that contributes ground water to the well which may cause excessive dilution. There are multiple hydrostratigraphic units beneath the facility. Needlessly overextending the length of the sand pack above the top of the screen increases the chances of the well taking in water from multiple hydrostratigraphic units. Ground water in a monitoring well needs to represent a discrete interval within a hydrostratigraphic unit. Unless the facility can demonstrate that a longer sand pack is needed for a particular well installation, DDAGW recommends that the length of the sand pack should not extend more than 3 feet above the top of the screen.	
19	**New Ground Water Comments**	The SAP (Volume 2, Appendix A, page 4-10) indicates that granular filter pack material used for monitoring well construction follows guidance in Section 5.4.2.3.5 of the SAP. The aforementioned section of the SAP appears to missing from the SAP. Because the aforementioned information is missing, it is unclear if the proposed granular material is appropriate for construction, given specific site characteristics. The National Guard needs to provide more information regarding the characteristics and appropriateness of the sand pack material for use in construction of monitoring wells at Camp Ravenna. Historically, high turbidity has been a problem in a number of existing monitoring wells at the facility. The proper sizing of sand pack materials may help reduce future problems with turbidity in wells. For general guidance of the selection of appropriate filter pack materials, refer to Chapter 7 (2008) of Ohio EPA's TGM.	The proposed filter pack material is identified in, Section 4.3.1.2 Construction Materials: Filter Pack, Bentonite and Grout of the FSP, "The granular filter pack material will be visually clean, free of material that would pass through a No. 200 sieve, inert, siliceous, and composed of rounded grains. The filter pack material will be approved by the ARNG/OHARNG prior to beginning fieldwork with the Granular Filter Pack Approval Form and (if needed) Water Approval Form included in Attachment A. The filter material will be packaged in bags or buckets by the supplier and delivered. Filter pack material in pre-packed screens also will meet these criteria" (FSP page 4- 9).
20	**New Ground Water Comments**	Section 3.7 (2016 FWGW Monitoring Program and RI Ground Water Sampling) of the plan does not clearly indicate which monitoring wells will be sampled, and which laboratory	Text in Section 3.7 has been revised to reflect updates to the RI sampling plan made as a result of additional review of the historically documented conditions made since submittal of the

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		analytical parameters will be tested for during the second semi-annual sampling event in the fall of 2016. On Page 3-6 of Section 3.7 states: *A total of 134 (116 existing and 18 new, including background wells) will be sampled to support the FWGW Monitoring Program, the RI, and the background study.* This statement is confusing for a number of reasons. First, Table 3-3 in the plan lists a total of 117 existing monitoring wells that will be sampled in the fall of 2016. Second, the plan only proposes 15 new wells (4 background wells and 11 extent wells). Third, Table 3-3 does not indicate that any of 11 proposed (new) monitoring wells will be sampled. Also, Table 3-3 describes metals laboratory testing for the second semi-annual sampling event in the fall of 2016 as "pending". The plan does not explain what "pending" means. Ohio EPA has recommended that background wells be analyzed for alkalinity, which is not shown on Table 3-3. Section 3.7 and Table 3-3 need to clarify which monitoring wells are sampled, and which laboratory analytical parameters will be tested for during the second semi-annual sampling event in the fall of 2016.	Draft RI Work Plan (new text in italics) and additional clarifying text in response to this comment: A total of *180* (*164* existing wells and *15* new, including background wells) will be sampled to support the FWGW Monitoring Program, the RI, and the background study. *The total of 164 existing wells includes 10 previously installed wells that will be utilized for metals background study…All new monitoring wells will be sampled for full suite VOCs, SVOCS, PCBs, Pesticides, metals, explosives, and cyanide for four consecutive quarters. New well FWGmw-SS/C1 will also be characterized for pH.* *All RI wells listed in Table 3-1 will be sampled at least once, currently anticipated to be conducted in association with the Fall 2016 FWGWMP monitoring event. Wells/constituents confirmed with stable or decreasing concentrations will generally only be sampled once for the purposes of the RI. Results of the initial sampling event and a list of wells planned for continued sampling will be provided in the 2017 Semi-annual Facility-Wide Groundwater Addendum.* Table 3-3 has been revised to include currently existing wells to be used for the background study, as listed in Table 1-4. The indicated testing suite for these wells includes cations, anions, and alkalinity (in addition to metals). Note that two of the currently existing wells to be used for the background study (SCFmw-006 and BKGmw-008) will also be sampled for full suite constituents to verify they are still not being impacted from up-gradient AOCs. The following text has been added to Table 3-3, Note 1 [1] - …*Wells/constituents confirmed with stable or decreasing concentrations will generally only be sampled once for the purposes of the RI.*

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			The following new foot notes have been added to Table 3-3: [7] - *Background study wells will be sampled for a minimum of three consecutive quarters in order to obtain a base representative sample set of 12 per aquifer* [8] - *metals to be characterized for the RI will be selected based on a comparison of historical sampling results to individual constituent upper-bound value concentrations in the pending metals background study following approval by Ohio EPA.*
21	**New Ground Water Comments**	Section 3.10 (Well Abandonment) of the plan discusses the proposed abandonment of 10 historical potable use production wells. The proposed abandonment of these 10 wells is discussed in a separate *Draft Well Abandonment Work Plan* dated February 19, 2016, that was received by Ohio EPA, NEDO on February 22, 2016. DDAGW defers on commenting on the proposed abandonment of historic potable use wells until it has reviewed the aforementioned work plan.	Noted. Comments on well abandonment of historical production wells were addressed during finalization of the Final Well Abandonment Work Plan.
22	**New Ground Water Comments**	Historically, eight existing monitoring wells: LL1mw-083, LL1mw-084, LL1mw-086, RQLmw-011, RQLmw-012, RQLmw-013, FWGmw-002, and FBQmw-174 have had pH measurements outside the typical range for natural ground water (i.e., <5 and >9). Five of the aforementioned wells: LL1mw-083, LL1mw-084, RQLmw-011, RQLmw-012, and RQLmw-013 are Upper Sharon Sandstone Aquifer wells. Two of the wells FWGmw-002 and LL1mw-086 are in the Unconsolidated Aquifer. Well FBQmw-174 is in the Homewood Sandstone Aquifer. It is not clear that the RI Work Plan addresses determining the extent of pH impacted ground water, particularly in the vicinity of Ramsdell Quarry and Load Line 1. The National Guard needs to clarify how the plan is addressing these issues.	Table 1-3 entries for LL1, RQL, FBQ and Appendix Map C-6 (for FWGmw-002) have been revised to indicate potential pH conditions requiring additional assessment in the applicable water bearing units. Table 2-1 and Table 3-3 entries for these sites have been updated to indicate the following wells will be characterized for potential pH conditions outside of naturally occurring conditions: Load Line 1: LL1mw-083, LL1mw-084, LL1mw-086, LL1mw-088, FWGmw-SS/C1 RQL: RQLmw-011, RQLmw-012, RQLmw-013, RQLmw-014 FBQ: FBQmw-171, FBQmw-174, FBQmw-175 Appendix C Map C-6: FWGmw-002 and BGKmw-021 Table 2-1 entries for these areas have been updated to indicate the

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			need for additional characterization/delineation of pH outside of naturally occurring ranges will be made following initial confirmation sampling activities.
23	**New Ground Water Comments**	The Potentiometric Surface Map for the Unconsolidated Aquifer (Figure 1-7) does not have labels identifying individual monitoring well locations on that map. Figure 1-7 needs to include well identification labels.	The Final RI Work Plan includes a supplemental map as an appendix at a scale allowing for including individual well labels.
1	**General Risk Assessment Comments**	The Remedial Investigation Work Plan for Facility-Wide Groundwater executive summary states the contaminant nature and extent and related risk assessment process will employ the use of Plume Groups to support a holistic, facility-wide determination of residual risk in order to determine if a remedial response is required. It is Ohio EPA's opinion that any grouping of plumes of ground water contamination is premature considering the large number of potential ground water data gaps at this time. It is not clear at this time how useful and appropriate the Plume Groups will be; the data collected will need to be able to connect ground water COPCs to a source area, and if the ground water data are pooled together into Plume Groups it may make this task difficult. Under the proposed Plume Group approach, it is unclear how a remedial response would be carried out should one be needed; would all the potential soil sources identified within that Plume Group need to be remedied under the approach? An easier method of evaluating the data may be to evaluate each plume on its own merit, or on a smaller, more localized scale than is presented in Attachment 1. Per U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9283.1-42 (February 2014), multiple discrete plumes may be present at a site due to releases from individual sources, and OSWER recommends that each plume be evaluated individually for a unique exposure point concentration (EPC). For sites that have comingled plumes from multiple sources and/or separate and	Comment acknowledged. As is stated in Draft RI WP, any potential Plume Group configurations will be based on data collected during the pending field investigation and provided for OHARNG and OEPA review and concurrence prior to submittal of the Draft FWGW RI Report. The use of plume groups to date has been to support an initial review of contaminant nature and extent, rather than selection of specific monitoring wells for sampling during the RI. Regardless of the level of implementation of a grouping strategy, the referenced OSWER publication will be used as a primary guidance document for development of EPCs.

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		distinct plumes that may comingle under stress conditions, the aggregate risk needs to be evaluated based on the consideration of the combined effects, when appropriate, from each contaminant present.	
2	**General Risk Assessment Comments**	Section 1.7 Background Study: A reminder that the calculated site-specific background levels should be compared to the maximum concentrations of COPCs detected on-site in the screening step of the risk assessment process (Ohio EPA Technical Decision Compendium, 21 August 2009).	Comment acknowledged.
3	**General Risk Assessment Comments**	Section 1.7.3.1.3: Duplicates, states, "…for comparable samples, the primary results (not the duplicate sample results) will be used in the statistical analysis". While this approach is consistent with the SAP, this approach was to be modified for future submittals for review. Duplicates should be treated as real data and thus included in the statistical analysis. Section 1.7.3.1.3 also states, "…if a pair of duplicate analyses is not comparable, they will be treated as possible outliers and subject to audits". In this case it might also be an appropriate response to resample.	Section 1.7.3.1.3 has been revised as follows (revised text in italics): For comparable samples, the *lower of the duplicate and* primary result ~~(not the duplicate sample result)~~ will be used in the statistical analysis
4	**General Risk Assessment Comments**	Section 1.8 and Figure 1-19: Conceptual Site Model for RVAAP-66 Facility-Wide Groundwater: The CSM is for the entire facility-wide ground water. However, every AOC/MRS/CRS site CSM will not have the same exposure routes and pathways; for example, ODA#2 has the ground water to surface water pathway, and sites with volatile and toxic VOCs and SVOCs will have the vapor intrusion pathway. And while Table 1-3 does provide some key conceptual site model inputs for each of the AOC/CRS?MRS sites, its purpose is more to identify further sampling needs or data evaluation and does not identify receptors and pathways. Therefore, each	Figure 1-19 has been revised to indicate exposure pathways complete based on AOC/MRS/CRS sites as applicable.

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		AOC/MRS/CRS should have its own CSM in order to better understand the receptors and pathways specific for that site.	
5	**General Risk Assessment Comments**	Section 2.0: Project Description states the primary objectives of the FWGW RI are to collect sufficient data to define the nature and extent of contaminants, to allow the completion of a baseline risk assessment, and to support the eventual execution of a Feasibility Study. The section is silent on whether these objectives will extend to collecting additional soil data should said data be needed to identify a previously unidentified soil source area to aid in fulfilling the primary objectives. Could additional soil sampling, if needed, be completed within this report/under this contract, or would it be completed under separate cover?	The following text has been added to the end of the last paragraph of Section 2.1 Work Plan Approach, Page 2-2, Line 19: *Evaluation of historical soil data, identification of data gaps, and collection of soil samples is outside of the scope of the FWGW RI. The FWGW RI is limited to characterization of groundwater only.*
6	**General Risk Assessment Comments**	Section 3.7, Page 3-7, lines 20-22 states, "Exposure Point Concentrations (EPCs) to be used for the baseline risk assessment will be based on monitoring wells within contiguous plume extents for comingled COPCs associated with multiple individual source areas". Keep in mind per U.S. EPA OSWER Directive 9283.1-42 (February 2014), data used in EPC calculations are most informative if from the core of the plume, and if the ground water CSM has identified a seasonal or other temporal influence on contaminant concentrations, OSWER recommends using data collected during times of higher detected concentrations in the EPC calculation. Therefore, in regards to EPCs, it is not enough that the wells are within the contiguous plume extent, but in the known core of the plume and samples taken during the season or time of highest concentrations.	Comment acknowledged. As previously stated, the referenced OSWER guidance document is currently intended to be the primary reference for determining groundwater EPCs.
7	**General Risk Assessment Comments**	Section 3.9.2: Screening Level Ecological Risk Assessment, Page 3-12, lines 15-23: The section outlines COPC refinement to be performed if ground water concentrations exceed screening levels. Another item to add to the list for use is the Facility-Wide Biological and Water Quality Study 2003	Bullets listed in Section 3.9.2 Screening Level Risk Assessment, Page 3-12, lines 17-23 have been revised to include the Facility-Wide Biological and Water Quality Study 2003 Ravenna Army Ammunition Plant (November 2005).

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		Ravenna Army Ammunition Plant (November 2005).	
8	**General Risk Assessment Comments**	Appendix C Figures. It would be helpful if the figures identified the soil sample with COPCs concentrations above leaching criteria to aid with well/sample placements.	Currently plotted soil samples indicated with a potential contaminant leaching potential to groundwater were obtained from historically completed AOC-specific RI actions. Mapped concentrations for the evaluation of contaminant nature and extent in soil and relative positioning with respect groundwater monitoring wells have been previously provided in AOC-specific documents. No revisions to the RI Work Plan will be conducted in response to this comment.
9	**General Risk Assessment Comments**	Section 7.0: Screening Levels. Include MCLs in the list of Human Health Screening levels.	Comment has been addressed as requested.
10	**General Risk Assessment Comments**	Section 7.0: Screening Levels. A comparison is needed between the facility-wide clean-up goal (FWCUGs) and the MCLs/Tap Water RSLs as was done with Soil FWCUGs to determine whether the FWCUGs are still relevant, or require revision.	Comparison of the FWCUGs with respect to current EPA Tapwater RSLs indicates the CUGs will require revision in order to be used in COPC screening. Section 7.0 has been revised to remove use of the FWCUGs for groundwater contaminant screening.
11	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Load Line 5 (Figure C-14)** a. Include LL5mw-001 in the 2016 FWGW Monitoring Program sampling, because the well is identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results, or provide justification explaining why they can be excluded from the sampling effort; b. Add VOCs to analytes list (Table 3-3) to evaluate potential VOC migration from LL 10 in the Homewood aquifer (ground water flow appears to be toward LL5); and c. Add SVOCs and metals to analytes list (Table 3-3), because the RI/FS predicted benzo(b)fluoranthene and	**LL5** a. See New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list. b. VOCs have been added to the Table 3-3 analyte list as requested. c. Review of historical well placement and groundwater sampling results for LL5 monitoring wells with respect to the suspected SVOC source area is indicates Benzo(b)fluoranthene

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		selenium were predicted to exceed screening criteria in the ground water beneath the source area. Also, ensure well placement is appropriate to evaluate the potential leaching pathway from the source area.	was not reported above MDLs in groundwater samples collected to date. LL5mw-003 and LL5mw-004 are installed within the maximum concentration identified areas in soil. Unconsolidated matrix in the vadose zone are likely inhibiting downward migration of COPCs to groundwater. No changes to the RI sampling plan have been made in response to this comment.
12	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Load Line 10 (Figure C-14)** a. Include LL10mw-002, LL10mw-004, and LL10mw-006 in the 2016 FWGW Monitoring Program sampling, or provide justification explaining why they can be excluded from the sampling effort, because the wells are identified as having either one or more non-metal COPCs above screening levels and/or one or more site COPC maximum results; b. Monitoring wells should be installed between LL5 and LL10 in the Homewood aquifer to evaluate potential migration/extent of ground water COPCs from LL 10 to LL 5; c. Add SVOCs to the analytes list (Table 3-3) for all wells because the RI/FS identified naphthalene, methylnaphthalene, and dibenzofuran were predicted to exceed screening criteria in the ground water beneath	**LL10** a. Response pending, see New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list. b. Based on the age of the presumed initial release of contaminants at LL10 and LL5, the historical data sets for these wells are considered adequate to have established delineation of contaminants in this portion of the post. It is recommended that the need for installation of additional characterization wells to support the pending BRA be reviewed after groundwater conditions have been updated by sampling during the RI. The relative stability of the groundwater plume (and the potential need for additional delineation wells) will be evaluated based on a statistical concentration trend analysis of the comprehensive data set for these wells, including results for sampled collected during the RI. c. Review of current well placement with respect to the suspected source area and historical SVOC sampling results for LL10 monitoring wells indicates naphthalene, dibenzofuran, and 2-methylnaphthalene were not reported above MDLs in groundwater samples collected to date. LL10 monitoring wells are located within specific areas identified with potential soil-to-groundwater contaminant leaching issues. No changes to the RI sampling plan have been made in

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		the source area; and d. Add the vapor intrusion pathway as a key CSM input (Table 1-3), because Table 3-3 identifies VOCs as a sampling analyte.	response to this comment. . d. The vapor intrusion pathway has been included on Figure 1-19 for all sites with currently existing surface structures potentially impacted by VOCs in groundwater and for locations with surface structures potentially impacted in the future from plume migration or through new construction.
13	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Load Line 9 (Figure C-14)** a. Include LL9mw-005 in the 2016 FWGW Monitoring Program sampling to aid in evaluating the potential migration of COPCs from LL9mw-003/extent of ground water COPCs (or install a well in between these two wells); b. Add SVOCs to the analyte list (Table 3-3), because naphthalene was predicted to exceed screening criteria in the ground water beneath the source area and exceed its criteria at the down-gradient receptor location; c. Add metals to the analyte list (Table 3-3), because arsenic, cobalt, manganese, and mercury were predicted to exceed screening criteria in the ground water beneath the source area; and d. Add the vapor intrusion pathway as a key CSM input (Table 1-3), because of the potential for naphthalene in ground water.	**LL9** a. LL9mw-005 has been added to the RI sampling program. b. SVOCs have been added to the testing suite for LL9. c. Evaluation of the nature and extent of metals contamination will be deferred pending Ohio EPA concurrence on the pending background study. d. The vapor intrusion pathway has been included on Figure 1-19 for all sites with currently existing surface structures potentially impacted by VOCs in groundwater and for locations with surface structures potentially impacted in the future from plume migration or through new construction.

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14	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Load Line 3 (Figure C-5)** a. Include LL3mw-235 and LL3mw-237 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because these wells are identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results; and b. Add the vapor intrusion pathway as a key CSM input (Table 1-3), because the sampling effort includes VOCs.	**LL3** a. See New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list. b. The vapor intrusion pathway has been included on Figure 1-19 for all sites with currently existing surface structures potentially impacted by VOCs in groundwater and for locations with surface structures potentially impacted in the future from plume migration or through new construction.
15	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Load Line 12 (Figure C-7)** a. Include any wells in the 2016 FWGW Monitoring Program sampling that are identified as still having one or more non-metal COPCs above screening levels or provide justification explaining why they can be excluded from the sampling effort; and b. RVAAP-18 LL 12 Pink Waste Water Treatment area wells are not included in the 2016 FWGW Monitoring Program (Table 3-3). According to the labeling on Figure C-7, some wells in RVAAP-18 still had one or more non-metal COPCs above screening levels. Will RVAAP-18 LL 12 Pink Waste Water Treatment area be sampled with the LL12 investigation or separately?	**LL12** a. See New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list. b. Investigation of the LL12 Pink Waste Water Treatment Area will be conducted as part of the greater LL12 AOC.
16	**Risk Assessment Comments: AOC-Specific Evaluations**	**Load Line 6 (Figure C-17)** a. Include wells LL6mw-001, LL6mw-003, LL6mw-004, and LL6mw-006 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort,	LL6 a. See New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list.

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	(Appendix C)	because these wells are identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results; and b. Install well(s) down-gradient of LL6mw-006 or sample LL6mw-007 in the unconsolidated aquifer to evaluate potential COPC migration.	b. LL6mw-007 is included in the proposed RI sampling set.
17	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Buildings F-15 and F-16 (Figure C-23)** a. No wells are currently at or proposed for the Buildings F-15 and F-16 AOC (Figure C-23 and Table 3-3). As indicated in the summary table in Appendix C, facility-wide coal storage areas represent a potential ground water data gap area. The Draft Remedial Investigation Report for Soil, Sediment, and Surface Water at RVAAP-46 Buildings F-15 and F-16 (November 23, 2011) indicated the need for ground water sampling, because "The maximum predicted concentrations of all final CMCOPCs (naphthalene at Building F-15 and naphthalene, nitroglycerin, and selenium at Building F-16) were predicted to exceed the screening criteria in the ground water beneath the source areas". Install wells at the Buildings F-15 and F-16 AOC to include the area in the 2016 FWGW Monitoring Program sampling.	**Buildings F-15 and F-16** Although the SESOIL modeling referenced in the comment indicates a potential for future leaching of selenium (Building F16 only), naphthalene (at both Buildings F15 and F16) and nitroglycerin (Building F16 only) into groundwater at concentrations above current regulatory screening levels, vertical delineation of naphthalene and selenium was accomplished during the Soil RI at Building F15 and/or F16. Vertical delineation of these constituents was reported to non-detectable or background concentrations within samples collected from the vadose zone, with the exception of one discreet sample location at Building F16 . A concentration of 0.0078 mg/kg was reported for naphthalene at a depth of 7-13 ft bgs, sample location F16sb-021. Nitroglycerin was not tested in vertical delineation samples at Building F16. Based on these reported vertical delineation sampling results and the conclusion of the Soil RI that, "SRCs found in the surface soil and subsurface soil samples and evaluated through the stepwise fate and transport screening evaluation presented here are eliminated as posing future impacts to groundwater.", no investigation of groundwater at these sites is planned for the RI.
18	**Risk Assessment Comments:**	**CC RVAAP-79, CC RVAAP-80 and CC RVAAP-51 (Figure C-6)** a. Table 1-3 states, "…additional review of historical	**CC RVAAP-79, CC RVAAP-80 and RVAAP-51** Review of the historical sampling record for monitoring wells in

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	AOC-Specific Evaluations (Appendix C)	down-gradient sampling results for these areas is necessary to determine the potential impacts from these sites". However, appears from Figure C-6 there are currently no immediate down-gradient wells between these three areas and Sand Creek. Install well(s) to investigate the potential migration of COPCs and add ecological receptors/pathways as a key input to the CSM (Table 1-3).	proximity to these sites (FWGmw-001 with respect to CC RVAAP-80 and RVAAP-51, BKGmw-004 and SCRmw-006 with respect to CC RVAAP-79) indicates no detections of site related non-metals soil COPCs in groundwater. No investigation of groundwater associated with these sites is planned for the RI.
19	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**Central Burn Pits (Figure C-9) (Figure C-15)** a. Add wells CBPmw-008 and CBPmw-009 (Table 3-3) to Figure C-9; and b. Include wells CBPmw-004, CBPmw-005, and CBPmw-006 in the 2016 FWGW Monitoring Program sampling or provide justification explaining why they can be excluded from the sampling effort, because these wells are identified as having one or more non-metal COPCs above screening levels and one or more site COPC maximum results, and install down-gradient wells to evaluate potential migration of COPCs, as needed.	**Central Burn Pits** a. Comment will be addressed as requested. b. See New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list.
20	**Risk Assessment Comments: AOC-Specific Evaluations (Appendix C)**	**ODA#2** a. Include DA2mw-105, DA2mw-106, DA2mw-107, DA2mw-111, DA2mw-110, DA2mw-013, DA2mw-112, and DA2mw-113 in the 2016 FWGW Monitoring Program sampling, because these wells are identified as having one or more non-metal COPCs above screening levels and/or one or more site COPC maximum results, or provide justification explaining why they can be excluded from the sampling effort; and b. Section 1.8.4.2: Ecological Receptors and Exposure Routes states "the upper portion of the Sharon	**ODA#2** a. See New Groundwater Comment No. 6 above regarding adding wells to the RI sampling list. b. The currently proposed sampling program includes sampling of monitoring wells (DET-3, DET-4 and DA2mw-115) directly

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		Formation has been found to be in direct communication with surface water at Sand Creek in the vicinity of Open Demolition Area #2." Include in sampling/install well(s) as needed to investigate the potential migration of COPCs from ODA#2 to Sand Creek and add ecological receptors/pathways as a key input to the CSM (Table 1-3).	adjacent to Sand Creek. Ecological receptors have been indicated as CSM inputs for ODA#2 on Figure 1-19.

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Well ID	RI COPC Characterization Wells	AOC Delineation Wells	2016 FWGWMP Wells	Comments
ASYmw-001				Draft RI WP well dropped based on DEHP indicated to be a lab contaminant based on detection level and site history
ASYmw-004	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only
ASYmw-005	X			
ASYmw-006				Draft RI WP well dropped based on BEHP indicated to be a lab contaminant based on detection level and site history
ASYmw-010		X		
B12mw-011		X		
B12mw-012	X			
BKGmw-004		X		
BKGmw-008		X		
BKGmw-010				Draft RI WP well dropped based on additional review of historical data set WRT non-metals COPCs and groundwater direction of flow
BKGmw-021	X			
CBLmw-001	X			Added to RI sampling based on OEPA comments on Draft RI
CBLmw-002		X		
CBLmw-003		X		
CBLmw-004	X			
CBPmw-001	X			
CBPmw-002	X			
CBPmw-004	X			Added to RI sampling based on OEPA comments on Draft RI
CBPmw-006	X			Added to RI sampling based on OEPA comments on Draft RI; DEHP and cyanide only
CBPmw-008		X		
CBPmw-009	X			
DA2mw-104	X			
DA2mw-105	X			Added to RI sampling based on OEPA comments on Draft RI; 2,6-DNT only
DA2mw-108	X			Added to RI sampling based on OEPA comments on Draft RI; nitroglycerin only
DA2mw-115			X	
DET-3			X	
DET-4	X		X	
EBGmw-123	X			
EBGmw-125	X			
EBGmw-126	X			
EBGmw-128	X			
EBGmw-129				Draft RI WP well dropped based on additional review of historical data set WRT non-metals COPCs and groundwater direction of flow
EBGmw-131		X		
FBQmw-166	X			Includes confirmation of DEHP
FBQmw-167		X		

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FBQmw-168	X			
FBQmw-171	X			Added to RI sampling based on OEPA comments on Draft RI
FBQmw-172	X			Added to RI sampling based on OEPA comments on Draft RI
FBQmw-173	X			Added to RI sampling based on OEPA comments on Draft RI
FBQmw-174	X		X	
FBQmw-175	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only
FBQmw-176		X		Includes confirmation of DEHP
FWGmw-002	X		X	
FWGmw-004			X	
FWGmw-006				Draft RI WP well dropped based on additional review of historical data set WRT non-metals COPCs and distance to any known source areas
FWGmw-007			X	
FWGmw-010		X		
FWGmw-011			X	
FWGmw-012			X	
FWGmw-013		X		
FWGmw-015			X	
FWGmw-016			X	
L10mw-001	X			
L10mw-003	X		X	
L10mw-006	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only
L12mw-107	X			Added to RI sampling based on OEPA comments on Draft RI
L12mw-153	X			Added to RI sampling based on OEPA comments on Draft RI; DEHP only
L12mw-154	X			
L12mw-182	X			
L12mw-183	X			Added to RI sampling based on OEPA comments on Draft RI; DEHP only
L12mw-185			X	
L12mw-186	X			Added to RI sampling based on OEPA comments on Draft RI
L12mw-187	X		X	
L12mw-188	X			Added to RI sampling based on OEPA comments on Draft RI; nitrobenzene only
L12mw-189	X			Added to RI sampling based on OEPA comments on Draft RI
L12mw-242			X	
L12mw-243	X			Added to RI sampling based on OEPA comments on Draft RI
L12mw-244	X			Added to RI sampling based on OEPA comments on Draft RI; benzene only
L12mw-245	X		X	
L12mw-246				Draft RI WP well dropped based on > 4 event ND trend
L12mw-247			X	

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LL11mw-001	X			Added to RI sampling based on OEPA comments on Draft RI; DEHP only
LL11mw-002		X		
LL11mw-003		X		
LL11mw-005		X		
LL11mw-006	X			
LL11mw-010	X			Added to RI sampling based on OEPA comments on Draft RI
LL1mw-063	X			
LL1mw-064	X		X	
LL1mw-065			X	
LL1mw-067				Draft RI WP well Dropped based on ProUCL results
LL1mw-078				Draft RI WP well dropped based on ProUCL results
LL1mw-080	X			Added to RI sampling based on OEPA comments on Draft RI
LL1mw-081	X			Added to RI sampling based on OEPA comments on Draft RI
LL1mw-083	X		X	
LL1mw-084	X		X	
LL1mw-086	X		X	
LL1mw-087			X	
LL1mw-088			X	
LL2mw-059	X		X	
LL2mw-060			X	
LL2mw-261		X		
LL2mw-262				Draft RI WP well dropped based on > 4 event ND trend
LL2mw-266				Draft RI WP well dropped based on > 4 event ND trend
LL2mw-267	X		X	
LL2mw-268	X			Added to RI sampling based on OEPA comments on Draft RI; benzene only
LL2mw-270	X			
LL2mw-271			X	
LL3mw-234	X			
LL3mw-236	X			
LL3mw-237	X			Added to RI sampling based on OEPA comments on Draft RI
LL3mw-238	X		X	
LL3mw-239	X			Added to RI sampling based on OEPA comments on Draft RI; RDX only
LL3mw-241	X		X	
LL3mw-243	X			Added to RI sampling based on OEPA comments on Draft RI
LL3mw-244	X		X	
LL3mw-246			X	
LL4mw-193	X			
LL4mw-194		X		
LL4mw-197	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only

Summary Of Proposed FWGW RI Groundwater Monitoring Wells
Camp Ravenna
June 2016

Well ID	RI COPC Characterization Wells	AOC Delineation Wells	2016 FWGWMP Wells	Comments
LL4mw-199				Draft RI WP well dropped based on > 4 event ND trend
LL4mw-200		X		
LL4mw-201	X			
LL5mw-001	X			Added to RI sampling based on OEPA comments on Draft RI; PCBs only
LL5mw-002	X			
LL5mw-006		X		
LL6mw-001	X			Added to RI sampling based on OEPA comments on Draft RI; DEHP and cyanide only
LL6mw-002		X		
LL6mw-003	X			Added to RI sampling based on OEPA comments on Draft RI
LL6mw-006	X			Added to RI sampling based on OEPA comments on Draft RI
LL6mw-007		X		
LL6mw-008		X		
LL7mw-001	X		X	
LL7mw-005	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only
LL7mw-006	X			
LL8mw-001	X			
LL9mw-003	X			
LL9mw-004		X		
LL9mw-005		X		Added to RI sampling based on OEPA comments on Draft RI
LL9mw-007	X			
LNWmw-025	X			
LNWmw-026	X			
MBSmw-004	X			
MBSmw-006	X			
NTAmw-109	X			Added to RI sampling based on OEPA comments on Draft RI; PCBs only
NTAmw-113	X			
NTAmw-115	X			Added to RI sampling based on OEPA comments on Draft RI
NTAmw-116	X			
NTAmw-118	X			Added to RI sampling based on OEPA comments on Draft RI
NTAmw-119	X		X	
RQLmw-007	X		X	
RQLmw-008			X	
RQLmw-009	X		X	
RQLmw-011	X		X	
RQLmw-012	X		X	
RQLmw-013			X	
RQLmw-014	X			Added to RI sampling based on OEPA comments on Draft RI; 2-nitrotoluene only
RQLmw-015	X			Added to RI sampling based on OEPA comments on Draft RI; PCBs only

Summary Of Proposed FWGW RI Groundwater Monitoring Wells
Camp Ravenna
June 2016

Well ID	RI COPC Characterization Wells	AOC Delineation Wells	2016 FWGWMP Wells	Comments
RQLmw-016	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only
RQLmw-017	X			Added to RI sampling based on OEPA comments on Draft RI; PCBs only
SCFmw-001		X		Added to RI sampling to confirm current conditions underling FBQ, LL5 through LL10 area
SCFmw-002			X	
SCFmw-003		X		
SCFmw-004			X	
SCFmw-006		X		
ULCPmw-001	X			Added to RI sampling based on OEPA comments on Draft RI; 2,6-DNT only
ULCPmw-003	X			Added to RI sampling based on OEPA comments on Draft RI; cyanide only
ULCPmw-006	X			Added to RI sampling based on OEPA comments on Draft RI; naphthalene only
OBG-1	X			Added to RI sampling based on OEPA comments on Draft RI
OBG-4	X			Added to RI sampling based on OEPA comments on Draft RI; 3-nitrotoluene only
WBGmw-005				Draft RI WP well dropped due to > 4 event ND trend
WBGmw-006	X		X	
WBGmw-007	X			Added to RI sampling based on OEPA comments on Draft RI
WBGmw-009	X		X	
WBGmw-014	X			Added to RI sampling based on OEPA comments on Draft RI; 2-nitrotoluene only
WBGmw-015				Draft RI WP well dropped due to > 4 event ND trend and addition of OBG-1
WBGmw-018	X			Added to RI sampling based on OEPA comments on Draft RI
WBGmw-019		X		
WBGmw-020			X	
WBGmw-021	X		X	

TABLES

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Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
C-1	Erie Burning Grounds, RVAAP-002-R-01, RVAAP-02	<u>MRS site description (RVAAP-002-R-01)</u>: From 1941 to 1951, bulk, obsolete, off-spec propellants, conventional explosives, rags, and large explosive contaminated items were thermally treated by open burning on the ground surface. A Final RI Report was accepted by OEPA 22 September 2015. A FS was recommended to deal with munitions constituents (MC) and munitions and explosives of concern (MEC). The MRS is collocated with an IRP AOC (RVAAP-02) and is 33.9 acres. <u>IRP site description (RVAAP-02)</u>: The water table at EBG is typically less than 10 ft. Groundwater flow is from north to south across the AOC, consistent with surface drainage patterns. A high degree of interaction exists between groundwater and surface water. Results of slug tests performed during a Phase II RI reveal moderately high horizontal hydraulic conductivities in the unconsolidated material underlying the EBG. <u>Unconsolidated Aquifer</u> Additional review of site-specific groundwater flow dynamics in the Unconsolidated Aquifer with respect to the potentiometric low at EBGmw-125 and to surface water; Potentiometric surface elevation contours generated from the most recent groundwater gauging measurements indicate water table flow in the unconsolidated aquifer is influenced by wetlands and stream features in the center of the site. <u>Upper Sharon Sandstone Aquifer</u> Vertical delineation of non-metals COPCs in the Unconsolidated Aquifer is apparently provided by EBGmw-131 installed in the Sharon SS/Cong. <u>DGA-EBG(A) and DGA-EBG(B)</u> • Unconsolidated Aquifer 1. Several EBG wells historically identified with SRCs above current screening levels have not been sampled within the last three years+. Current groundwater conditions in these wells will need to be characterized to support the BRA. 2. Review of historical COPC concentration levels and distribution indicates no SRCs are present at EBGmw-127 at levels requiring additional assessment. The need for additional sampling of EBGmw-127 will be based on results for centerline wells planned for updating during the RI.
C-2	Load Line 1 (LL1)/RVAAP-08, RVAAP-008-R-01,	<u>IRP site description (RVAAP-08)</u>: Load Line 1 was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
	CC RVAAP-73, CC RVAAP-79, RVAAP-31	equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond, known as Criggy's Pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in some instances. MRS site description (RVAAP-008-R-01): The load line also was used for the demilitarization of projectiles and the production and reconditioning of anti-tank mines from 1973 -1974. RVAAP-008-R-01 is an area at the northern end of LL1 where propellants were historically identified. The principle sources of MEC at LL1 MRS were reported to be accidental releases during the loading of munitions during World War II and the Korean War. CRS site descriptions (CC RVAAP-73, CC RVAAP-79/RVAAP-31): CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. CC RVAAP-79/RVAAP-31: Various ores were historically stored (stock-piled) in ASTs for the General Services Administration (GSA). The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils. Unconsolidated Aquifer Historical sampling results indicate LL1mw-088 provides down-gradient delineation of nitroglycerin at mw-086. Pesticide concentration at LL1mw-088 is consistent with prescribed use (i.e., not indicative of a CERCLA regulated release). Measured pH values at LL1mw-086 have been reported outside of the naturally occurring range expected for groundwater. DGA-LL1B The historical dataset indicates the presence of perchlorate in groundwater above MDLs but below screening levels in recent sample results at LL1mw-087 (January 2013). Additional sampling of LL1mw-087 is necessary to monitor groundwater conditions migrating off-post to the southeast.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		Upper Sharon Sandstone Aquifer Ramsdell Quarry Landfill (RQL) wells to the northeast will be evaluated for impact from LL1 COPCs. Measured pH values at LL1mw-083, LL1mw-084, and LL1mw-086 have been reported outside of the naturally occurring range expected for groundwater. DGA-LL1A Additional characterization of groundwater required to determine COPCs potentially present to the east of the central load line area will be accomplished through installation of a new monitoring well. Basal Sharon Conglomerate Aquifer Vertical delineation of non-metals COPCs in the downgradient direction of LL1 is provided to the south-southeast by SCFmw-004.
C-3	Ramsdell Quarry Landfill (RQL)/ RVAAP-01, RVAAP-001-R-01	IRP site description (RVAAP-01): Unlined landfill in former quarry excavated to the underlying Sharon Sandstone/Conglomerate. A pool of water is intermittently present at the bottom of the quarry at approximately 10.7 meters (35 ft) below ground surface (bgs). This landfill was used from 1941 to 1989. During the period of 1946 to 1950 the site was used as a land-surface burning site to thermally destroy waste explosives from Load Line 1 and napalm bombs. Dioxins and furans are not suspected to be present at the RQL site as a result of the historical napalm open burn activities (NGB, 2016). From 1976 to 1989, a portion of the site was used strictly as a nonhazardous solid waste landfill. No historical information has been located for 1950 to 1976. The landfill ceased operation in September 1989. Closure of the landfill was completed in May 1990 under state of Ohio solid waste regulations. Land Use Controls (LUCs) are in place including fencing to restrict exposure. Site is included in the RVAAP Five Year Review process. MRS site description (RVAAP-001-R-01): The MRS is comprised of two separate areas: a northern area where OB/OD operations were conducted in a former quarry, and a southern area that contains a small inactive quarry and wooded area where installation personnel had found munitions debris. The northern quarry area is collocated with an IRP AOC (RVAAP-01). Munition debris was identified as part of the field investigation of the IRP site. There are two sites Area one and Area two. Area one is the actual quarry, Area two is south of the railroad tracks. Area one is recommended for NFA. Area two is recommended for a FS to be conducted. Unconsolidated Aquifer Saturated unconsolidated matrix materials have not been characterized to date for potential impact from RVAAP-01/RVAAP-01-R. Based on

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		documented historical contaminant release characteristics, groundwater impact from these source areas is limited to the Upper Sharon Sandstone Aquifer. Upper Sharon Sandstone Aquifer Continued sampling is required to monitor groundwater COPC conditions migrating down-gradient to the northeast. Horizontal delineation is provided by FWGmw-012 to the east; however FWGmw-012 has historically been designated as a Sharon Shale well. The actual monitored formation and suitability of this well to provided horizontal delineation of the COPCs in the Upper Sharon formation will be further evaluated during the RI. Measured pH values at RQLmw-011, RQLmw-012, and RQLmw-013 have been reported outside of the naturally occurring range expected for groundwater. Basal Sharon Conglomerate Vertical delineation of non-metals site COPCs is provided to the northeast by SCFmw-005.
C-4	Load Line 2 (LL2)/ RVAAP-09, CC RVAAP-68, CC RVAAP-73	IRP site description (RVAAP-09): Load Line 2 (RVAAP-09) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in some instances. The settling pond, known as Kelley's Pond, was an unlined triangular-shaped pond approximately one acre in size with an average depth of four feet. Water from the impoundment discharged to a stream that ultimately exited the installation. CRS site description (CC RVAAP-68, CC RVAAP-73): Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. The East Substation is located close to the intersection of Remalia Road and Load Line No. 2 Road. The substation comprises an area of approximately 12,300 square ft, which includes the land surrounding Building 25-27. There are no documented releases. However, stained concrete was noted in the building during the historical records review. Target analytes noted in the Historical Records Review (HRR) included Target Analyte List (TAL)

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		metals, PCBs, and SVOCs. <u>Unconsolidated Aquifer</u> Saturated unconsolidated matrix materials have not been characterized to date for potential impact from RVAAP-09. Based on documented historical contaminant release characteristics, groundwater impact from LL2 source areas is limited to the Upper Sharon Sandstone Aquifer... <u>Upper Sharon Sandstone Aquifer</u> A potentiometric rise in the center of LL2 results in radial flow in the Upper Sharon. Horizontal delineation of non-metals COPCs is provided to current screening levels by LL2mw-271 and LL2mw-060 to the southeast; however, reported concentrations are above laboratory MDLs. <u>Basal Sharon Conglomerate</u> The historical dataset indicates the presence of potential SRCs in groundwater above MDLs but below screening levels in the most recent sample results at SCFmw-003. <u>DGA-LL2(A)</u> • Upper Sharon Sandstone Aquifer 1. A horizontal delineation gap is present to the southwest of LL2mw-267. 2. Basal Sharon Conglomerate 3. A vertical delineation gap is present to the south-southwest of LL2mw-267. <u>DGA-LL2(B)</u> • Upper Sharon Sandstone Aquifer 1. Additional review of historical/pending RI sampling COPC concentrations at LL2mw-270 and evaluation of area hydrogeology (e.g., the potential for discharge of site contaminants to surface water) will be conducted to determine the need for additional characterization to the northwest of LL2. DGA-LL2(C) • Upper Sharon Sandstone Aquifer 1. A horizontal and vertical delineation gap is present south-southeast of LL2mw-059.
C-5	Load Line 3 (LL3)/ RVAAP-10,	<u>IRP sites description (RVAAP-10)</u>: Load Line 3 (RVAAP-10) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
	RVAAP-063, CC RVAAP-79	water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in some instances. Water from the impoundment discharged to a stream that flowed in a northerly direction and ultimately discharged into RVAAP-29 Cobbs Pond. Predominant groundwater flow direction is to the east. Site-specific assessment/investigation for the presence of residual contamination associated with historical site uses has not been conducted for RVAAP-063. <u>CRS site description (CC-RVAAP-079)</u>: Various ores were historically stored (stock-piled) in ASTs for the GSA. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils. <u>Unconsolidated Aquifer</u> Saturated unconsolidated matrix materials have not been characterized to date for potential impact from RVAAP-10/CC-RVAAP-79. Based on the documented historical contaminant release characteristics, groundwater impact from these source areas is limited to the Upper Sharon Sandstone Aquifer. Groundwater conditions associated with Unconsolidated Aquifer wells visible in the western portion of Map C-5 are discussed with review of conditions on Maps C-7 and C-8. <u>Upper Sharon Sandstone Aquifer</u> A statistics-based evaluation of historical COPC concentration trends for LL3mw-238 and LL3mw-241 indicates stable to declining COPC concentrations with a low potential for contamination to have migrated downgradient such that current concentrations between these wells and the proposed location of FWG-SS/C3 are at levels higher than at LL3mw-241. Horizontal delineation of LL3 groundwater contaminants is provided to current screening levels by LL3mw-246 to the south; however, reported concentrations are above laboratory MDLs. <u>DGA-LL3(A)</u> • Upper Sharon Sandstone Aquifer 1. A horizontal delineation gap is potentially present to the southwest of LL3mw-241 to the west of LL3mw-246.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		DGA-LL3(B) • Upper Sharon Sandstone Aquifer 1. Review of historical sampling results and site hydrogeology is necessary to determine why LL3mw-246 has not exhibited non-metals constituents above current screening levels while the same does not apply for LL3mw-244 (adjacent to the northeast).
C-6	Building 1200/ RVAAP-13, CC RVAAP-79, CC RVAAP-80, RVAAP-51	IRP site description (RVAAP-13, RVAAP-51): From approximately 1941 to 1971, ammunition was demilitarized by steaming out munitions rounds at building 1200 (RVAAP-13). The steam decontamination generated pink water, which drained to a man-made ditch. The ditch discharged into a 0.5-acre sedimentation pond, and the overflow from this pond discharged into Sand Creek. The site buildings have been demolished and all foundations and footings were removed. CRS site description (CC RVAAP-79, CC RVAAP-80): Site is also identified with the DLA Ore Storage Area 2 (Ammunition Storage Area) and the Group 2 Propellant Can Tops (CC RVAAP-80). CC RVAAP-80 consists of approximately 539,572 square feet (12.4 acres). Propellant can tops were identified at the ground surface at the southern end of the former Group 2 Ammunition Storage Area. The area is addressed by CC RVAAP-80. The tops were observed by OHARNG trainees in fall 2008 in the vegetative area located immediately south of the ammunition storage magazines near the railroad spur lines. As a result, the Louisville District USACE performed an initial geophysical survey of the southern area ground surface. Results of the initial investigation revealed multiple magnetic anomalies in the surface and near surface soils. On-site UXO personnel visually identified the surface anomalies as propellant can lids or tops. CC RVAAP-79 is associated with storage of various ores historically stored (stock-piled) in ASTs for the GSA. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils Upper Sharon Sandstone Aquifer, Basal Sharon Conglomerate Aquifer, and Unconsolidated Aquifer Based on most recent groundwater results, there is no indication of non-metal COPCs requiring additional assessment at this AOC. Additional review of site hydrogeology is required to confirm direction of flow and the influence of surface water in this portion of post on contaminant fate and transport. Additional evaluation of historical groundwater sampling results for monitoring wells located downgradient of CC RVAAP-79, CC-RVAAP-80 and RVAAP-51 is necessary to determine the potential for impact from these sites.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		DGA-FWG(A) • Measured pH values at FWGmw-002 (Unconsolidated Aquifer) have been reported outside of the naturally occurring range expected for groundwater.
C-7	Load Line 12 (LL12)/ RVAAP-12, RVAAP-18, RVAAP-29, RVAAP-012-R-01 CC RVAAP-73	IRP site description (RVAAP-12, RVAAP-18, RVAAP-29): From 1941-1943 and 1946-1950, ammonium nitrate was produced at Load Line 12 (RVAAP-12). From 1949 to 1993, munitions were periodically demilitarized at this AOC. Building wash-down water and wastewater from the bomb melt out facility operations was collected in a house gutter system, and flowed through a piping system to two stainless steel tanks. The first tank was used for settling, and the second tank was used for filtration. Prior to the 1980s, the water leaked under the building and ponded there. Building wash-down water from Building F-904 was also swept out through doorways onto the ground surrounding the building. After 1981, the water was treated in the Load Line 12 wastewater treatment system, which discharged to an on-site pond then discharged to a receiving stream that ultimately entered into RVAAP-29, Cobbs Ponds. RVAAP-29 is comprised of approximately five acres (Upper Cobbs Pond) and four acres (Lower Cobbs Pond). The Upper and Lower Cobbs Ponds are unlined ponds that contain abundant fish and wildlife. A ponded area known as "a backwater area" is located south of Upper Cobbs Pond. This area, approximately one acre, was created by beaver activity and was not present during facility operations. The Upper and Lower Cobbs Ponds were used as sedimentation basins for Load Line 12 (RVAAP-12) and Load Line 3 (RVAAP10) wastewater effluent from 1941 to 1971 and storm water runoff. The COCs at this site include explosive compounds, nitrates, and heavy metals. Media of concern include soil, surface water, sediment, and groundwater. MRS site description (RVAAP-012-R-01): Site-specific assessment/investigation for the presence of residual contamination associated with historical site uses has not been conducted for RVAAP-012-R-01. CRS site description (CC RVAAP-73): Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>Preliminary CSM Inputs</th></tr>
<tr><td></td><td></td><td><u>Unconsolidated, Upper and Lower Sharon Aquifers</u>
Evaluation of the effect of the variable direction of groundwater flow in the Unconsolidated, Upper and Lower Sharon aquifers is required to determine the nature and extent of COPCs related to historical operations at LL12. The continued CSM development and results of groundwater modeling will be used to confirm the adequacy of currently existing Upper Sharon and Basal Sharon Conglomerate delineation wells to the southwest of LL12.

<u>DGA-LL3(A)</u>
• Unconsolidated Aquifer
1. Horizontal and vertical delineation gaps are present to the southeast of the LL12.</td></tr>
<tr><td>C-8</td><td>Upper and Lower Cobbs Ponds (ULCP), Central Burn Pits (CBP)/ RVAAP-29, RVAAP-49</td><td><u>IRP site description (RVAAP-29, RVAAP-49)</u>: RVAAP-29 is comprised of approximately five acres (Upper Cobbs Pond) and four acres (Lower Cobbs Pond). The Upper and Lower Cobbs Ponds are unlined ponds that contain abundant fish and wildlife. A ponded area known as "a backwater area" is located south of Upper Cobbs Pond. This area, approximately one acre, was created by beaver activity and was not present during facility operations. The Upper and Lower Cobbs Ponds were used as sedimentation basins for Load Line 12 (RVAAP-12) and Load Line 3 (RVAAP-10) wastewater effluent from 1941 to 1971 and storm water runoff. Waste types associated with this site include but are not limited to TNT, RDX, HMX, Composition B, lead, chromium, mercury, and aluminum chloride. Currently fishing at Cobbs Pond is catch and release only.

The CBP (RVAAP-49) is an approximately 20-acre AOC used early in RVAAP history as a construction yard by Cleveland Builders Supply. Multiple areas within the site were later used to burn non-explosive combustible scrap, and to dump construction/industrial waste. Sand Creek forms the west boundary of the AOC. There are several (approximately 15) debris piles located in the central portion of the site, and another near the western edge of the AOC.

<u>Unconsolidated Aquifer</u>
Evaluate the effect of area surface water on localized direction of flow in the Unconsolidated Aquifer. Low levels of historically documented impact at the Cobbs Ponds will be updated during RI.

<u>Upper Sharon Sandstone Aquifer</u>
Vertical delineation is generally provided by CBPmw-009, with the exception of bis (2-ethylhexyl)phthatlate (DEHP). The potential presence of DEHP as a SRC, rather than an introduced laboratory cross-contaminant,</td></tr>
</table>

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		will be evaluated during the RI. <u>Basal Sharon Conglomerate</u> No wells within AOC.
C-9	RVAAP 34/34R, RVAAP-034-R-01	IRP site description: RVAAP-34 was reported by former workers at RVAAP to have been an open dump for materials including, but not limited to, concrete, wood, asbestos debris, lab bottles, 55-gallon drums and fluorescent light tubes. Debris was disposed at the surface, but became covered by vegetation. The site is approximately 2.7 acres and located adjacent to Sand Creek. The dates of operation of this site are unknown, but believed to be between 1950 and 1960. This site used to carry the facility-wide non-groundwater LTM and programmatic support requirements. These requirements are now carried in Program Management and RVAAP-66. MMRP issues will be addressed separately under RVAAP-034-R-01. <u>MRS site description (RVAAP-034-R-01)</u>: The Sand Creek Dump is a munitions response site collated with an IRP site Sand Creek Disposal Road Landfill (RVAAP-34). The MRS portion of the site is 0.9 acres in size. This site was identified in the SI as a smaller area located within the IR site. There is no MC or MEC potential in the area. The site is planned for closure with NFA under the MMRP program. NFA.
C-10	Atlas Scrap Yard (ASY), RVAAP-50, RVAAP-050-R-01, CC RVAAP-73,	<u>IRP site description (RVAAP-50)</u>: In the 1940s, RVAAP-50 (Atlas Scrap Yard) contained a complex of buildings including barracks type housing that supported the principal construction and engineering company staff and included barracks type housing. After WWII, a majority of the Atlas building complex was demolished leaving the remaining portion of structures to support the installation roads and grounds maintenance staff and equipment as well as a large contingent of railroad maintenance personnel. The post WWII structures stood until after the Vietnam War at which point all remaining buildings were demolished and the site became a storage/stockpile yard for various types of bulk materials used in the day-to-day installation operations such as gravel, railroad ballast, sand, culvert pipe, railroad ties, and telephone poles. In the mid to late-1980s, the southeastern portion of the old Atlas area became a staging area for salvaged ammunition boxes from the demilitarization of defunct Vietnam War era munitions. <u>MRS site description (RVAAP-050-R-01)</u>: The Atlas Scrap Yard (RVAAP-050-R-01), which is collocated with IRP AOC RVAAP-50, consists of mostly open land that contains a network of roads. Originally used as a

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		construction camp, the site, which is 66 acres, was formerly used for scrap storage and currently consists of scattered piles of debris. <u>CRS site description (CC RVAAP-73)</u>: CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. <u>Unconsolidated Aquifer</u> Additional evaluation of the effect of the variable direction of groundwater flow in the Unconsolidated aquifer is required to determine the nature and extent of COPCs related to historical operations at the ASY. Additional sampling of ASYmw-010 to monitor groundwater COPC conditions migrating down-gradient to the west. <u>Upper Sharon Sandstone</u> Additional evaluation of the effect of the variable direction of groundwater flow in the Upper Sharon Sandstone is required to determine the nature and extent of COPCs related to historical operations at the ASY. Additional characterization of groundwater is required to determine COPCs in the central and eastern portions of the ASY. <u>Sharon Conglomerate</u> Additional evaluation of the effect of the variable direction of groundwater flow in the Sharon Conglomerate is required to determine the nature and extent of COPCs related to historical operations at the ASY potentially present at SCFmw-002. <u>DGA-ASY(A)</u> • Unconsolidated Aquifer 1. Evaluate potential contribution of contamination on the western edge of LL12 to the ASY groundwater plume. Determine if the absence of Unconsolidated Aquifer wells in the central part of the site (in the area of ASYmw-004) constitutes a data gap.
C-11	Load Line 4 (LL4)/ RVAAP-11, CC-RVAAP-73 (LL4 Powerhouse Coal Storage), CC RVAAP-79 (DLA Ore Storage Building 841	<u>IRP site description (RVAAP-11)</u>: Load Line 4 (RVAAP-11) was used between 1941 and 1971 to melt and load TNT and Composition B into large-caliber projectiles. Workers would periodically use steam and hot water to hose down equipment and the floors and walls of buildings contaminated with explosive dust, spills, and vapors. Wash-down water and wastewater from the load line operations was collected in concrete sumps, pumped through sawdust filtration units, and then discharged to a settling pond. Wash-down water from the melt-pour buildings would be swept out through doorways onto the ground surrounding the buildings, in

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Map ID	Site ID	Preliminary CSM Inputs
	Area)	some instances. The on-site settling pond, known as Load Line 4 Pond, was an unlined earthen impoundment approximately one acre, based on a Geographic Information Systems approximation. Water from the impoundment discharged to a stream that ultimately exited through the southern side of the installation. CRS site descriptions (CC RVAAP-73, CC RVAAP-79): CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. CC RVAAP-79: Various ores were historically stored (stock-piled) in ASTs for the GSA. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with the underlying soils. Unconsolidated Aquifer Update COPC conditions at LL4mw-199 and LL4mw-200 to determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs. Upper Sharon Sandstone Aquifer Update COPC conditions at LL4mw-201 to determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs. Basal Sharon Conglomerate Aquifer Confirm vertical delineation of non-metals COPCs is provided by SCFmw-002, DGA-LL4(A) • Unconsolidated, Upper and Lower Sharon Aquifers 1. Additional evaluation of the effect of the variable direction of groundwater flow in the Unconsolidated Aquifer is required to determine the nature and extent of COPCs related to historical operations at LL4.
C-12	Winklepeck Burning Grounds (WBG), Landfill North of Winklepeck	IRP site description (RVAAP-05, RVAAP-07, RVAAP-17, RVAAP-19, RVAAP-36, RVAAP-47): The Winklepeck Burning Grounds (RVAAP-05), consisted of approximately 216 acres and, operated from 1948 to 1998. Prior to 1980, there were open-burning activities performed in unlined pits, pads, and sometimes on the roads within the 216 acre area. Materials that were

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Map ID	Site ID	Preliminary CSM Inputs
	Burning Grounds (LNW)/ RVAAP-05, RVAAP-07 (Building 1601 Hazardous Waste Storage), RVAAP-17 (Deactivation Furnace), RVAAP-19, RVAAP-019-R-01, RVAAP-36 (Pistol Range), RVAAP-47 (Building T-5301)	burned included: RDX, antimony sulfide, Composition B, lead azide, TNT, propellants, black powder, waste oils, sludge from the load lines, domestic wastes, explosively contaminated wastes (e.g. rags, papers, cardboard) and small amounts of laboratory chemicals. The pre-1980 burning was conducted on bare ground and resulting ash was abandoned in-place. Munitions, munitions debris (primarily scrap metal) and explosive constituents are present at the site. From 1980-1998, burning of scrap explosives, propellants, and explosively contaminated materials was conducted within raised refractory-lined trays located within a 1.5-acre area. RVAAP-07 (Building 1601 Hazardous Waste Storage): Historical reports indicate RVAAP-07 is addressed under RVAAP-05. RVAAP-17 (Deactivation Furnace): Historical reports did not include a site description for RVAAP-17. RVAAP-19: RVAAP-19 is a 2.5-acre unlined and unpermitted landfill (a non-regulated solid waste disposal unit), which operated from 1969 to 1976 and is located upgradient of a wetland. The general appearance of the site suggests that a trench and fill method type of operation was used for waste disposal. Waste types possibly associated with this landfill include booster cups, aluminum liners, municipal waste, explosive and munitions waste and ash, and scrap metal from the Winklepeck Burning Grounds (RVAAP-05). The landfill was covered with soil in 1978. Site recommended for Restricted Access. RVAAP-36: The 1.2 acre Pistol Range is located in the north-central region of RVAAP, west of George Road, east of Greenleaf Road and due north of the WBG. The shooting qualifier stood on the south side of the creek and shot over the creek toward targets on the north side. A soil embankment or berm on the north side of the creek acted as a backstop for the bullets. The embankment is approximately 165 ft. long by 48 ft. high and is located 150 to 200 feet from the edge of the creek. The Pistol Range was used regularly from 1941 to 1993 by the Army and the local police departments, and currently is inactive. RVAAP-47: Building T-5301 was located on the east side of George Road at the entrance to the WBG. A small Guard Post (Building T3402) was located adjacent to George Road and the gravel driveway. Originally built as a smokehouse, Building T25301 was utilized to decontaminate and steam clean small miscellaneous production equipment of explosives and propellants as the equipment left the WBG. The quantity of decontamination fluids wastes produced is unknown. The dates of usage of

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		this building are unknown, but would roughly correspond to dates of production occurring at the installation, i.e., intermittently from World War II to Vietnam. Transite asbestos sheets were used to partition the building into two separate areas - a larger cleaning area and a small area for boilers. Within the interior of the building there was a floor drain that exited out of the southern wall of the building and materials would have discharged into two concrete sedimentation basins that drained, via a ditch, towards Sand Creek located to the southeast. MRS site description (RVAAP-019-R-01): The Landfill North of Winklepeck MRS encompasses a 2.3 acre area that lies adjacent and downstream from the former landfill. The MRS footprint was reconfigured during the historical records review to exclude the former landfill, which is covered with soil and the dump area is considered to be a Response Complete site under the MMRP. Based on the SI, it includes the area adjacent and along the length of the former landfill extending down and including the unnamed stream. Unconsolidated Aquifer Evaluate potential groundwater contaminant contributions from Open Demolition Area #2 to the western portion of WBG. Upper Sharon Sandstone Aquifer Horizontal delineation of all constituents in the downgradient direction of WBG is provided to the east by WBGmw-019. Basal Sharon Conglomerate Aquifer Evaluate site hydrogeology, contaminant mass, and vertical gradients to determine if a Basal Sharon Conglomerate well is required to characterize historical site COPCs potentially present at depth outside of the current well network. DGA-WBG(A) • Unconsolidated Aquifer 1. Update groundwater COPC conditions to evaluate a potential horizontal delineation gap downgradient of WBGmw-12. DGA-LNW(A) • Unconsolidated Aquifer 1. Update groundwater COPC conditions to evaluate a potential horizontal delineation gap to the east of LNWmw-026. 2. Evaluate the potential presence of the Sharon Shale indicated by coal content described in monitoring well logs at LNW.

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Map ID	Site ID	Preliminary CSM Inputs
C-13	Motor Pool Area RVAAP-25, RVAAP-37, CC RVAAP-69, CC RVAAP-73, CC RVAAP-74, CC RVAAP-77, CC RVAAP-83	IRP site description (RVAAP-25, RVAAP-37): Historical documentation indicates that RVAAP-25 is addressed under CC-RVAAP-74, and RVAAP-37 is addressed under CC-RVAAP-70. CRS site descriptions (CC RVAAP-69, CC RVAAP-73, CC RVAAP-74, CC RVAAP-77, CC RVAAP-83): CC RVAAP-69: The Building 1048 Fire Station (CC RVAAP-69) AOC was located in the former plant administration area in the northwest quadrant of the intersection of George Road and South Service Road. In 1968, the fire station was referred to as the Fire and Guard Building, and consisted of 12,130 square feet. The fire station building was demolished in late 2008, and the site currently remains undeveloped. The AOC consists of the ground area located west/northwest of the former building. The area is currently marked with Siebert stakes. Reportedly, it was common practice for the fire department to clean out fire extinguishers behind the west side of the fire building, and to allow the contents of the fire extinguishers (carbon tetrachloride) to spill onto the ground surface. The area of potential impact (ground surface west of the building) is approximately 28,000 square ft. CC RVAAP-70: Classification yards were used for the switching and maintenance of railroad cars. This yard was equipped with a locomotive repair building (Round House), an herbicide storage shed, several outbuildings, a washrack area, and a storage tank area. The herbicide shed contained a mobile herbicide tank. The AOC area consists of the following areas within the East Classification Yard: storage tank area, herbicide shed, Round House building, and former washrack area. CC RVAAP-73: Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. CC RVAAP-74: An in-ground hydraulic floor lift system located at Building 1034 has been identified and included in CC RVAAP-74. The hydraulic floor lift system is depicted in a 1969 drawing as a twin-post lift system constructed of metal. The below-grade system consists of a cast in concrete L- shaped pit measuring approximately 12 feet in length and four feet in length, three feet in width, and four feet in height. The pit is reportedly buried at depths ranging from four feet bgs to approximately eight feet bgs. The twin-post lift reportedly has a clearance of six ft between the floor surface and the bottom of the lift (height in the air). The

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		floor lift system remains in place, and has reportedly exhibited a slow leak of hydraulic fluids for an extended period of time. The potential COCs associated with the floor lift system are total petroleum hydrocarbons, PAHs, and PCBs. CC RVAAP-77: CC RVAAP-77 consists of a former below ground concrete sump located on the north side of Building 1037. The sump had a capacity of approximately 5,765 gallons. The unit was previously used as a settling tank for the discharge of laundry rinse water. Wash water was emptied approximately 12 times during eight hours of operation and rinsing three times each eight hours. The wash water entering the tank prior to the rinse water discharge had sufficient settling time so that the increase in rate from the rinse water did not disturb the settled matter on the tank bottom. Rinse water was then sent to CC RVAAP-75 (George Road Sewage Treatment Plant). Wastes of concern are TNT and RDX. The concrete wastewater sump was removed in 2009. CC RVAAP-83: Building 1039 - Former Laboratory Building: This former Laboratory Building measured approximately 16,500 square ft. The structure contained three powder test rooms for the routine analyses of lead azide, mercury fulminate, and percussion element mixes. The laboratory was used for the testing of Load Line materials. During operations, the building contained and operated a photography laboratory, a chemistry laboratory, and a medical x-ray facility. The photo laboratory was historically used for all large scale photo development activities until its closure in the early-1970s. Waste x-ray acid/silver mix solutions were reportedly disposed in the sanitary George Road sewage treatment system. The Defense Property Disposal Organization/Defense Reutilization and Marketing Office termed the waste as a reclaimed precious metal resource. Unconsolidated Aquifer Historical non-metals sampling results indicate no COPCs are present at monitoring well FWGmw-015 (south of motor pool area). Groundwater has not been characterized to determine potential impact from historical site use associated with AOC and CRS sites in the Motor Pool area. Upper Sharon Sandstone Aquifer Historical non-metals sampling results indicate no COPCs are present at monitoring wells and FWGmw-016; however, historical results for FWGmw-015 indicate the potential for off-post migration of perchlorate below screening levels but above laboratory MDLs.

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Map ID	Site ID	Preliminary CSM Inputs
		DGA-FWG(B): • Evaluation of cyanide concentrations is required at FWGmw-004 (Unconsolidated Aquifer).
C-14	Load Line 9 (LL9), Load Line 10 (LL10), Load Line 5 (LL5)	IRP Site Description (RVAAP-39, RVAAP-42, and RVAAP-43): RVAAP-39 (Load Line 5) operated from 1941 to 1945 to produce fuzes for artillery projectiles. Load Line 5 was deactivated and its equipment was removed in 1945. RVAAP-42 (Load Line 9) operated from 1941 to 1945 to produce detonators. Load Line 9 was deactivated and its equipment removed in 1945. RVAAP-43 (Load Line 10) operated from 1941 to 1945 to produce percussion elements. Load Line 10 went on standby status in 1945. From 1951 to 1957, Load Line 10 produced primers and percussion elements. From 1969 to 1971, Load Line 10 was reactivated, and produced munitions primers. The load line has been inactive since that time. CRS Site Description (CC RVAAP-68 and CC RVAAP-73): Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. The West Substation is located west of Load Line 5 on Fuze & Booster Service Road. The substation comprises an area of approximately 3,000 square ft, which includes the area north/northeast of Building 28-28 This AOC excludes Building 28-28. One spill of approximately 500 gallons of transformer fluid occurred on the north side of the building. The impacted area was cleaned up by Emerald Environmental in 1997. Possible impacted soils may exist outside the building around the former transformers. No visual evidence of impacts was noted during the historical records review, Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. Substation No. 3 is located in the Fuze & Booster area between Load Lines 10 and 11. The substation comprises an area of approximately 10,000 square ft. The substation and all transformer equipment have been removed from the site. There are no documented releases and no visual evidence of impacts was noted during the historical records review. Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		total area of potentially impacted media associated with the coal consists of approximately 222,500 sq ft (about five acres). <u>Homewood Aquifer:</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL5 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. Additional evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer, and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport. Evaluate the potential for discharge of site groundwater COPCS to surface water. <u>Sharon Sandstone Aquifer</u> Vertical delineation of groundwater COPCs is not provided by the current monitoring well network. <u>Basal Sharon Conglemerate</u> Vertical delineation of groundwater COPCs is not provided by the current monitoring well network. <u>DGA-LL5/LL10/LL9(A)</u> • Homewood Aquifer 1. Determine the extent of hydraulic connection between these three sites and the associated effect on COPC distribution in this area of the post. • Sharon Sandstone Aquifer 1. Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at LL9 and LL10. The new well will be installed adjacent to the paved access road between LL9 and LL10, outside of the LL10 perimeter fence and approximately 400 feet northeast

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Map ID	Site ID	Preliminary CSM Inputs
		of LL10mw-005. • Basal Sharon Conglomerate Aquifer 1. Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated and Homewood Aquifers at LL5, LL9, and LL10. The new well will be installed as a nested well adjacent to FWG-SS/C5 on the southeastern edge of LL10.
C-15	DA2/ RVAAP-45 RVAAP-004-R-01	<u>IRP Site Description (RVAAP 04, RVAAP 45):</u> RVAAP 45 (Wet Storage Area) was used from 1941 to 1945 to store primary explosives in water filled tanks and metal carboys. There is no documentation of any spills in the area. Four of the six igloos were demolished in spring 2003 2004. RVAAP-04 was moved to the MMRP program under RVAAP-004-R-01. Building T-5301 (designated as RVAAP-47) was located on the east side of George Road at the entrance to the Winklepeck Burning Grounds (VVBG). A small Guard Post (Building T3402) was located adjacent to George Road and the gravel driveway that led up to Building T-5301. Originally built as a smokehouse, Building T25301 was utilized to decontaminate and steam clean small miscellaneous production equipment of explosives and propellants as the equipment left the WBG. The quantity of decontamination fluids wastes produced is unknown. In addition, the dates of usage of this building are unknown, but would roughly correspond to dates of production occurring at the installation, i.e., intermittently from World War II to Vietnam. The building was essentially a 25-foot by 25-foot sheet-metal structure with a concrete block wall extending approximately 3 feet above ground surface. Transite asbestos sheets were used to partition the building into two separate areas - a larger cleaning area and a small area for boilers. Within the interior of the building there was a floor drain that exited out of the southern wall of the building and materials would have discharged into two concrete sedimentation basins that drained, via a ditch, towards Sand Creek located to the southeast. <u>MRS Site Description (RVAAP-004-R-01):</u> The 35.4 acre Open Demolition Area #2 was used from 1948 until 1991 to detonate large caliber munitions and off- specification bulk explosives and for burial of white phosphorus and bombs of unknown type. The MRS is collocated with an IRP AOC (RVAAP-04). The MRS consists of the former demolition area, Burial Sites 1 and 2, Rocket Ridge, the Bomb Disposal Area located adjacent to the northwestern section of the MRS, and all areas in between. The depth to groundwater at the MRS ranges between 4 to 30 feet bgs and the past munitions OB/OD and burial activities at the MRS occurred at the higher elevations of the MRS, away from Sand Creek where

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Map ID	Site ID	Preliminary CSM Inputs
		the lower depths to groundwater are found. Evaluation of the groundwater beneath the Open Demolition Area #2 MRS is included as part of the facility-wide groundwater monitoring program. There are COCs, MD, and MC on the site. A FS is recommended to be completed for the site. A RTC to OEPA comments on MFR were sent 21 January 2015 an approval was received from OEPA on 24 February 2015. <u>Unconsolidated Aquifer</u> Direction of flow in the Unconsolidated Aquifer is heavily influenced by the area stream locations, additional review of localized gradients is required to determine effect on contaminant fate and transport. Based on lack of GW COPCs in soil at RVAAP-45, no additional evaluation of this AOC is applicable for the current project. <u>Sharon Shale Aquifer</u> Vertical delineation for DA2 is provided by monitoring well DA2mw-114 (Sharon Shale).
C-16	Block D Igloo/ RVAAP-060-R-01	<u>MRS Site Description (RVAAP-060-R-01):</u> The Block D Igloo MRS resulted when fuzed bombs in Igloo 7-D-15 (D Block) exploded on 24 March 1943. The initial 3,000-foot radial MRS boundary was established by the USACE, Huntsville District to capture the probable debris field resulting from the explosion and was based on the type of munitions stored in the bunker at the time of the explosion. In 1943 a response action was performed by USACE immediately after the explosion. As described below, the area of this site was adjusted based on the 2008 SI findings. Historical assessment of the Block D Igloo site indicates no potential for residual contamination is present at levels indicating unacceptable risk to human and ecological receptors.
C-17	LL6/ RVAAP-14, RVAAP15, RVAAP-33, RVAAP-033-R-01, CC RVAAP-73	<u>IRP Site Description (RVAAP-14, RVAAP-15, and RVAAP-33):</u> Load Line 6 (RVAAP-33) is approximately 45 acres and operated primarily as a fuze assembly line from 1941 to 1945. Demolition of all Load Line 6 buildings was competed July 2006. A portion of the AOC was reactivated in 1950 when the Firestone Defense Products Division became a tenant which lasted until the late-1980s. During this time Firestone sold its Defense Products Division to Physics International. Three years later, Physics International became a subsidiary of Olin Corporation and Olin remained as a tenant until early 1993. Throughout the history of the tenant occupancy the work regimen remained the same. As reported by former workers at RVAAP, Load Line 6 was a classified experimental test facility for munitions. Shaped charges were constructed and tested under

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

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		contract for the Department of Defense. The site consisted of a pond (underwater test chamber), two above ground test-firing chambers, and several buildings. The test chamber foundation and the concrete blocks around the test pond remain at the site. No original file documentation exists for this site. The contaminants of potential concern are explosives and metals. RVAAP-14 (Evaporation Unit) and RVAAP-15 (Treatment Plant) are being addressed under RVAAP-33. <u>CRS Site Description (CC RVAAP-73):</u> Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP0-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 sq ft (about five acres). <u>MRS Site Description (RVAAP-033-R-01):</u> The 0.4 acre Firestone Test Facility (RVAAP-033-R-01) consisted of two buildings used as test chambers for tube-launched, optically-tracked, wire-guided missiles and Dragon missiles. In addition, shaped charges were tested in a small nearby pond. The site was used from the late-1960s to 1993. The former test chambers have been demolished and all of the debris removed. The test chamber foundations remain. Another suspect area was included in the SI fieldwork that consists of a small clearing and piles of dirt and large timbers. The site is collocated with an IRP AOC Load Line 6 (RVAAP-33). <u>Unconsolidated Aquifer</u> Additional evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer, and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport. Based on current monitoring well locations, an apparent potential for hydraulic connection between LL5 and LL6. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL6 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed

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		in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours.
C-18	Load Line 11 (LL11)/ RVAAP-44, CC RVAAP-68	<u>IRP Site Description (RVAAP-44):</u> RVAAP-44 (Load Line 11) operated from 1941 to 1945 to produce primers for artillery projectiles. Load Line 11 was placed on standby in 1945. From 1951 to 1957, Load Line 11 was used to produce primers and fuzes. <u>CRS Site Description (CC RVAAP-68):</u> Electricity for the installation was purchased from the Ohio Edison Company. The electricity was supplied from Newton Falls and Garrettsville, Ohio. Distribution occurred through three substations, each having approximately 24,000 volts. Three of these substations are included in CC RVAAP-68. Substation No. 3 is located in the Fuze & Booster area between Load Lines 10 and 11. The substation comprises an area of approximately 10,000 square ft. The substation and all transformer equipment have been removed from the site. There are no documented releases and no visual evidence of impacts was noted during the historical records review. Target analytes noted in the HRR included TAL metals, PCBs, and SVOCs. <u>Unconsolidated Aquifer</u> Direction of flow in the Unconsolidated Aquifer is heavily influenced by the area stream locations, additional review of localized gradients is required to determine effect on contaminant fate and transport. <u>DGA-LL11(A)</u> • Upper Sharon Sandstone Aquifer 1. Review of site-specific hydrogeology and historically characterized contaminant mass to determine if additional well installations are required to address vertical delineation of groundwater COPCs.
C-19	Load Line 7 (LL7)/ RVAAP-30, RVAAP-40 RVAAP-062-R-01	<u>IRP Site Description (RVAAP-30 and RVAAP-40):</u> The Load Line 7 Treatment Plant was a pink water treatment plant operation from 1989 to 1993. This AOC was closed out in January 2000. Load Line 7, formerly known as Booster Line #1, is a 37-acre fenced AOC located on the west side of Fuze and Booster Spur Road, south of Load Line 11, and northeast of Water Works #4 in the south- central portion of RVAAP. A fence exists as the perimeter boundary of the AOC. From 1941 to 1945, Load Line 7 operated at full capacity to produce booster charges for

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		artillery projectiles. At the end of World War II, Load Line 7 was deactivated, and the process equipment was removed. In 1968, Load Line 7 was modified for the production of M-406 High Explosive and M- 407A1 practice 40mm projectiles. Load Line 7 was reactivated from 1969 to 1970. During this time, 16,000,000 40mm projectiles were assembled and produced at Load Line 7. In 1970, Load Line 7 was deactivated, and the process equipment was removed. Topographic relief at the AOC is moderate, with a topographic high on the western boundary of the AOC that slopes downward to the topographic low in the northeastern boundary of the AOC. Surface water follows topographic relief and drains into ditches that exit the AOC. <u>MRS Site Description (RVAAP-062-R-01):</u> The Water Works #4 Dump is an approximate 0.77 acre open area located immediately west of Water Works No.4 and Load Line 7, in the southwestern portion of RVAAP. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL7 wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. Evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer, and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport. Review of historical monitoring well installation logs should be conducted to confirm the indicated extent of the Homewood Sandstone Aquifer at LL7. <u>DGA-LL7(A)</u> • Homewood Aquifer 1. Determine the extent of hydraulic connection between the Fuze and Booster Quarry and LL7, evaluate any associated effect on

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Map ID	Site ID	Preliminary CSM Inputs
		COPC distribution in this area of the post. Evaluate the potential for discharge of site groundwater COPCS to surface water. • Sharon Sandstone Aquifer 1. Review of site-specific hydrogeology and historically characterized contaminant mass should be conducted to determine if additional well installations are required to address vertical delineation of groundwater COPCs.
C-20	RVAAP-32 RVAAP-032-R-01, RVAAP -062-R-01	<u>IRP Site Description (RVAAP-32):</u> The 1.3-acre 40mm Firing Range is a former test range for the 40mm cartridge and is surrounded by forest. The MRS was used from 1969 to 1971. The impact area was located in the western portion of the site while the firing point was sited at the opposite end. MEC was reported to be present beyond the impact area, on the slope that leads down to the Fuze and Booster Quarry. Evaluation of residual contamination associated with the site was addressed under RVAAP-032-R-01. <u>CRS Site Description(RVAAP-032-R-01 and RVAAP-062-R-01):</u> The Water Works #4 Dump (RVAAP-032-R-01) is an approximate 0.77 acre open area located immediately west of Water Works No.4 and Load Line 7, in the southwestern portion of RVAAP. The Final RI report for RVAAAP-31-R-01 indicates that "no SRCs were detected in the surface soil samples collected during the RI field activities (CB&I, 2015)".
C-21	Load Line 8 (LL8)/ RVAAP-41	<u>IRP Site Description (RVAAP-41):</u> Load Line 8, formerly known as Booster Line #2, is a 44-acre fenced AOC located on Fuze and 6 Booster Road, west of Load Line 6, and south of the former 40mm Test Area in the south-central 7 portion of RVAAP. From 1941 to 1945, Load Line 8 operated at full capacity to produce booster 8 charges for artillery projectiles. At the end of World War II, Load Line 8 was deactivated, and the 9 process equipment was removed. Load Line 8 has not been used since 1945. <u>Unconsolidated Aquifer</u> Horizontal delineation of LL8 groundwater COPCs is provided at LL8mw-002 and LL8mw-004. Vertical delineation of COPCs is provided by Homewood Sandstone wells LL8mw-006 and LL8mw-005. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of LL8 wells historically identified to be

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. DGA-LL8(A) • Unconsolidated Aquifer 1. Historical dataset indicates presence of cyanide in groundwater above screening levels at LL8mw-001, but has not been sampled since 2009.
C-22	Fuze and Booster Quarry (FBQ)/ RVAAP-16, RVAAP-26, RVAAP-32, CC RVAAP-78	IRP Site Description (RVAAP-16, RVAAP-26, and RVAAP-32): RVAAP-16: The 4.9 acre Fuze and Booster Quarry (RVAAP 16) site consists of three elongated ponds separated by berms which were constructed within an abandoned rock quarry. The ponds were used for open burning of various types of munitions from 1945 to 1975. RVAAP-26 (Fuze and Booster Area Settling Tanks) is addressed under Fuze and Booster Quarry (RVAAP-16). RVAAP-32: see discussion in C-20. CRS Site Description (CC RVAAP-78): The Quarry Pond Surface Dump (CC RVAAP-78) consists of an area of former dumping along a small topographic ridge located north and northeast of the northern-most quarry pond within the Fuze and Booster Quarry. The potentially impacted area consists of approximately 8,750 (250 ft by 35 ft) square feet. The debris pile appears to have an average thickness of about five feet (where present). Contents of the debris pile appear to consist of potential ACM, construction debris, scrap metal, and other unknown materials. A former burn location is also present along the northeastern portion of the surface dump and is characterized by ground charring. The Quarry Pond Surface Dump appears to be a possible northern extension of the existing Fuze and Booster Quarry AOC (RVAAP-16). Constituents of concern include explosives, propellants, VOCs, SVOCs, metals, asbestos, and PCBs in soil and groundwater.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		<u>MRS Site Description (RVAAP-016-R-01 and RVAAP-032-R-01):</u> See IRP Site Description. <u>Unconsolidated Aquifer</u> Confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant migration to the north and west. <u>Homewood Aquifer</u> Review of local geology resources with respect to upper contact bedrock formations indicates a portion of the FBQ wells historically identified to be installed within the Homewood Sandstone aquifer may actually be screened within other formations (e.g., the Mercer or Massillon Member of the Pottsville Group). Preliminary review of well logs and site hydrogeology characteristics indicates that, regardless of actual formation, groundwater within the upper contact bedrock at the site may nevertheless be hydraulically connected as has been historically assumed in mapping of Homewood Sandstone potentiometric surface elevation contours for the site. The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. Evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport; especially radial flow indicated from the center of the site. Determine the extent of hydraulic connection between the Fuze and Booster Quarry and LL7, evaluate any associated effect on COPC distribution in this area of the post. Confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant migration to the north and west. Measured pH values at FBQmw-174 have been reported outside of the naturally occurring range expected for groundwater. <u>Upper Sharon Sandstone Aquifer</u> Vertical delineation of COPCs is absent at the FBQ site. <u>DGA-FBQ(A)</u> • Homewood Aquifer 1. Vertical delineation for various non-metals COPCs present in the

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		Homewood Aquifer at the FBQ. DGA-FBQ(B) • Unconsolidated Aquifer 1. Historical dataset indicates presence of 2,6-dinitrotoluene in groundwater above screening levels at FBQmw-166, but has not been sampled since 2009. 2. Horizontal delineation in the downgradient (southwest) direction has not been achieved.
C-23	RVAAP-46/46-R-01, CC RVAAP-73	IRP Site Description (RVAAP-46): RVAAP-46 (Building F-15 and F-16) was used during World War II, the Korean Conflict, and Vietnam War to test disassembly processes and munitions surveillance. Quantities and types of materials utilized as well as exact dates of testing are unknown. MRS site description (RVAAP-046-R-01): No historical documentation was available for this MRS site. CRS Site Description (CC RVAAP-73): Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP0-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 sq ft (about five acres). Unconsolidated Aquifer There are currently no AOC-specific permanent monitoring wells installed at RVAAP-46. Based on documented historical contaminant release characteristics, impact form documented sources at the site is limited to near-surface, unsaturated soil.
C-24	NACA Test Area (NTA), Suspected Mustard Burial Site (MBS)/ RVAAP-03, RVAAP-28, RVAAP-38, CC RVAAP-71	IRP Site Description (RVAAP-38, RVAAP-28, and RVAAP-03): RVAAP-38 (NACA Test Area), an approximately 69-acre site, was previously used as an aircraft test area by NACA. Surplus military aircraft crashed into constructed barriers, using a fixed rail attached to the aircraft landing gear, in an attempt to develop crash-worthy fuel tanks and/or high flashpoint aviation fuel. Burial of some demolished aircraft occurred at the site after the tests. Based on review of historical assessment documents for RVAAP 38 NACA Test Area, aircraft crash testing and associated firefighting responses were

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		conducted from 1947 through 1953. According to the Phase I RI (add date and source), the site was used for "training and parking" after 1969. As PFCs were not used in firefighting foam products prior to 1970, assessment of these compounds is not warranted at the NACA Test Area (SAIC, 2001). RVAAP-28 (Mustard Agent Burial Site) consists of three potential disposal areas: 1. Records indicate that in 1969 an EOD unit excavated a suspected mustard agent burial site near the west end of the NACA crash strip. Recovered from the site in 1969 were one 190-liter drum and seven rusty canisters. All recovered items were empty and no evidence of contamination was found. 2. Another suspected area, located to the southwest across Hinckley Creek, is presently marked by reflective Seibert stakes. 3. An additional potential burial area located at the west end of the NACA crash strip was suggested by a member of public and investigated in FY08. RVAAP-03 (Open Demolition Area 1), consisting of approximately six acres, was used to thermally treat munitions by OB/OD. The site now consists of a circular one-ft berm surrounding a grassed area of approximately 1.5-acres. The entire AOC is located within the NACA Test Area. Contaminants of concern include explosive compounds and metals. The 1989 report from Jacobs Engineering indicates that munition fragments including scrap metal, small arms primers, and fuzes were found outside the bermed area and that the area was operational from 1941 through 1949. Fires and live ammunition were prohibited at the site after 1960 when it became a training area. <u>CRS Site Description (CC RVAAP-71):</u> Barn No. 5 was formerly located on the south central portion of the RVAAP close to the Post No. 6 gate. A letter dated May 13, 1964, documents the release of approximately 20 barrels of gasoline (840 gallons) to the ground surface inside of the south fence south of Barn No. 5. Reportedly, the release occurred from a buried pipeline that runs parallel to, and outside of, the RVAAP fence line at this location. This release is addressed by CC RVAAP-71. The area of potential impact consists of approximately 0.6 acres, which includes the footprint of the former barn area and the land between the former barn and the fence line. Potential COCs consist of VOCs, SVOCs, and lead.

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		Unconsolidated Aquifer The NACA Test Area overlies a buried glacial valley feature in the upper contact of the Sharon Member Sandstone/Conglomerate Unit (see **Figure 1-11**). Preferential flow paths associated with coarse-grained alluvial deposits present at the site tending to direct water table groundwater flow toward surface water features and the thickness of low-permeability glacial till material underling the site effectively limit the extent of downward contaminant migration at the site. The relatively low levels of contaminant concentrations reported at the site, which have continued to attenuate over time, further limit the potential for downward migration of contaminants. DGA-NTA(A) • Unconsolidated Aquifer 1. Current COPC conditions for the site at large need to be updated to determine potential horizontal and vertical delineation needs for various non-metals COPCs present in the Unconsolidated Aquifer of the NTA area. 2. Evaluate the potential for Unconsolidated Aquifer discharge to surface water in the southern portions of the NTA site. • Upper Sharon Sandstone Aquifer 1. The potential for NTA contaminants to have impacted the Upper Sharon Sandstone Aquifer will be evaluated by installation of a new monitoring well downgradient (based on presumed direction of flow in that formation) to the east. DGA-MBS(A) • Unconsolidated Aquifer 1. Current COPC conditions for the site at large need to be updated to determine potential horizontal and vertical delineation needs for various non-metals COPCs present in the Unconsolidated Aquifer of the MBS area.
C-25	C Block Quarry/ RVAAP-06, RVAAP-21, RVAAP-24 CC RVAAP-73, CC RVAAP-76,	IRP Site Description (RVAAP-06 and RVAAP-24): Block Quarry is a 0.96-acre AOC located between roads 3C and 4C of the C Block Storage Area, north of Newton Falls Road, in the northwestern portion of RVAAP. The C Block Storage Area 31 contains parallel roads of above ground cement igloos that formerly stored munitions. In the 1940s and 1950s, this area was used to mine Homewood Sandstone. The sandstone was quarried for the purpose of road and construction base material. The AOC was used as a disposal area for annealing process waste for a short duration during the 1950s. Liquid waste, including annealing process liquids and spent pickle liquor containing lead, mercury,

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		chromium, and sulfuric acid from brass finishing operations, were dumped on the ground surface in the bottom of the abandoned unlined borrow pit. Potential C Block Quarry chemicals are residues from the storage of materials at the AOC, such as TAL metals, and SVOCs, explosives, and ACM. The quarry bottom within C Block has a maximum depth of 25 ft below the surrounding grade. The AOC is currently heavily forested with brush and trees of at least 1 ft in diameter. Construction debris assumed to be the result of dumping is present at the AOC. Site-specific assessment/investigation for the presence of residual contamination associated with historical site uses has not been conducted for RVAAP-021 or RVAAP-24. <u>CRS Site Description (CC RVAAP-79, CC RVAAP-73, and CC RVAAP-76):</u> Installation records document the former presence of 17 coal storage locations at RVAAP, all of which are included in CC RVAAP0-73. Coal was historically used to fuel powerhouses and various other buildings at the site. Typically, coal storage consisted of placing the coal on the ground surface as surface piles or in railcars adjacent to the subject buildings. The total area of potentially impacted media associated with the coal consists of approximately 222,500 sq ft (about five acres). The Depot Area (CC RVAAP-76) consists of multiple historical operations including: fueling stations, locomotive repair shop, motor repair shop, petroleum storage building, solid waste incinerator, demilitarization activities at Building U-10, service station and AST associated with Building U-5. The steel 400 gallon AST located between Depot Buildings U-5 and U-4 has been removed, but the soils beneath and around the former tank are stained. The tank sat on crushed slag next to the motor oil storage shed. Waste oil from the motor pool area was stored in the AST until it was removed by an oil reclaimer. The AST was in operation from 1983 through 1993. In 1993, the contents of the AST were removed and the tank remained inactive until its removal (after 1996). CC RVAAP-73: Various ores were historically stored (stock-piled) at this facility for the General Services Administration. The DLA, Defense National Stockpile Center leased space at the Ravenna facility for the storage of the ore materials on the ground and in ASTs, which are addressed by CC RVAAP-79. The ASTs were referred to as strategic material tanks. Many of the ASTs were constructed without floors; therefore, the ores were allowed to make direct contact with underlying soils. The following GSA materials were stock-piled on the ground surface: brass ingots, chemical chrome ore, copper ingots, ferrochrome ore, ferro manganese ore, and metallurgical manganese ore. The following GSA materials were stored in strategic material tanks: magnesium, kyanite, antimony sulfide, asbestos

Table 1-3. Key CSM Inputs for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	Preliminary CSM Inputs
		(raw), cobalt rutile sand, silicon carbide, talc, and zircon sand ore. The monazite sand contained radioactive element Thorium 232. <u>Homewood Aquifer</u> Evaluation of groundwater horizontal/vertical gradients, relative permeability of the Homewood, Mercer and Sharon formation aquifers and ground surface topography to determine effect on contaminant fate and transport; especially radial flow indicated from the center of the site. Evaluate the potential for discharge of site groundwater COPCS to surface water to the east. Confirm that historically characterized COPC concentrations indicate site related contaminant mass presents limited potential for significant horizontal or vertical migration. <u>DGA-CBL(A)</u> • Homewood Aquifer 1. Evaluate the potential for historically detected COPCs to have migrated downgradient after the collection of RI samples. • Sharon Shale Aquifer 1. Evaluate the effect of the Sharon Shale on vertical contaminant migration.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>RI Goals and Objectives for Each AOC/MRS/CRS Site</th></tr>
<tr><td>C-1</td><td>Erie Burning Grounds
RVAAP-02</td><td>Update groundwater COPC conditions as necessary for the baseline risk assessment (BRA) for the following constituents.

• <u>Constituents</u>: Nitrobenzene; Cyanide

<u>DGA-EBG(A):</u>
• RI sampling wells: EBG-126
• No new wells currently proposed for this DGA.
<u>DGA-EBG(B):</u>
• Evaluate the need for additional sampling of EBGmw-127 based on sampling results for DGA-EBG(C) wells.
RI Wells outside DGAs: EBGmw-123; EBGmw-125 (additional review of site-specific groundwater flow dynamics); EBGmw-126; EBGmw-128; EBGmw-131 (confirmation of current vertical delineation)

<u>FWGWMP Wells:</u> none currently planned</td></tr>
</table>

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-2	Load Line 1 (LL1)	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • <u>Constituents</u>: 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Cyanide; Nitroglycerin; RDX <u>DGA-LL1(A):</u> • RI sampling wells: LL1mw-063; LL1mw-080; LL1mw-081; LL1mw-083*; LL1mw-084*; LL1mw-86*; FWGmw-010 (confirmation of downgradient conditions indicative of no COPC results exceeding screening level) • Install a horizontal delineation well in the Sharon SS/Cong to the northeast of the central load line area. <u>DGA-LL1(B):</u> • RI sampling wells: none currently planned • No new wells currently proposed for this DGA. RI Wells Outside DGAs: LL1mw-064* <u>FWGWMP Wells:</u> FWGmw-011, LL1mw-064*; LL1mw-065; LL1mw-083*; LL1mw-084*; LL1mw-086*; LL1mw-087; LL1mw-088; SCFmw-004 <u>Alkalinity assessment</u> LL1mw-083, LL1mw-084, LL1mw-086, LL1mw-088, and new well FWGmw-SS/C1 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-3	Ramsdell Quarry Landfill (RQL), RVAAP-01	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: 2,4-Dinitrolouene; 2,6-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; Nitroglycerin; Cyanide; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,1,2,2-Tetrachloroethene; Benzene; DEHP DGA-RQL(A) • <u>RI Wells: </u>RQLmw-007*; RQLmw011*; RQLmw-012*; RQLmw-014; RQLmw-015 (PCBs only), RQLmw-016, RQLmw-017 (PCBs only) • <u>Confirm monitored formation for RQLmw-012</u> • No new wells currently proposed for this DGA. FWGWMP Wells: RQLmw-007*; RQLmw-008; RQLmw-009; RQLmw011*; RQLmw012*[1]; RQLmw-013; FWGmw-012 [1]FWGWMP Well identified for pH testing only. Alkalinity assessment RQLmw-011, RQLmw-012, RQLmw-013, RQLmw-014 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-4	Load Line 2 (LL2), CC RVAAP-68, CC RVAAP-73	Update groundwater COPC conditions as necessary for the BRA and determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs for the following constituents. • Constituents: 2,4-Dinitrotluene; 2,6-Dinitrotoluene; RDX; Cyanide; Pentachlorophenol; Benzene DGA-LL2(A): • RI sampling wells: none currently planned • A horizontal delineation well will be installed to the south of LL2mw-267. The potential need for installation of an additional down-gradient delineation well will be evaluated following obtaining sample results for the new well. DGA-LL2(B): • RI sampling wells: LL2mw-270 • No new wells currently proposed for this DGA. DGA-LL2(C): • RI sampling wells: LL2mw-059*, SCFmw-003 (confirmation of current vertical delineation only) • Horizontal and vertical delineation wells will be installed in the Upper Sharon SS/Cong and Basal Sharon Conglomerate in the area of the post boundary to the south of LL2mw-271. FWGWMP Wells: LL2mw-059*; LL2mw-060; LL2mw-267*; LLWmw-271 RI Wells outside DGAs: LL2mw-059*; LL2mw-261 (update current conditions); LL2mw-267; LL2mw-268;

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-5	Load Line 3 (LL3)	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Nitrobenzene; RDX; Cyanide; Pentachlorophenol, DEHP DGA-LL3(A): • RI sampling wells: none currently planned. • Horizontal and vertical delineation is not provided by the current monitoring well network for non-metals COPCs present in the Unconsolidated Aquifer at LL12 and in the Upper Sharon formation at LL3 to determine the potential for off-post migration of SRCs. The new well will be installed across Route 5 to the southeast of LL12. DGA-LL3(B): • RI sampling wells: none currently planned • Determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs at LL3mw-246. A horizontal delineation well will be installed to the south of LL3mw-246. FWGMP Wells: LL3mw-238*; LL3mw-241*; LL3mw-244*; LL3mw-246 RI Wells outside DGAs: LL3mw-234; LL3mw-236; LL3mw-237; LL3mw-238*; LL3mw-239; LL3mw-241*; LL3mw-243; LL3mw-244*
C-6	Building 1200, CC RVAAP-79, CC RVAAP-80, and RVAAP-51	Update groundwater COPC conditions at Building 1200 as necessary for the BRA for the following constituents. • Constituents: Di-n-octylphthalate; Indeno(1,2,3-cd)pyrene FWGMP Wells: none currently planned RI Wells: B12mw-011 (confirmation of current upgradient delineation); B12mw-012; BKGmw-004(characterize current conditions downgradient of AOC); BKGmw-008 (characterize current conditions downgradient of AOC); SCFmw-006 (confirmation of current conditions downgradient of AOC) DGA-FWGmw002(A) Alkalinity assessment FWGmw-002 and BKGmw-021 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-7	Load Line 12 (LL12)	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • <u>Constituents</u>: 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; RDX; Cyanide; Benz(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,2-Dichloroethene; 2,6-Dinitrotoluene; 3-Nitrotoluene; Nitroglycerin; Hydrazine; Benzene <u>DGA-LL3(A):</u> • RI sampling wells: L12mw-182 • New Sharon SS/Cong and Basal Sharon Conglomerate wells will be installed for vertical and horizontal delineation of non-metals COPCs that is not provided by the current monitoring network to the southeast of LL12. <u>FWGMP Wells:</u> L12mw-185; L12mw-187*; L12mw-242; L12mw-245*; L12mw-247; SCFmw-002 <u>RI Wells outside DGAs:</u> L12mw-107; L12mw-154; L12mw-182;L12mw-153 (DEHP only); L12mw-183 (DEHP only); L12mw-186; L12mw-187*; L12mw-188; L12mw-189; L12mw-243; L12mw-244; L12mw-245*
C-8	Upper and Lower Cobbs Ponds (ULCP), Central Burn Pits (CBP)	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • <u>Constituents</u> (ULCP): 2,6-Dinitrotoluene; Cyanide; Naphthalene • <u>Constituents</u> (CBP): 2,6-Dinitrotoluene; Nitroglycerin; Cyanide, bis(2-ethylhexylphthalate (DEHP) <u>DGA-CBP-(A):</u> • RI sampling wells: CBP-004; CBP-006; CBPmw-008 (confirm downgradient delineation) • Additional characterization of groundwater conditions. • No new wells currently proposed for this DGA. <u>FWGMP Wells:</u> none currently planned <u>RI Wells outside DGA:</u> ULCPmw-001; ULCPmw-003; ULCPmw-006; CBPmw-001; CBP-002; CBPmw-009
C-9	RVAAP 34/34-R-01	No RI actions are planned for RVAAP 34 or RVAAP 34-R-01.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-10	Atlas Scrap Yard (ASY), RVAAP-50, CC RVAAP-73, RVAAP-050-R-01	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: 2,6-Dinitrotoluene; Cyanide DGA-ASY(A): • RI sampling wells: ASYmw-004; ASYmw-005 • Evaluate potential contribution of contamination on the western edge of LL12 to the ASY groundwater plume. • Determine if the absence of Unconsolidated Aquifer wells in the central part of the site (in the area of ASYmw-004 and ASYmw-006) constitutes a data gap. • No new wells currently proposed for this DGA. FWGMP Wells: none currently planned RI Wells Outside DGA: ASYmw-006, ASYmw-010 (confirmation of current downgradient delineation)
C-11	Load Line 4 (LL4)	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: Naphthalene; 2,6-Dinitrotoluene; Cyanide; Benzene DGA-LL4(A): • RI sampling wells: LL4mw-193; LL4mw-194 (confirmation of current conditions); LL4mw-197 • No new wells currently proposed for this DGA. FWGMP Wells: none currently planned • RI Wells outside DGA: Confirm no off-post migration of SRCs below screening levels but above laboratory MDLs at LL4mw-199, LL4mw-200, and LL4mw-201.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>RI Goals and Objectives for Each AOC/MRS/CRS Site</th></tr>
<tr><td>C-12</td><td>Winkelpeck Burning Grounds (WBG), Landfill North of Winklepeck Burning Grounds (LNW), RVAAP-36, RVAAP-17, RVAAP-07, RVAAP-47</td><td>Update groundwater COPC conditions as necessary for the BRA for the following constituents.

• <u>Constituents</u> (WBG): Cyanide; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Nitrotoluene; 3-Nitrotoluene; RDX; DEHP
• <u>Constituents</u> (LNWBG): Cyanide; 2,6-Dinitrotoluene, DEHP
<u>DGA-WBG(A):</u>
• RI sampling wells: none currently planned
• Update groundwater COPC conditions to evaluate a potential horizontal delineation gap downgradient of WBGmw-12.
• No new wells currently proposed for this DGA.
<u>DGA-LNW(A):</u>
• RI sampling wells: LNWmw-026
• Update groundwater COPC conditions to evaluate a potential horizontal delineation gap to the east of LNWmw-026.
• No new wells currently proposed for this DGA.
<u>FWGMP Wells:</u> WBGmw006*; WBGmw009*; WBGmw020; WBGmw021*

<u>RI Wells outside DGAs:</u> OBG-1; OBG-4 (3-nitrotoluene only), WBGmw006*; WBGmw007; WBGmw009*; WBGmw014; WBGmw-018; WBGmw-019 (confirm current conditions downgradient to the east); WBGmw-021*; LNWmw-025

Other RI activities: evaluate the potential presence of the Sharon Shale indicated by coal content described in monitoring well logs at LNW.</td></tr>
<tr><td>C-13</td><td>Motor Pool Area: CC RVAAP-83, CC RVAAP-69, CC RVAAP-73, CC RVAAP-74, CC RVAAP-77, CC RVAAP-83, RVAAP-25, RVAAP-37</td><td>Unconsolidated Aquifer monitoring wells will be installed in the motor pool area during site-specific investigations planned to be conducted by ARNG/OHARNG during 2016 under other contracts. Continued monitoring of groundwater wells installed during the investigation with confirmed contamination levels requiring additional assessment/monitoring will be incorporated into the FWGWM Program after four quarters of initial characterization sampling have been completed. Conduct additional sampling at FWGmw-015 to determine the potential for off-post migration of perchlorate below screening levels but above laboratory MDLs.

• <u>Constituents</u>: cyanide; perchlorate(both constituent due to being above MDLs but below EPA screening levels)
<u>DGA-MPA(A):</u>
• RI sampling wells: none currently planned
• No new wells currently proposed for this DGA.
FWGMP Wells: FWGmw-004; FWGmw-015; FWGmw-016</td></tr>
</table>

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-14	Load Line 9 (LL9), Load Line 10 (LL10), Load Line 5 (LL5)	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, cyanide, carbon tetrachloride DGA-LL5/LL10/LL9(A): • RI sampling wells: LL5mw-001 (PCBs only), LL5mw-002, LL9mw-003, LL9mw-007, LL9mw-004 (confirmation of current conditions downgradient to the southeast), LL10mw-001, L10mw-003*; L10mw-006New wells will be installed in the Upper Sharon formation and in the Basal Sharon Conglomerate for vertical delineation not provided for non-metal COPCs by the current monitoring well network. The Upper Sharon Sandstone and Basal Sharon Conglomerate wells will be installed in the area of highest COPC concentrations for the series of AOCs (near LL10). . FWGMP Wells: LL10mw-003* RI Wells outside DGA: LL5mw-006 (confirmation of horizontal delineation southwest of DGA-LL5/LL10/LL9(A); SCFmw-001 (confirmation of current conditions with respect to nitroglycerin and cyanide)
C-15	DA2, RVAAP-45	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: 2,6-dinitrotoluene, cyanide, nitroglycerin, RDX, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, naphthalene FWGMP Wells: DA2mw-115, DET-3, DET-4* RI Wells not associated with DGA: DA2mw-104, DA2mw-105, DA2mw-108, DET-4*, FWGmw-013 (confirm current conditions for cyanide such that no COPCs are above screening levels)
C-16	Block D Igloo	None.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-17	LL6, CC RVAAP-73	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents. • <u>Constituents</u>: 2,6-dinitrotoluene, cyanide, nitroglycerin, 4-nitrobenzamine, DEHP <u>FWGMP Wells:</u> none currently planned <u>RI Wells not associated with DGA:</u> LL6mw-001; LL6mw-002 (confirmation of horizontal delineation upgradient to the northeast), LL6mw-003; LL6mw-006 LL6mw-007 (confirmation of downgradient vertical delineation, LL6mw-008 (confirmation of current conditions downgradient to the southeast)
C-18	Load Line 11 (LL11)	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • <u>Constituents</u>: 2,6-dinitrotoluene, cyanide, trichloroethene, DEHP <u>DGA-LL11(A):</u> • LL11mw-002 (confirm delineation of COPCs); LL11mw-003 (confirm current conditions indicative of no COPCs exceed screening levels; LL11mw-005 (confirm downgradient delineation); LL11mw-006 • No new wells currently proposed for this DGA. <u>FWGMP Wells:</u> none currently planned <u>RI Wells outside DGA:</u> LL11mw-001 (DEHP only); LL11mw-010

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

<table>
<tr><th>Map ID</th><th>Site ID</th><th>RI Goals and Objectives for Each AOC/MRS/CRS Site</th></tr>
<tr><td>C-19</td><td>Load Line 7 (LL7)</td><td>The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours.

The RI will update groundwater COPC conditions as necessary for the BRA.

• <u>Constituents</u>: 1,1-dichloroethane, cyanide, RDX
<u>DGA-LL7(A):</u>
• RI sampling wells: LL7mw-005; LL7mw-006
• No new wells currently proposed for this DGA. 1. Review site specific hydrogeology and contaminant trends following RI sampling to determine if additional well installations are required to address vertical delineation of groundwater COPCs.
<u>FWGMP Wells:</u> LL7mw-001*

<u>RI Wells outside DGA</u>: LL7mw-001*</td></tr>
<tr><td>C-20</td><td>RVAAP-032-R-01, RVAAP -062-R-01</td><td>None.</td></tr>
<tr><td>C-21</td><td>Load Line 8 (LL8)</td><td>The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours.

The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents.

• Constituents: cyanide
<u>DGA-LL8(A):</u>
• RI Wells: LL8mw-001
• No new wells currently proposed for this DGA.
FWGMP Wells: none currently planned</td></tr>
</table>

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-22	Fuze and Booster Quarry (FBQ)	The RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours. The RI will update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene,; Nitrobenzene; Cyanide; Trichloroethene, DEHP DGA-FBQ(A): • RI sampling wells: FBQmw-174* • Vertical delineation is not provided by the current monitoring well network for non-metal COPCs present in the Homewood Aquifer. A vertical delineation well will be installed in the Upper Sharon formation to the east of FBQmw-174. The need for additional characterization of potential vertical migration of contaminants underlying AOC-specific source areas will be based on relative localized gradients determined between the aquifers and on sample results obtained from the new well. DGA-FBQ(B): • RI sampling wells: FBQmw-166; FBQmw-167 (confirmation of current conditions indicative of no COPCs exceeding SLs); FBQmw-168; FBQmw-176 (confirmation of current conditions indicative of no COPCs exceeding SLs) • No new wells currently proposed for this DGA FWGMP Wells: FBQmw-174* RI Wells not associated with DGA: FBQmw-171; FBQ-172; FBQmw-173; FBQmw-175 Alkalinity assessment FBQmw-171, FBQmw-174, FBQmw-175 will be assessed for pH conditions outside the range of naturally occurring conditions. The need for additional characterization/delineation of pH will be made following initial confirmation sampling activities.
C-23	RVAAP-46/46-R-01, CC RVAAP-73	Update groundwater COPC conditions as necessary for the BRA.

Table 2-1. RI Goals and Objectives for Each AOC/MRS/CRS Site, RVAAP-66

Map ID	Site ID	RI Goals and Objectives for Each AOC/MRS/CRS Site
C-24	NACA Test Area (NTA), Suspected Mustard Burial Site (MBS), RVAAP-03, CC RVAAP-71	Update groundwater COPC conditions as necessary for the BRA. For the following constituents. • Constituents: 2,6-dinitrotoluene, cyanide, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene DGA-NTA(A): • RI sampling wells: NTAmw-113: NTA-mw-115; NTAmw-116; NTAmw-118; • Evaluate the potential for Unconsolidated Aquifer discharge to surface water in the southern portions of the NTA site. • Vertical delineation is not provided by the current monitoring well network for non-metal COPCs present in the Unconsolidated Aquifer. A vertical delineation well will be installed in the Upper Sharon formation to the east of NTAmw-117. The need for additional characterization of potential vertical migration of contaminants underlying AOC-specific source areas will be based on relative localized gradients determined between the aquifers and on sample results obtained from the currently planned new well installations. DGA-MBS(A) • RI sampling wells: MBSmw-004; MBSmw-006 • No new wells currently proposed for this DGA FWGMP Wells: NTAmw-119*, FWGmw-007 RI Wells outside DGAs: NTAmw-109 (PCBs only), NTAmw-119*
C-25	C Block Quarry, CC RVAAP-73, CC RVAAP-76, RVAAP-21, RVAAP-24	Update groundwater COPC conditions as necessary for the BRA for the following constituents. • Constituents: cyanide, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, DEHP DGA-CBL(A) • RI sampling wells: CBLmw-001; CBLmw-003; CBLmw-004 • No new wells currently proposed for this DGA. • Evaluate the potential for historically detected COPCs to have migrated downgradient after the collection of RI samples. • Evaluate the effect of the Sharon Shale on vertical contaminant migration. FWGMP Wells: none currently planned RI Wells outside DGA: CBLmw-002 (confirm delineation downgradient of AOC)

Notes:
*Well proposed for RI and FWGMP sampling.

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Atlas Scrap Yard	ASYmw-004	Sharon Sandstone	960.10	950.10		X[1]						X[1]		
Atlas Scrap Yard	ASYmw-005	Sharon Sandstone	963.60	953.60		X[1]				X[1]		X[1]		pending
Atlas Scrap Yard	ASYmw-010	Unconsolidated	961.20	951.20		X[1]				X[1]		X[1]		pending
Building 1200	B12mw-011	Sharon Sandstone	989.76	979.76		X[1]		X[1]						pending
Building 1200	B12mw-012	Sharon Sandstone	991.43	981.43		X[1]		X[1]			X[1]			pending
Background	BKGmw-004	Unconsolidated	955.96	945.96		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending
Background	BKGmw-005	Unconsolidated	1141.24	1131.24		Background Study[2]							Anions, Cations, Alkalinity[7]	X[2]
Background	BKGmw-006	Sharon Sandstone	1001.68	991.68		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-008	Sharon Sandstone	955.70	945.70		X[1], Background Study[2]	X[1]	X[1]	X[1]	X[1]		X[1]	Anions, Cations, Alkalinity	X[2]
Background	BKGmw-015	Sharon Sandstone	1007.80	987.80		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-016	Unconsolidated	1090.02	1079.92		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-017	Unconsolidated	1109.60	1099.50		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-018	Sharon Sandstone	1028.56	1018.56		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Background	BKGmw-021	Unconsolidated	964.46	954.36		Background Study[2]							Anions, Cations, Alkalinity	X[2]
C-Block Quarry	CBLmw-001	Homewood	1139.50	1129.50		X[1]		X[1]	X[1]					pending3
C-Block Quarry	CBLmw-002	Homewood	1138.00	1128.00		X[1]		X[1]	X[1]					pending3
C-Block Quarry	CBLmw-003	Homewood	1139.22	1129.22		X[1]		X[1]	X[1]					pending3
C-Block Quarry	CBLmw-004	Homewood	1138.08	1128.08		X[1]		X[1]	X[1]					pending3
Central Burn Pits	CBPmw-001	Unconsolidated	950.91	940.91		X[1]			X[1]	X[1]		X[1]		pending[3]
Central Burn Pits	CBPmw-002	Unconsolidated	947.83	937.83		X[1]			X[1]	X[1]		X[1]		pending[3]
Central Burn Pits	CBPmw-004	Unconsolidated	951.58	941.58		X[1]			X[1]	X[1]		X[1]		pending[3]
Central Burn Pits	CBPmw-006	Unconsolidated	952.51	942.51		X[1]		X[1]				X[1]		pending[3]
Central Burn Pits	CBPmw-008	Unconsolidated	955.57	945.57		X[1]		X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Central Burn Pits	CBPmw-009	Sharon Sandstone	915.90	905.90				X[1]	X[1]	X[1]		X[1]		pending[3]

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite: VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Demolition Area 2	DA2mw-104	Unconsolidated	1054.52	1044.52		X[1]		X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Demolition Area 3	DA2mw-105	Unconsolidated	1034.36	1029.36		X[1]				X[2]				pending[3]
Demolition Area 4	DA2mw-108	Unconsolidated	1020.62	1015.62		X[1]				X[1]	X[1]			pending[3]
Demolition Area 2	DA2mw-115	Sharon Sandstone	1001.65	991.65	X	X		X[4]	X[1]	X		X[1]		X
Demolition Area 2	DET-003	Unconsolidated	1028.81	1023.81	X	X	X	X[4,5,6,7]	X	X	X	X		X
Demolition Area 2	DET-004	Unconsolidated	1031.68	1026.68	X	X	X	X[4,5,6,7]	X	X	X	X		X
Erie Burning Grounds	EBGmw-123	Unconsolidated	924.59	914.59		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-125	Unconsolidated	933.55	923.55		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-126	Unconsolidated	923.00	913.00		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-128	Unconsolidated	927.47	917.47		X[1]				X[1]		X[1]		pending[3]
Erie Burning Grounds	EBGmw-131	Sharon Sandstone	887.00	877.00		X[1]				X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-166	Unconsolidated	1099.37	1089.37		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-167	Unconsolidated	1107.05	1097.05		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-168	Homewood	1122.27	1112.27		X[1]	X[1]			X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-171	Homewood	1122.49	1112.49		X[1]	X[1]			X[1]		X[1]	Alkalinity	pending[3]
Fuze and Booster Quarry	FBQmw-172	Homewood	1125.71	1115.71		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-173	Homewood	1132.93	1112.93		X[1]	X[1]			X[1]		X[1]		pending[3]
Fuze and Booster Quarry	FBQmw-174	Homewood	1123.78	1113.78	X	X	X[1]	X[4]		X	X	X[1]	Alkalinity	X
Fuze and Booster Quarry	FBQmw-175	Homewood	1125.16	1115.16		X[1]						X[1]	Alkalinity	pending[3]
Fuze and Booster Quarry	FBQmw-176	Unconsolidated	1118.57	1108.57		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Facility-Wide	FWGmw-002	Unconsolidated	913.60	903.60	X[8]	X[8], X[1]		X[1]	X[1]	X[1]			**Alkalinity**	pending[3]
Facility-Wide	FWGmw-004	Unconsolidated	1025.00	1015.00	X	X	X[1]	X[4]	X[1]	X		X[1]		X
Facility-Wide	FWGmw-005	Homewood	1148.25	1138.25		Background Study[2]							Anions, Cations, Alkalinity	X[2]
Facility-Wide	FWGmw-007	Unconsolidated	1053.30	1043.30	X	X	X[1]	X[4]	X[1]	X		X[1]		X
Facility-Wide	FWGmw-010	Unconsolidated	953.50	943.50		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Facility-Wide	FWGmw-011	Unconsolidated	933.00	923.00	X	X		X[4]	X[1]	X				X
Facility-Wide	FWGmw-012	Sharon Sandstone	909.40	899.40	X	X		X[4]	X[1]	X				X
Facility-Wide	FWGmw-013	Sharon Sandstone	1033.10	1023.10		X[1]						X[1]		pending[3]
Facility-Wide	FWGmw-015	Unconsolidated	998.60	988.60	X	X	X[1]	X[4]	X[1]	X		X[1]		X
Facility-Wide	FWGmw-016	Sharon Sandstone	957.40	947.40	X	X		X[4]	X[1]	X				X
Load Line 1	LL1mw-063	Sharon Sandstone	975.10	965.10		X[1]				X[1]	X[1]	X[1]		pending[3]
Load Line 1	LL1mw-064	Unconsolidated	924.32	914.32	X	X		X[4]	X[1]	X		X[1]		X
Load Line 1	LL1mw-065	Unconsolidated	931.33	921.33	X	X		X[4]	X[1]	X		X[1]		X
Load Line 1	LL1mw-080	Sharon Sandstone	984.20	974.70		X[1]				X[1]		X[1]		pending[3]
Load Line 1	LL1mw-081	Sharon Sandstone	967.00	957.50		X[1]				X[1]		X[1]		pending[3]
Load Line 1	LL1mw-083	Sharon Sandstone	963.70	954.20	X	X		X[4]	X[1]	X	X	X[1]		X
Load Line 1	LL1mw-084	Sharon Sandstone	969.70	960.10	X	X		X[4]	X[1]	X	X	X[1]		X
Load Line 1	LL1mw-086	Unconsolidated	873.50	863.50	X	X		X[4]	X[1]	X		X[1]		X

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Load Line 1	LL1mw-087	Unconsolidated	934.80	924.80	X	X		X[4]	X[1]	X		X[1]		X
Load Line 1	LL1mw-088	Unconsolidated	922.40	912.40	X	X		X[4]	X[1]	X	X	X[1]		X
Load Line 2	LL2mw-059	Sharon Sandstone	955.03	945.23	X	X		X[4]	X[1]	X		X[1]		X
Load Line 2	LL2mw-060	Sharon Sandstone	950.83	941.03	X	X		X[4]	X[1]	X		X[1]		X
Load Line 2	LL2mw-261	Sharon Sandstone	999.75	989.75		X[1]			X[1]	X[1]		X[1]		pending[3]
Load Line 2	LL2mw-267	Sharon Sandstone	1003.01	993.01	X	X		X[4]	X[1]	X		X[1]		X
Load Line 3	LL2mw-268	Sharon Sandstone	998.17	988.17		X[1]	X[1]							pending[3]
Load Line 2	LL2mw-270	Sharon Sandstone	1000.13	990.13		X[1]			X[1]	X[1]	X[1]	X[1]		pending[3]
Load Line 2	LL2mw-271	Sharon Sandstone	944.10	934.10	X	X		X[4]	X[1]	X		X[1]	Perchlorate	X
Load Line 3	LL3mw-234	Sharon Sandstone	994.67	984.67		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Load Line 3	LL3mw-236	Sharon Sandstone	995.14	985.14		X[1]	X[1]			X[1]		X[1]		pending[3]
Load Line 3	LL3mw-237	Sharon Sandstone	990.87	980.87		X[1]	X[1]			X[1]		X[1]		pending[3]
Load Line 3	LL3mw-238	Sharon Sandstone	994.25	984.25	X	X	X[1]	X[4]	X	X	X	X[1]		X
Load Line 3	LL3mw-239	Sharon Sandstone	976.80	966.80		X[1]				X[1]				pending[3]
Load Line 3	LL3mw-241	Sharon Sandstone	979.71	969.71	X	X	X[1]	X[4]	X	X	X	X[1]		X
Load Line 3	LL3mw-243	Sharon Sandstone	975.56	965.56		X[1]	X[1]			X[1]	X[1]	X[1]		pending[3]
Load Line 3	LL3mw-244	Sharon Sandstone	951.70	941.70	X	X	X[1]	X[4]	X	X	X	X[1]		X + Cr(VI)
Load Line 3	LL3mw-246	Sharon Sandstone	953.70	943.70	X	X	X[1]	X[4]	X	X		X[1]	Perchlorate	X
Load Line 4	LL4mw-193	Unconsolidated	969.58	959.58		X[1]	X[1]	X[1]		X[1]	X[1]	X[1]		pending[3]
Load Line 4	LL4mw-194	Unconsolidated	970.57	960.57		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 4	LL4mw-197	Unconsolidated	972.99	962.99		X[1]						X[1]		pending[3]
Load Line 4	LL4mw-200	Unconsolidated	973.37	963.37		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 4	LL4mw-201	Sharon Sandstone	919.40	909.40		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 5	LL5mw-001	Homewood	1111.00	1101.00		X[1]	X[1]		X[1]					pending[3]
Load Line 5	LL5mw-002	Homewood	1110.80	1100.80		X[1]	X[1]		X[1]			X[1]		pending[3]
Load Line 5	LL5mw-006	Homewood	1111.10	1101.10		X[1]	X[1]		X[1]			X[1]		pending[3]
Load Line 6	LL6mw-001	Unconsolidated	N/A	N/A		X[1]		X[1]				X[1]		pending[3]
Load Line 6	LL6mw-002	Unconsolidated	N/A	N/A		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-003	Homewood	N/A	N/A		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-006	Unconsolidated	N/A	N/A		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-007	Homewood	N/A	N/A		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 6	LL6mw-008	Unconsolidated	1114.10	1104.10		X[1]		X[1]		X[1]		X[1]		pending[3]
Load Line 7	LL7mw-001	Homewood	1107.40	1097.40	X	X	X	X[4]		X		X[1]		X
Load Line 7	LL7mw-005	Homewood	1115.30	1105.30		X[1]						X[1]		pending[3]
Load Line 7	LL7mw-006	Homewood	1103.20	1093.20		X[1]	X[1]	X[1]		X[1]	X[1]	X[1]		pending[3]
Load Line 8	LL8mw-001	Unconsolidated	1104.69	1094.69		X[1]						X[1]		pending[3]
Load Line 9	LL9mw-003	Homewood	N/A	N/A		X[1]		X[1]		X[1]				pending[3]
Load Line 9	LL9mw-004	Homewood	N/A	N/A		X[1]		X[1]		X[1]				pending[3]
Load Line 9	LL9mw-005	Homewood	N/A	N/A		X[1]		X[1]		X[1]				pending[3]
Load Line 9	LL9mw-007	Homewood	N/A	N/A		X[1]		X[1]		X[1]	X[1]			pending[3]

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Load Line 10	LL10mw-001	Homewood	1113.00	1103.00		X[1]	X[1]			X[1]		X[1]		pending[3]
Load Line 10	LL10mw-003	Homewood	1111.40	1101.40	**X**	**X**	**X**	**X[4,5]**		X[1]		X[1]		**X**
Load Line 10	LL10mw-006	Unconsolidated	1107.70	1097.70		X[1]						X[1]		pending[3]
Load Line 11	LL11mw-001	Unconsolidated	1086.06	1076.06				X[1]						pending[3]
Load Line 11	LL11mw-002	Unconsolidated	1073.99	1063.99		X[1]		X[1]		X[1]	X[1]	X[1]		pending[3]
Load Line 11	LL11mw-003	Unconsolidated	1082.55	1072.55		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 11	LL11mw-005	Unconsolidated	1073.40	1063.40		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 11	LL11mw-006	Unconsolidated	1081.01	1071.01		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 11	LL11mw-010	Unconsolidated	1069.32	1059.32		X[1]	X[1]	X[1]		X[1]		X[1]		pending[3]
Load Line 12	LL12mw-107	Unconsolidated	957.33	947.33		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-153	Unconsolidated	963.04	953.04				X[1]						pending[3]
Load Line 12	LL12mw-154	Unconsolidated	960.60	950.60		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-182	Unconsolidated	957.00	947.00		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-183	Sharon Shale	957.29	947.05		X[1]		X[1]			X[1]			pending[3]
Load Line 12	LL12mw-185	Unconsolidated	968.29	958.29	**X**	**X**	X[1]	X[1]	X[1]	X[1]		X[1]	**Nitrate**	**Arsenic**
Load Line 12	LL12mw-186	Sharon Shale	967.54	957.54		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Load Line 12	LL12mw-187	Unconsolidated	960.70	950.70	**X**	**X, X[1]**	X[1]	**X[4], X[1]**	X[1]	**X**		X[1]	**Nitrate, Hydrazine[1]**	**X**
Load Line 12	LL12mw-188	Unconsolidated	968.66	958.66		X[1]				X[1]	X[1]			pending[3]
Load Line 12	LL12mw-189	Sharon Shale	968.67	958.67		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
Load Line 12	LL12mw-242	Unconsolidated	962.90	952.90	**X**	**X**	X[1]	**X[4]**	X[1]	**X**		X[1]	**Nitrate**	**X**
Load Line 12	LL12mw-243	Unconsolidated	965.10	955.10		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
Load Line 12	LL12mw-244	Unconsolidated	958.60	948.60		X[1]	X[1]				X[1]		Hydrazine[1]	pending[3]
Load Line 12	LL12mw-245	Unconsolidated	959.50	949.50	**X**	**X**	X[1]	**X[4]**	X[1]	**X**	X[1]	X[1]	**Nitrate**	**X**
Load Line 12	LL12mw-247	Unconsolidated	971.30	961.30	**X**	**X**		**X[4]**	X[1]	**X**	X[1]	X[1]	**Nitrate**	**X + Cr(VI)**
Landfill North of Winklepeck	LNWmw-025	Unconsolidated	1019.20	1009.20		X[1]		X[1]		X[1]		X[1]		pending[3]
Landfill North of Winklepeck	LNWmw-026	Unconsolidated	1012.00	1002.00		X[1]		X[1]		X[1]		X[1]		pending[3]
Suspected Mustard Agent Burial Site	MBS-004	Unconsolidated	1064.85	1055.15		X[1]				X[1]		X[1]		pending[3]
Suspected Mustard Agent Burial Site	MBS-006	Unconsolidated	1063.79	1053.79		X[1]				X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-109	Unconsolidated	1068.89	1058.89		X[1]			X[1]					pending[3]
NACA Test Area	NTAmw-113	Unconsolidated	1055.61	1045.61		X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]		pending[3]
NACA Test Area	NTAmw-115	Unconsolidated	1074.41	1064.41		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-116	Unconsolidated	1081.68	1071.68		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-118	Unconsolidated	1066.86	1056.86		X[1]	X[1]	X[1]	X[1]	X[1]		X[1]		pending[3]
NACA Test Area	NTAmw-119	Unconsolidated	987.40	977.40	**X**	**X**	**X**	**X[4,5,6]**	X[1]	**X**		X[1]		**X**
Ramsdell Quarry Landfill	RQLmw-007	Sharon Sandstone	957.86	947.86	**X**	**X**	**X**	**X[4,6,7]**	**X**	**X**	**X**	**X**	Phosphorus[1]	**X**
Ramsdell Quarry Landfill	RQLmw-008	Sharon Sandstone	957.82	947.82	**X**	**X**	**X**	**X[4,6,7]**	**X**	**X**	**X**	**X**		**X**
Ramsdell Quarry Landfill	RQLmw-009	Sharon Sandstone	956.70	946.70	**X**	**X**	**X**	**X[4,6,7]**	**X**	**X**	**X**	**X**		**X**
Ramsdell Quarry Landfill	RQLmw-011	Sharon Sandstone	962.20	942.20	**X[8]**	**X[8]**	X[1]	X[1]	X[1]	X[1]		X[1]	**Alkalinity**	pending[3]
Ramsdell Quarry Landfill	RQLmw-012	Sharon Sandstone	955.32	945.32	**X[8]**	**X[8]**	X[1]	X[1]	X[1]	X[1]		X[1]	**Alkalinity**	pending[3]

Table 3-3
FWGW and RI Monitoring Wells
Camp Ravenna

RVAAP Area	Well ID	Monitored Zone	Top of Screen Elevation (ft AMSL)	Bottom of Screen Elevation (ft AMSL)	Wells Sampled Spring 2016 FWGMP Wells Shaded	Wells Sampled Fall 2016 FWGMP Wells Shaded	Analytical Testing Suite VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals
Ramsdell Quarry Landfill	RQLmw-013	Sharon Sandstone	954.34	944.34	**X**[8]	**X**[8]	X[1]	X[1]	X[1]	X[1]	X[1]	X[1]	**Alkalinity**	pending[3]
Ramsdell Quarry Landfill	RQLmw-014	Sharon Sandstone	952.23	942.23		X[1]				X[1]			Alkalinity	pending[3]
Ramsdell Quarry Landfill	RQLmw-015	Sharon Sandstone	959.99	949.99		X[1]			X[1]					pending[3]
Ramsdell Quarry Landfill	RQLmw-016	Sharon Sandstone	965.52	955.52		X[1]						X[1]		pending[3]
Ramsdell Quarry Landfill	RQLmw-017	Sharon Sandstone	968.89	958.89		X[1]			X[1]					pending[3]
Sharon Conglomerate	SCFmw-001	Basal Sharon Cong.	917.53	907.53		X[1]	X[1]	X	X[1]	X[1]		X[1]		pending[3]
Sharon Conglomerate	SCFmw-002	Basal Sharon Cong.	845.28	835.28	**X**	**X**	X[1]	**X**[4]	X[1]	**X**	**X**	X[1]		**X + Cr(VI)**
Sharon Conglomerate	SCFmw-003	Basal Sharon Cong.	830.64	820.64		X[1]	X[1]	X	X[1]	X[1]		X[1]		pending[3]
Sharon Conglomerate	SCFmw-004	Basal Sharon Cong.	841.87	831.87	**X**	**X**	X[1]	**X**[4]	X[1]	**X**	**X**	X[1]		**X**
Sharon Conglomerate	SCFmw-006	Basal Sharon Cong.	887.69	877.69		X[1], Background Study[2]	X[1]	X[1]	X[1]	X[1]		X[1]	Anions, Cations, Alkalinity	X[2]
Upper and Lower Cobbs Pond	ULCPmw-001	Unconsolidated	950.91	940.91		X[1]				X[1]				pending[3]
Upper and Lower Cobbs Pond	ULCPmw-003	Unconsolidated	957.54	947.54		X[1]						X[1]		pending[3]
Upper and Lower Cobbs Pond	ULCPmw-006	Unconsolidated	952.51	942.51		X[1]		X[6]						pending[3]
Winklepeck Burning Grounds	OBG-1	Unconsolidated	N/A	N/A		X[1]	X[1]			X[1]		X[1]		pending[3]
Winklepeck Burning Grounds	OBG-4	N/A	N/A	N/A		X[1]				X[1]				pending[3]
Winklepeck Burning Grounds	WBGmw-006	Unconsolidated	1004.56	994.56	**X**	**X**	X[1]	**X**[4]	X[1]	**X**		X[1]		**X**
Winklepeck Burning Grounds	WBGmw-007	Unconsolidated	984.59	974.59		X[1]	X[1]			X[1]		X[1]		pending[3]
Winklepeck Burning Grounds	WBGmw-009	Unconsolidated	1033.63	1023.63	**X**	**X**	X[1]	**X**[4]		**X**		X[1]		**X**
Winklepeck Burning Grounds	WBGmw-014	Unconsolidated	982.10	972.10		X[1]				X[1]				pending[3]
Winklepeck Burning Grounds	WBGmw-018	Unconsolidated	977.00	967.00		X[1]				X[1]				pending[3]
Winklepeck Burning Grounds	WBGmw-019	Sharon Sandstone	949.75	939.75		X[1]	X[1]			X[1]		X[1]		pending[3]
Winklepeck Burning Grounds	WBGmw-020	Sharon Sandstone	1010.50	1000.50	**X**	**X**		**X**[4]	X[1]	**X**				**X**
Winklepeck Burning Grounds	WBGmw-021	Sharon Sandstone	978.00	968.00	**X**	**X**	X[1]	**X**[4]	X[1]	**X**		X[1]		**X**

Notes:
AMSL = above mean sea level
FWGMP = Facility-Wide Groundwater Monitoring Program
X - indicates well or constituent to be sampled as part of the 2016 FWGWMP or during the RI characterization sampling
Bold and shaded cells indicate content associated with the 2016 FWGWMP
[1] Indicates monitoring well or constituents to be sampled as part of the RI characterization effort only (not part of the FWGWMP). All RI Wells will be sampled at least once in association with the Fall 2016 FWGMP event. Additional rounds of sampling for select wells and constituents will be conducted based on the initial RI testing results. Wells/constituents confirmed with stable or decreasing concentrations will generally only be sampled once for the purposes of the RI.
[2] Background study wells will be sampled for a minimum of three consecutive quarters in order to obtain a base representative sample set of 12 per aquifer
[3] Metals to be characterized for the RI will be selected based on a comparison of historical sampling results to individual constituent upper-bound value concentrations in the pending metals background study following approval by Ohio EPA.
[4] SVOCs: phthalates
[5] SVOCs: nitroaromatics
[6] SVOCs: polycyclic aromatic hydrocarbons
[7] SVOCs: phenols
[8] Indicates FWGMP well identified for alkalinity testing only

FIGURES

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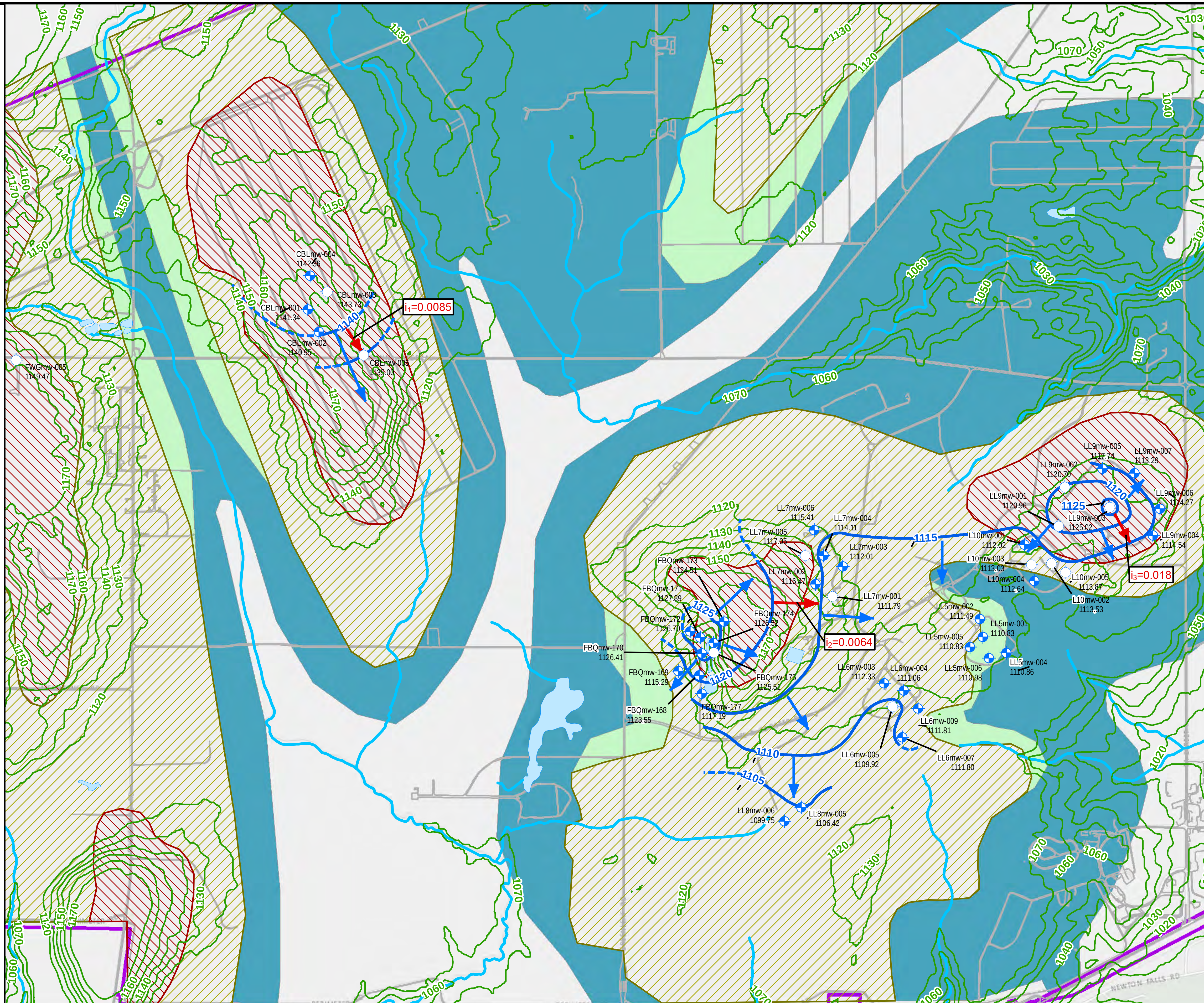
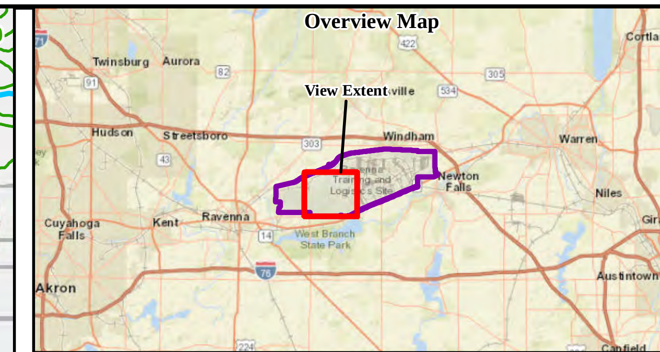




Legend

- Upper Bedrock Aquifer Well Locations
- Homewood and Mercer Contour Intervals
- Inferred Homewood and Mercer Contour Intervals
- Direction Of Flow
- i1 = Hydraulic Gradient (ft/ft)
- Roads
- Creeks and Streams
- Elevation Contours (Feet)
- Camp Ravenna Property Line

Geology Formation

- Homewood Sandstone Member
- Mercer Member
- Massillon Sandstone
- Sharon Member - Shale

Add note:
All wells presented are installed within the upper contact saturated zone of the initial bedrock formation, reported in previously prepared documents as the Homewood Sandstone. The pending RI will include review of historical well installation records with respect to monitored formations and evaluation of the localized hydrogeology to confirm hydraulic connection of the monitoring well saturated intervals utilized for generating potentiometric surface elevation contours.

Notes:
- Potentiometric Surfaces based on data collected in July 2015
- Basemap Sources: ESRI Map Services - Canvas/World_Light_Gray_Base and World_Street_Map
- Surface Elevation Contours - USDA

N

0 1,625 3,250 Feet

1:19,500
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

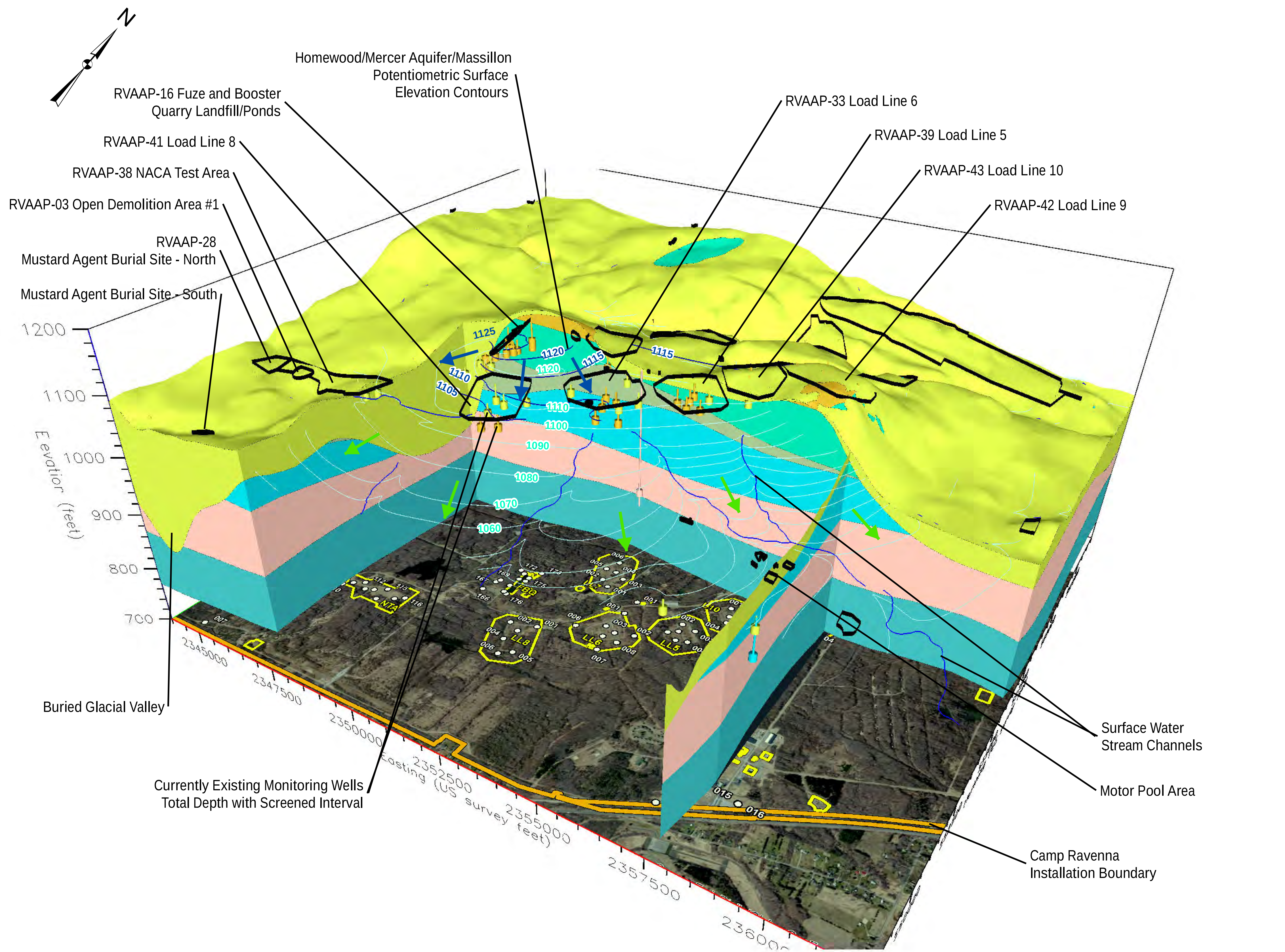
POTENTIOMETRIC SURFACE MAP
HOMEWOOD SANDSTONE AQUIFER

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-8

FINAL

Path: I:\GIS Project Files\15363_Cardno Weston Services\Ravenna\GIS\MXDs\Work_Plans\RI_WP_FINAL\Fig_1_08 Potentiometric Surface Map - Homewood Sandstone Aquifer.mxd, 6/13/2016 1:25:58 PM, herrinm



Legend

- AOC Physical Location Boundaries
- Unconsolidated Aquifer Potentiometric Surface Elevation Contours
- Homewood/Mercer/Massillon Aquifer Potentiometric Surface Elevation Contours
- Surface Water Stream Channels
- Unconsolidated Aquifer Flow Direction
- Homewood/Mercer/Massillon Aquifer Flow Direction
- Homewood Well
- Overburden Well
- Basal Sharon Conglomerate Well
- Sharon Member Shale Unit Well

Geology

- Unconsolidated
- Homewood Sandstone Member
- Mercer Member
- Massillon Sandstone Member
- Sharon Member, Shale Unit
- Sharon Member, Sandstone/Conglomerate Unit
- Cuyahoga Group

(Homewood Sandstone Member through Sharon Member, Sandstone/Conglomerate Unit: Pottsville Formation)

Notes:
This illustration is a preliminary draft intended for discussion purposes only. Figure is not to scale.

TEC-Weston Joint Venture

FUZE AND BOOSTER QUARRY AREA
KEY HYDROGEOLOGY DYNAMICS
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 1-11

FINAL

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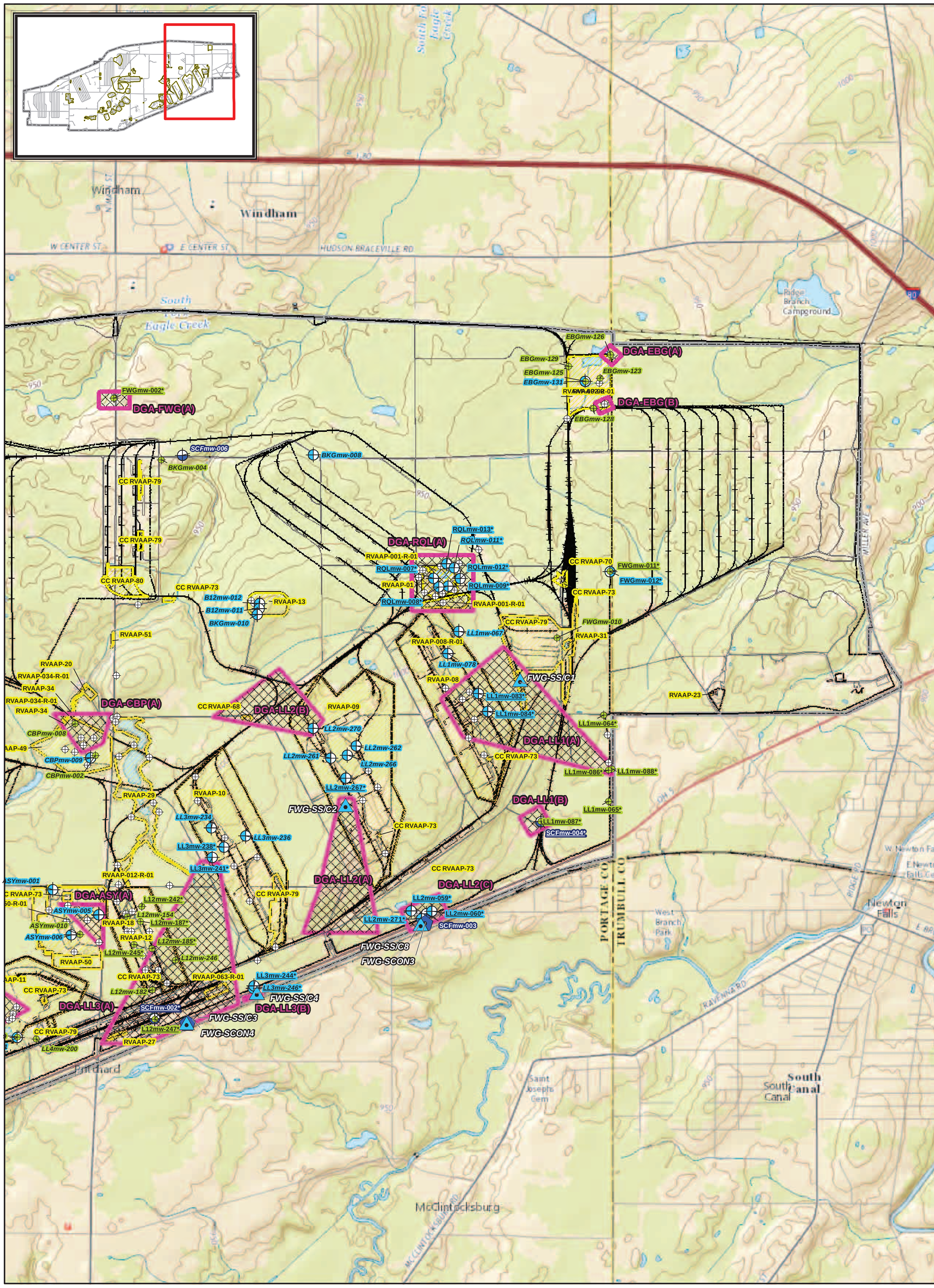

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Existing Groundwater Monitoring Wells to be Sampled During the RI

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- * Wells with underlined labels are Proposed 2016 FWGW Monitoring Program Wells
- Other Existing Monitoring Well - (Not to be sampled during the RI)

Proposed Well Installations

- Upper Sharon Sandstone
- Basal Sharon Conglomerate
- Unconsolidated
- AOCs
- Potential Horizontal and Vertical Delineation Gap Area
- Camp Ravenna Boundary

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,500 ft
NAD83 UTM Zone 17N

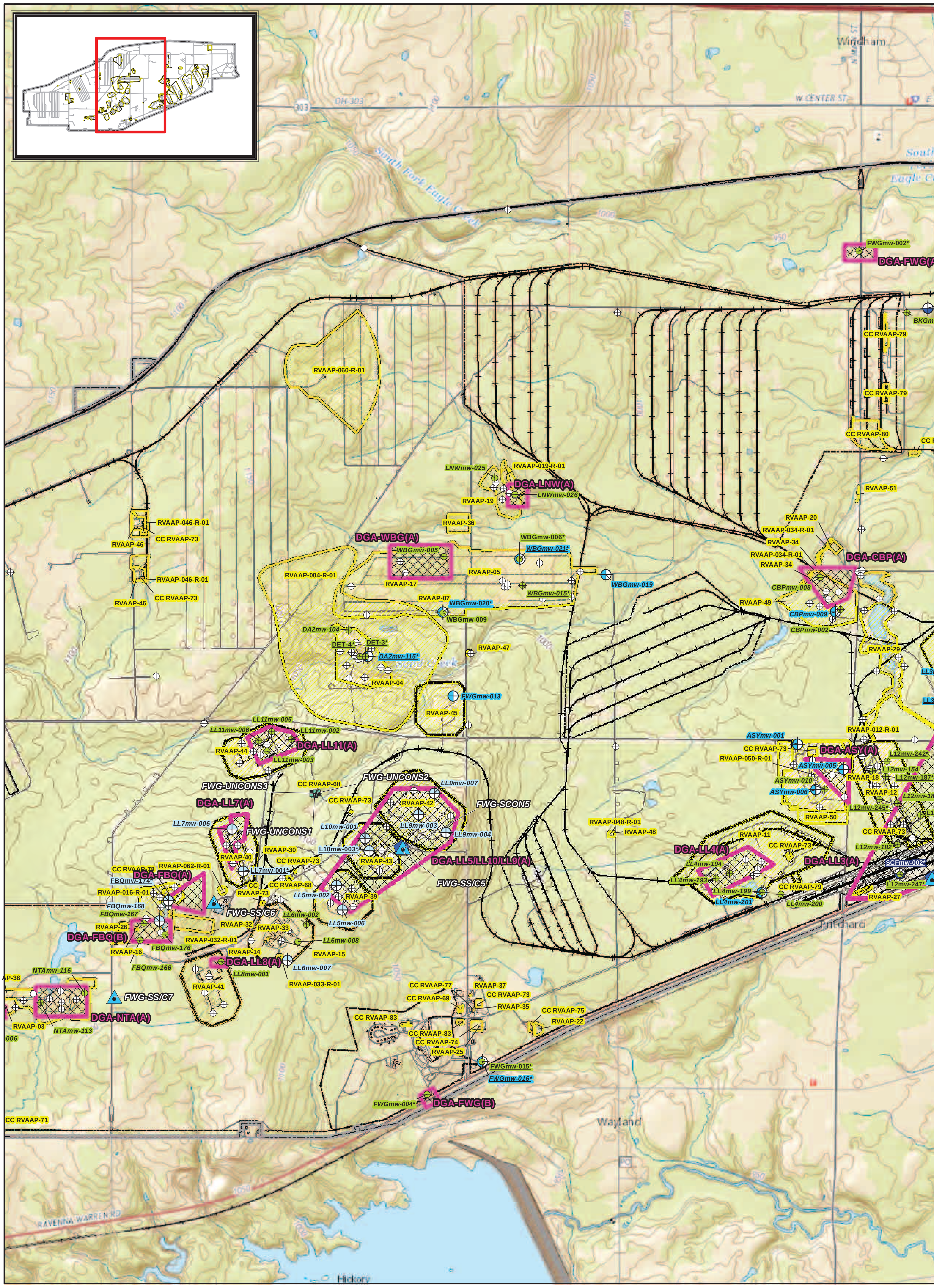
TEC-Weston Joint Venture

RI SAMPLE AND NEW GROUNDWATER MONITORING WELL LOCATIONS - EAST

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-1

FINAL



Existing Groundwater Monitoring Wells to be Sampled During the RI

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review
- * Wells with underlined labels are Proposed 2016 FWGW Monitoring Program Wells
- Other Existing Monitoring Well - (Not to be sampled during the RI)

Proposed Well Installations

- Upper Sharon Sandstone
- Basal Sharon Conglomerate
- Unconsolidated
- AOCs
- Potential Horizontal and Vertical Delineation Gap Area
- Camp Ravenna Boundary

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,490 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RI SAMPLE AND NEW GROUNDWATER MONITORING WELL LOCATIONS - CENTRAL

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-2

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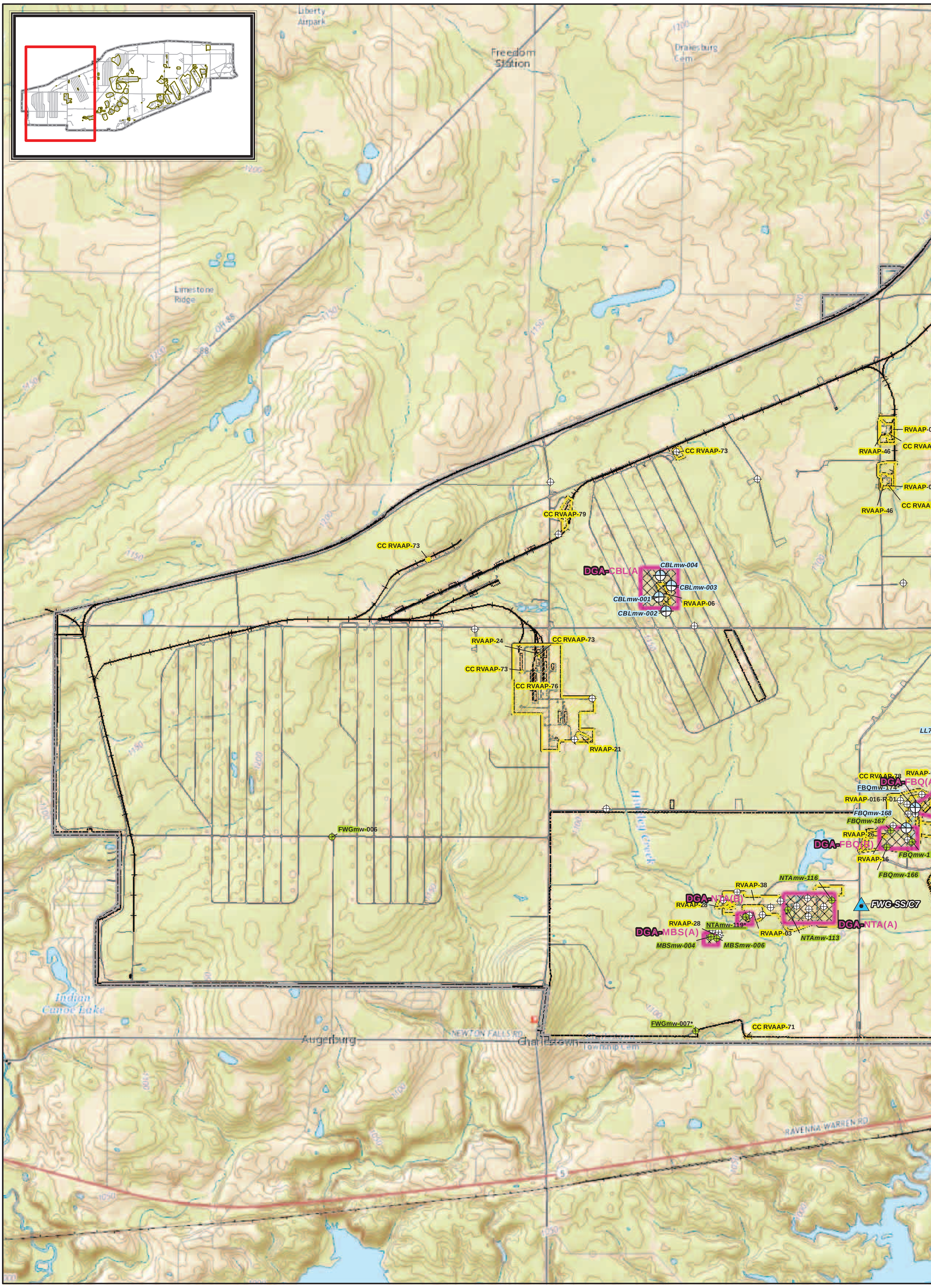

Existing Groundwater Monitoring Wells to be Sampled During the RI

- Groundwater Station (Unconsolidated Unit)
- Groundwater Station (Homewood)
- Groundwater Station (Sharon Sandstone)
- Groundwater Station (Sharon Shale)
- Groundwater Station (Sharon Cong.)
- Groundwater Station (unknown unit); Current Well Status Under Review

* Wells with underlined labels are Proposed 2016 FWGW Monitoring Program Wells

- Other Existing Monitoring Well - (Not to be sampled during the RI)

Proposed Well Installations

- Upper Sharon Sandstone
- Basal Sharon Conglomerate
- Unconsolidated
- AOCs
- Potential Horizontal and Vertical Delineation Gap Area
- Camp Ravenna Boundary

N

0 1,300 2,600 3,900 5,200 Feet

1 " = 2,490 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RI SAMPLE AND NEW GROUNDWATER MONITORING WELL LOCATIONS - WEST

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: 3-3

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APPENDIX C

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Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	2,4-Dinitrotoluene	Yes	178	8	0.00005	0.001	0.00024	4	1	0.000033	0.00035	7/22/2015	5/28/1999	9/20/2001	2/14/1999	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	2,6-Dinitrotoluene	Yes	178	4	0.00005	0.001	0.000048	178	4	0.000066	0.00027	7/22/2015	4/27/2009	7/22/2015	4/27/2009	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	2-Nitrotoluene	Yes	178	5	0.000099	0.001	0.00031	84	1	0.000089	0.00032	7/22/2015	4/6/2011	10/12/2011	4/6/2011	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	Nitrobenzene	Yes	178	12	0.00005	0.001	0.00014	60	7	0.000044	0.00062	7/22/2015	7/23/2012	7/23/2012	7/23/2012	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Explosives	Nitroglycerin	Yes	168	4	0.0005	0.017	0.0002	168	4	0.00067	0.0028	7/22/2015	8/19/2013	7/22/2015	8/19/2013	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Miscellaneous	Cyanide	Yes	168	9	0.005	0.01	0.00015	169	9	0.0034	0.01	7/22/2015	7/22/2015	7/22/2015	7/22/2015	
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**alpha-BHC**	**No**	**156**	**4**	**0.0000095**	**0.00024**	**0.0000071**	**156**	**4**	**0.0000083**	**0.000023**	**7/22/2015**	**10/14/2010**	**7/22/2015**	**10/14/2010**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**156**	**20**	**0.0000095**	**0.00024**	**0.000025**	**123**	**5**	**0.0000083**	**0.000075**	**7/22/2015**	**7/24/2014**	**7/22/2015**	**7/23/2012**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**156**	**1**	**0.0000095**	**0.00024**	**0.0000014**	**156**	**1**	**0.0000088**	**0.0000088**	**7/22/2015**	**10/9/2008**	**7/22/2015**	**10/9/2008**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	Pest/PCBs	PCB-1248	Yes	157	4	0.00019	0.002	0.0000078	157	4	0.0001	0.00026	7/22/2015	10/9/2008	7/22/2015	10/9/2008	
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**Pest/PCBs**	**Toxaphene**	**No**	**156**	**1**	**0.00048**	**0.01**	**0.000015**	**156**	**1**	**0.00064**	**0.00064**	**7/22/2015**	**10/9/2007**	**7/22/2015**	**10/9/2007**	**Pesticide from historical agricultural use**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	178	67	0.00048	0.013	0.0056	97	8	0.00022	0.084	7/22/2015	8/19/2013	10/12/2011	4/27/2009	Potential lab contaminant
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Dibenz(a,h)anthracene	Yes	178	1	0.000095	0.013	0.0000034	178	1	0.00014	0.00014	7/22/2015	10/12/2011	7/22/2015	10/12/2011	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	178	1	0.000095	0.013	0.000034	178	1	0.00014	0.00014	7/22/2015	10/12/2011	7/22/2015	10/12/2011	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	SVOCs	Naphthalene	Yes	178	1	0.000095	0.013	0.00017	145	1	0.00024	0.00024	7/22/2015	10/14/2010	10/12/2011	10/14/2010	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	VOCs	1,1,2,2-Tetrachloroethane	Yes	178	1	0.00025	0.005	0.000076	178	1	0.00084	0.00084	7/22/2015	7/27/1998	7/22/2015	7/27/1998	
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	VOCs	Benzene	Yes	178	1	0.00025	0.005	0.00045	153	1	0.00052	0.00052	7/22/2015	7/25/1998	7/22/2015	7/25/1998	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-(
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date	Most Recent Result (mg/L)
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Explosives	Nitrobenzene	10	1	0.0002	0.00014	7	1	0.0003	10/19/98	< 0.0001 U	08/19/13	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Explosives	Nitroglycerin	10	2	0.0025	0.0002	10	2	0.0028	07/25/98	< 0.00051 U	08/19/13	0.00051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Pesticides and PCBs	beta-BHC	7	2	0.00005	0.000025	6	1	0.000063	10/11/11	0.000013 JB	08/19/13	0.000013
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	Volatile Organics	Benzene	10	1	0.005	0.00045	9	1	0.00052	07/25/98	< 0.00025 U	08/19/13	0.00025
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Explosives	2,6-Dinitrotoluene	30	1	0.001	0.000048	30	1	0.00008	04/27/09	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Explosives	Nitrobenzene	30	2	0.001	0.00014	8	1	0.00062	10/20/98	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Miscellaneous	Cyanide	29	8	0.01	0.00015	30	8	0.01	07/22/15	0.01 J	07/22/15	0.01
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Miscellaneous	Total Phosphorus as P	2	1	0.1	0.00004	2	1	0.1	09/20/01	< 0.1 U	09/20/01	0.1
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Semi-Volatile Organics	Dibenz(a,h)anthracene	30	1	0.01	0.0000034	30	1	0.00014	10/12/11	< 0.000098 U	07/22/15	0.000098
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	30	1	0.01	0.000034	30	1	0.00014	10/12/11	< 0.000098 U	07/22/15	0.000098
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	2,4-Dinitrotoluene	27	4	0.00029	0.00024	2	1	0.00035	02/14/99	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	2,6-Dinitrotoluene	27	1	0.00013	0.000048	27	1	0.00027	04/16/07	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	Nitrobenzene	27	4	0.00073	0.00014	6	3	0.00058	10/20/98	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Explosives	Nitroglycerin	24	2	0.0025	0.0002	24	2	0.002	07/22/98	< 0.00052 U	07/22/15	0.00052
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Pesticides and PCBs	alpha-BHC	24	3	0.00015	0.0000071	24	3	0.000023	10/14/09	< 0.000051 UJ	07/22/15	0.000051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Pesticides and PCBs	beta-BHC	24	7	0.00015	0.000025	17	3	0.000075	07/23/12	< 0.000051 UJ	07/22/15	0.000051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Pesticides and PCBs	Toxaphene	24	1	0.01	0.000015	24	1	0.00064	10/09/07	< 0.002 UJ	07/22/15	0.002
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	27	8	0.01	0.0056	14	1	0.0075	04/27/09	< 0.0053 U	07/22/15	0.0053
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Explosives	2,6-Dinitrotoluene	36	1	0.00013	0.000048	36	1	0.000071	04/10/08	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Explosives	Nitrobenzene	36	2	0.0002	0.00014	7	2	0.00041	10/20/98	< 0.0001 U	07/22/15	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Pesticides and PCBs	beta-BHC	32	4	0.00005	0.000025	21	1	0.00005	07/24/14	< 0.000048 UJ	07/22/15	0.000048
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Pesticides and PCBs	Heptachlor	32	1	0.00005	0.0000014	32	1	0.0000088	10/09/08	< 0.000048 UJ	07/22/15	0.000048
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	36	12	0.011	0.0056	15	1	0.047	04/27/09	< 0.0048 U	07/22/15	0.0048
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	3	0.01	0.0056	6	1	0.011	05/27/99	0.00063	08/19/13	0.00063
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Inorganics	Beryllium	20	6	0.005	0.0025	1	1	0.014	02/13/99	< 0.001 U	08/19/13	0.001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	4	0.01	0.0056	9	2	0.084	05/27/99	0.00022 B	08/19/13	0.00022
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Semi-Volatile Organics	Naphthalene	11	1	0.013	0.00017	10	1	0.00024	10/14/10	< 0.000095 U	08/19/13	0.000095
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-011	Volatile Organics	1,1,2,2-Tetrachloroethane	11	1	0.005	0.000076	11	1	0.00084	07/27/98	< 0.00025 U	08/19/13	0.00025
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	Pesticides and PCBs	PCB-1248	13	1	0.002	0.0000078	13	1	0.00014	10/09/08	< 0.0005 UJ	10/11/11	0.0005
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	13	6	0.013	0.0056	8	1	0.022	05/20/04	0.001 JB	10/11/11	0.001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-013	Pesticides and PCBs	alpha-BHC	8	1	0.00006	0.0000071	8	1	0.0000083	01/19/09	0.0000083 J	01/19/09	0.0000083
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-014	Explosives	2-Nitrotoluene	9	1	0.00056	0.00031	7	1	0.00032	04/06/11	< 0.00052 U	10/11/11	0.00052
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-014	Pesticides and PCBs	PCB-1248	9	1	0.0015	0.0000078	9	1	0.0001	10/09/08	< 0.00051 UJ	10/11/11	0.00051
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-015	Pesticides and PCBs	PCB-1248	8	1	0.0015	0.0000078	8	1	0.00016	10/09/08	< 0.00052 U	10/12/11	0.00052
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Explosives	2,6-Dinitrotoluene	9	1	0.00016	0.000048	9	1	0.000066	10/09/08	< 0.0001 U	10/11/11	0.0001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Miscellaneous	Cyanide	8	1	0.01	0.00015	8	1	0.0067	10/09/08	< 0.01 U	04/06/11	0.01
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.013	0.0056	5	1	0.015	05/21/04	0.0012 JB	10/11/11	0.0012
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-017	Inorganics	Beryllium	9	5	0.001	0.0025	1	1	0.0027	05/19/04	< 0.001 U	10/11/11	0.001
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-017	Pesticides and PCBs	PCB-1248	9	1	0.0015	0.0000078	9	1	0.00026	10/09/08	< 0.00054 U	10/11/11	0.00054
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-017	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	4	0.013	0.0056	6	1	0.0095	05/19/04	< 0.0099 U	10/11/11	0.0099

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-011**	**1,1,2,2-Tetrachloroethane**	**7.60E-05**	**0.00084**	**07/27/98**	**11.1**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-008**	**2,4-Dinitrotoluene**	**0.00024**	**0.00035**	**02/14/99**	**1.5**	**=**	**1**	**mg/L**	**8**	**339**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-006	2,4-Dinitrotoluene	0.00024	0.00022	02/13/99	0.9	=	2	mg/L	8	339	1	No	Well has had 4 consecutive ND results since last detection.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	2,4-Dinitrotoluene	0.00024	0.00016	02/14/99	0.7	=	3	mg/L	8	339	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-008**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00027**	**04/16/07**	**5.6**		**1**	**mg/L**	**5**	**339**	**5**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	MW-4	2,6-Dinitrotoluene	4.80E-05	8.50E-05	07/13/98	1.8	J	2	mg/L	5	339	5	No	Well has been abandoned.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	2,6-Dinitrotoluene	4.80E-05	8.00E-05	04/27/09	1.7	J	3	mg/L	5	339	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-014**	**2-Nitrotoluene**	**0.00031**	**0.00032**	**04/06/11**	**1.0**	**J**	**1**	**mg/L**	**5**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	2-Nitrotoluene	0.00031	0.00016	09/19/98	0.5	J	2	mg/L	5	184	1	Yes	To be sampled under the FWGWMP.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	2-Nitrotoluene	0.00031	0.00011	04/16/07	0.4	J	3	mg/L	5	184	1	No	Well has had 16 consecutive ND results since last detection.
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-011**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.084**	**05/27/99**	**15.0**	**=**	**1**	**mg/L**	**67**	**184**	**7**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Bis(2-ethylhexyl)phthalate	0.0056	0.047	04/27/09	8.4		2	mg/L	67	184	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	Bis(2-ethylhexyl)phthalate	0.0056	0.022	05/20/04	3.9	=	3	mg/L	67	184	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-006**	**Benzene**	**0.00045**	**0.00052**	**07/25/98**	**1.2**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**No**	**Well has had 9 consecutive ND results since last detection.**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Cyanide**	**0.00015**	**0.01**	**07/22/15**	**66.7**	**J**	**1**	**mg/L**	**10**	**175**	**9**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-016	Cyanide	0.00015	0.0067	10/09/08	44.7	J	2	mg/L	10	175	9	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00014**	**10/12/11**	**41.2**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00014**	**10/12/11**	**4.1**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-011**	**Naphthalene**	**0.00017**	**0.00024**	**10/14/10**	**1.4**	**J**	**1**	**mg/L**	**1**	**184**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-007**	**Nitrobenzene**	**0.00014**	**0.00062**	**10/20/98**	**4.4**	**J**	**1**	**mg/L**	**12**	**339**	**7**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Nitrobenzene	0.00014	0.00058	10/20/98	4.1	J	2	mg/L	12	339	7	Yes	To be sampled under the FWGWMP.
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-009	Nitrobenzene	0.00014	0.00041	10/20/98	2.9	J	3	mg/L	12	339	7	No	Well has had 23 consecutive ND results since last detection.
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-006**	**Nitroglycerin**	**0.0002**	**0.0028**	**07/25/98**	**14.0**	**J**	**1**	**mg/L**	**4**	**174**	**4**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Nitroglycerin	0.0002	0.002	07/22/98	10.0	J	2	mg/L	4	174	4	Yes	To be sampled under the FWGWMP.
RVAAP-01 Ramsdell Quarrry Landfill	**Sharon**	**RQLmw-017**	**PCB-1248**	**0.0000078**	**0.00026**	**10/09/08**	**33.3**	**J**	**1**	**mg/L**	**4**	**157**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-015	PCB-1248	0.0000078	0.00016	10/09/08	20.5	J	2	mg/L	4	157	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-012	PCB-1248	0.0000078	0.00014	10/09/08	17.9	J	3	mg/L	4	157	4	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-007	Cyanide	0.00015	0.01	07/22/15	66.7	J	1	mg/L	5	24	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-01 Ramsdell Quarrry Landfill	Sharon	RQLmw-008	Nitroglycerin	0.0002	0.00067	08/19/13	3.4		1	mg/L	1	25	1	Yes	To be sampled under the FWGWMP.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-02 Erie Burning Grounds	Unconsolidated	Explosives	Nitrobenzene	Yes	49	7	0.000094	0.00016	0.00014	9	1	0.000057	0.00015	1/20/2011	1/22/2009	12/1/2003	11/20/2003	
RVAAP-02 Erie Burning Grounds	Unconsolidated	Miscellaneous	Cyanide	Yes	49	1	0.01	0.01	0.00015	49	1	0.0051	0.0051	1/20/2011	4/16/2008	1/20/2011	4/16/2008	
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**49**	**4**	**0.00003**	**0.00008**	**0.000025**	**46**	**1**	**0.000018**	**0.000026**	**1/20/2011**	**1/20/2009**	**1/20/2011**	**4/15/2008**	**Pesticide from historical agricultural use**
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**52**	**28**	**0.00076**	**0.013**	**0.0056**	**24**	**1**	**0.00081**	**0.013**	**1/21/2013**	**1/21/2013**	**1/20/2011**	**10/13/2008**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-(
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-123	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.013	0.0056	4	1	0.013	11/25/03	< 0.01 U	01/20/11
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-125	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0051	04/16/08	< 0.01 U	01/20/09
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-126	Explosives	Nitrobenzene	7	2	0.00016	0.00014	2	1	0.00015	11/20/03	< 0.000096 U	01/20/11
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-127	Pesticides and PCBs	beta-BHC	9	3	0.00005	0.000025	7	1	0.000026	04/15/08	0.000025 JB	01/20/09

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**EBGmw-125**	**Cyanide**	**0.00015**	**0.0051**	**04/16/08**	**34.0**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-02 Erie Burning Grounds	**Unconsolidated**	**EBGmw-126**	**Nitrobenzene**	**0.00014**	**0.00015**	**11/20/03**	**1.1**	**J**	**1**	**mg/L**	**7**	**99**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-123	Nitrobenzene	0.00014	9.00E-05	04/16/08	0.6	J	2	mg/L	7	99	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-02 Erie Burning Grounds	Unconsolidated	EBGmw-128	Nitrobenzene	0.00014	7.00E-05	10/13/08	0.5	J	3	mg/L	7	99	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-04 Open Demolition Area #2	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**16**	**5**	**0.00048**	**0.0053**	**0.0056**	**1**	**1**	**0.00056**	**0.0092**	**7/23/2015**	**8/20/2013**	**7/26/2012**	**7/26/2012**	**Lab contaminant**
RVAAP-04 Open Demolition Area #2	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	126	10	0.00005	0.00015	0.000048	126	10	0.00005	0.000082	7/23/2015	10/14/2011	7/23/2015	10/14/2011	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Explosives	Nitroglycerin	Yes	112	1	0.0005	0.00099	0.0002	112	1	0.00034	0.00034	7/23/2015	10/14/2011	7/23/2015	10/14/2011	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Explosives	RDX	Yes	126	21	0.00005	0.00015	0.0007	12	12	0.00016	0.0061	7/23/2015	7/23/2015	7/23/2015	7/23/2015	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Miscellaneous	Cyanide	Yes	117	2	0.005	0.01	0.00015	117	2	0.0025	0.009	7/23/2015	4/17/2007	7/23/2015	4/17/2007	
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**115**	**1**	**0.0000095**	**0.000053**	**0.0000071**	**110**	**1**	**0.000011**	**0.000011**	**7/23/2015**	**10/13/2008**	**7/23/2015**	**10/13/2008**	**Pesticide from historical agricultural use**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**115**	**10**	**0.0000095**	**0.000053**	**0.000025**	**89**	**1**	**0.0000094**	**0.000028**	**7/23/2015**	**8/20/2013**	**7/23/2015**	**10/14/2008**	**Pesticide from historical agricultural use**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**115**	**1**	**0.0000095**	**0.000053**	**0.0000014**	**115**	**1**	**0.0000081**	**0.0000081**	**7/23/2015**	**1/26/2009**	**7/23/2015**	**1/26/2009**	**Pesticide from historical agricultural use**
RVAAP-04 Open Demolition Area #2	Unconsolidated	Pest/PCBs	PCB-1242	Yes	124	1	0.00038	0.001	0.0000078	124	1	0.00057	0.00057	7/23/2015	4/11/2008	7/23/2015	4/11/2008	
RVAAP-04 Open Demolition Area #2	Unconsolidated	Pest/PCBs	PCB-1254	Yes	124	1	0.00019	0.001	0.0000078	124	1	0.00016	0.00016	7/23/2015	7/13/2006	7/23/2015	7/13/2006	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	2,6-Dinitrotoluene	Yes	102	1	0.00076	0.0054	0.000048	102	1	0.0046	0.0046	2/1/2012	4/17/2007	2/1/2012	4/17/2007	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Benz(a)anthracene	Yes	116	1	0.000095	0.0002	0.000012	116	1	0.00015	0.00015	7/23/2015	8/20/2013	7/23/2015	8/20/2013	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Benzo(a)pyrene	Yes	116	1	0.000095	0.0002	0.0000034	116	1	0.00012	0.00012	7/23/2015	8/20/2013	7/23/2015	8/20/2013	
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Benzo(b)fluoranthene	Yes	116	1	0.000095	0.0002	0.000034	116	1	0.00012	0.00012	7/23/2015	8/20/2013	7/23/2015	8/20/2013	
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**125**	**49**	**0.00048**	**0.011**	**0.0056**	**59**	**2**	**0.00035**	**0.018**	**7/23/2015**	**8/20/2013**	**10/14/2011**	**10/13/2008**	**Lab contaminant**
RVAAP-04 Open Demolition Area #2	Unconsolidated	SVOCs	Naphthalene	Yes	116	1	0.000095	0.0002	0.00017	98	1	0.00028	0.00028	7/23/2015	10/15/2010	10/11/2011	10/15/2010	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-04 Open Demolition Area #2	Sharon	DA2mw-115	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	16	5	0.0053	0.0056	1	1	0.0092	07/26/12	< 0.0052 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-104	Explosives	2,6-Dinitrotoluene	6	2	0.00011	0.000048	6	2	0.000082	10/14/11	0.000082 J	10/14/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-104	Pesticides and PCBs	PCB-1242	6	1	0.0005	0.0000078	6	1	0.00057	04/11/08	< 0.00048 UJ	10/14/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-105	Explosives	2,6-Dinitrotoluene	5	3	0.00011	0.000048	5	3	0.000074	10/13/08	0.00006 J	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-106	Pesticides and PCBs	Heptachlor	6	1	0.00003	0.0000014	6	1	0.0000081	01/26/09	< 0.00003 UJ	01/21/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-107	Miscellaneous	Cyanide	14	1	0.01	0.00015	14	1	0.0025	03/09/06	< 0.01 UJ	01/21/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-107	Pesticides and PCBs	PCB-1254	15	1	0.001	0.0000078	15	1	0.00016	07/13/06	< 0.00048 UJ	10/12/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-108	Explosives	2,6-Dinitrotoluene	10	2	0.0001	0.000048	10	2	0.000065	10/13/08	< 0.0001 U	01/24/13
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-108	Explosives	Nitroglycerin	10	1	0.00066	0.0002	10	1	0.00034	10/14/11	< 0.0005 U	01/24/13
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-108	Pesticides and PCBs	alpha-BHC	5	1	0.00003	0.0000071	5	1	0.000011	10/13/08	< 0.00003 UJ	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-110	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.01	0.0056	4	1	0.018	10/13/08	< 0.01 U	01/21/11
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-111	Explosives	2,6-Dinitrotoluene	6	1	0.00011	0.000048	6	1	0.00005	01/26/09	0.00005 J	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-113	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000068	04/11/08	0.000054 J	01/26/09
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-1	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	2	0.00051	0.0056	4	1	0.008	05/17/01	0.0034 B	08/20/13
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Miscellaneous	Cyanide	22	1	0.01	0.00015	22	1	0.009	04/17/07	< 0.01 UJ	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	2,6-Dinitrotoluene	14	1	0.005	0.000048	14	1	0.0046	04/17/07	< 0.00076 U	02/01/12
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Benz(a)anthracene	22	1	0.0002	0.000012	22	1	0.00015	08/20/13	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Benzo(a)pyrene	22	1	0.0002	0.0000034	22	1	0.00012	08/20/13	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Benzo(b)fluoranthene	22	1	0.0002	0.000034	22	1	0.00012	08/20/13	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Semi-Volatile Organics	Naphthalene	22	1	0.0002	0.00017	14	1	0.00028	10/15/10	< 0.000097 U	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-4	Explosives	RDX	22	18	0.00015	0.0007	12	12	0.0061	01/23/13	0.0025	07/23/15
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-4	Pesticides and PCBs	beta-BHC	21	2	0.000053	0.000025	13	1	0.000028	10/14/08	< 0.000051 U	07/23/15

Notes:

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0046**	**04/17/07**	**95.8**	**J**	**1**	**mg/L**	**11**	**228**	**11**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-104	2,6-Dinitrotoluene	4.80E-05	8.20E-05	10/14/11	1.7	J	2	mg/L	11	228	11	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-105	2,6-Dinitrotoluene	4.80E-05	7.40E-05	10/13/08	1.5	J	3	mg/L	11	228	11	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Benz(a)anthracene**	**1.20E-05**	**0.00015**	**08/20/13**	**12.5**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Benzo(a)pyrene**	**3.40E-06**	**0.00012**	**08/20/13**	**35.3**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.00012**	**08/20/13**	**3.5**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Cyanide**	**0.00015**	**0.009**	**04/17/07**	**60.0**	**JB**	**1**	**mg/L**	**2**	**117**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-107	Cyanide	0.00015	0.0025	03/09/06	16.7	J	2	mg/L	2	117	1	No	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-3**	**Naphthalene**	**0.00017**	**0.00028**	**10/15/10**	**1.6**		**1**	**mg/L**	**1**	**116**	**1**	**Yes**	**To be sampled under the FWGWMP.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DA2mw-108**	**Nitroglycerin**	**0.0002**	**0.00034**	**10/14/11**	**1.7**	**J**	**1**	**mg/L**	**1**	**112**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DA2mw-104**	**PCB-1242**	**0.0000078**	**0.00057**	**04/11/08**	**73.1**	**J**	**1**	**mg/L**	**1**	**124**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DA2mw-107**	**PCB-1254**	**0.0000078**	**0.00016**	**07/13/06**	**20.5**	**J**	**1**	**mg/L**	**1**	**124**	**1**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-04 Open Demolition Area #2	**Unconsolidated**	**DET-4**	**RDX**	**0.0007**	**0.0061**	**01/23/13**	**8.7**		**1**	**mg/L**	**21**	**126**	**12**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-111	RDX	0.0007	0.00048	09/11/02	0.7	J	2	mg/L	21	126	12	No	Well has had 4 consecutive ND results since last detection.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DA2mw-110	RDX	0.0007	0.00031	09/11/02	0.4	J	3	mg/L	21	126	12	No	Well has had 5 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Benz(a)anthracene	0.000012	0.00015	08/20/13	12.5		1	mg/L	1	14	1	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Benzo(a)pyrene	0.0000034	0.00012	08/20/13	35.3		1	mg/L	1	14	1	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-3	Benzo(b)fluoranthene	0.000034	0.00012	08/20/13	3.5		1	mg/L	1	14	1	Yes	To be sampled under the FWGWMP.
RVAAP-04 Open Demolition Area #2	Unconsolidated	DET-4	RDX	0.0007	0.0061	01/23/13	8.7		1	mg/L	6	15	6	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-05 Winklepeck Burning Grounds	Sharon	Miscellaneous	Cyanide	Yes	16	1	0.005	0.01	0.00015	16	1	0.0042	0.0042	7/23/2014	7/23/2014	7/23/2014	7/23/2014	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	2,4-Dinitrotoluene	Yes	137	14	0.00005	0.0005	0.00024	17	2	0.000033	0.00095	7/22/2015	1/26/2009	10/10/2007	11/3/2000	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	137	6	0.00005	0.0005	0.000048	137	6	0.000051	0.00025	7/22/2015	10/10/2008	7/22/2015	10/10/2008	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	2-Nitrotoluene	Yes	137	11	0.000099	0.0025	0.00031	90	4	0.000091	0.0026	7/22/2015	4/16/2008	1/19/2011	4/16/2008	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	3-Nitrotoluene	Yes	137	2	0.000099	0.0025	0.00017	110	1	0.000076	0.00031	7/22/2015	11/1/2000	2/1/2012	11/1/2000	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Explosives	RDX	Yes	138	59	0.00005	0.005	0.0007	49	48	0.000099	0.074	7/22/2015	7/22/2015	7/22/2015	7/22/2015	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	Miscellaneous	Cyanide	Yes	123	10	0.01	0.01	0.00015	123	10	0.0013	0.019	8/21/2013	10/10/2008	8/21/2013	10/10/2008	
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**113**	**1**	**0.0000095**	**0.00015**	**0.0000014**	**113**	**1**	**0.0000063**	**0.0000063**	**8/21/2013**	**3/9/2006**	**8/21/2013**	**3/9/2006**	**Pesticide from historical agricultural use**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**113**	**2**	**0.0000095**	**0.00015**	**0.0000014**	**113**	**2**	**0.0000076**	**0.000056**	**8/21/2013**	**3/8/2006**	**8/21/2013**	**3/8/2006**	**Pesticide from historical agricultural use**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**Pest/PCBs**	**Lindane**	**No**	**113**	**9**	**0.0000095**	**0.00015**	**0.000041**	**21**	**3**	**0.000013**	**0.000057**	**8/21/2013**	**10/4/2006**	**1/19/2011**	**10/4/2006**	**Pesticide from historical agricultural use**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	SVOCs	2,6-Dinitrotoluene	Yes	112	1	0.00076	0.01	0.000048	112	1	0.00066	0.00066	2/1/2012	1/23/2007	2/1/2012	1/23/2007	
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	136	48	0.00048	0.012	0.0056	66	5	0.00031	0.049	7/22/2015	8/21/2013	1/19/2011	1/26/2009	Potential lab contaminant
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**VOCs**	**Chloroform**	**No**	**129**	**5**	**0.00025**	**0.005**	**0.00022**	**129**	**5**	**0.00064**	**0.0017**	**8/21/2013**	**11/2/2000**	**8/21/2013**	**11/2/2000**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-05 Winklepeck Burning Grounds	Sharon	WBGmw-021	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.0042	07/23/14	0.0042 J	07/23/14
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.0062	04/16/08	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	10	4	0.01	0.0056	7	1	0.0058	07/09/08	< 0.01 U	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	Volatile Organics	Chloroform	10	1	0.005	0.00022	10	1	0.0017	05/20/98	< 0.001 U	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Explosives	2,4-Dinitrotoluene	23	1	0.0005	0.00024	13	1	0.00095	11/03/00	< 0.0001 U	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Explosives	2,6-Dinitrotoluene	23	1	0.0005	0.000048	23	1	0.00025	11/03/00	< 0.0001 U	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Explosives	RDX	24	24	0.005	0.0007	24	24	0.074	04/15/05	0.01	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Miscellaneous	Cyanide	17	4	0.01	0.00015	17	4	0.009	04/18/07	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Pesticides and PCBs	Lindane	15	8	0.00006	0.000041	5	3	0.000057	10/04/06	< 0.00006 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	7	0.01	0.0056	10	1	0.0098	05/02/06	< 0.0048 U	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Miscellaneous	Cyanide	19	2	0.01	0.00015	19	2	0.0095	10/10/07	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Pesticides and PCBs	Heptachlor	15	1	0.00005	0.0000014	15	1	0.0000063	03/09/06	< 0.00003 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Semi-Volatile Organics	2,6-Dinitrotoluene	16	1	0.01	0.000048	16	1	0.00066	01/23/07	< 0.00076 U	02/01/12
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	18	4	0.012	0.0056	9	1	0.049	11/03/00	0.00093 J	01/24/13
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-008	Volatile Organics	Chloroform	6	1	0.005	0.00022	6	1	0.00064	05/20/98	< 0.001 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Explosives	RDX	24	24	0.0005	0.0007	24	24	0.013	07/15/05	0.0028	07/22/15
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Miscellaneous	Cyanide	17	2	0.01	0.00015	17	2	0.019	05/20/98	< 0.01 UJ	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Pesticides and PCBs	Heptachlor epoxide	15	1	0.00015	0.0000014	15	1	0.0000076	03/08/06	< 0.00003 U	01/19/11
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	Volatile Organics	Chloroform	20	1	0.005	0.00022	20	1	0.0011	05/20/98	< 0.00025 U	01/24/13
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Explosives	2,4-Dinitrotoluene	8	2	0.00013	0.00024	1	1	0.00028	11/02/00	< 0.000099 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Explosives	2,6-Dinitrotoluene	8	1	0.00028	0.000048	8	1	0.000051	07/09/08	< 0.000099 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Pesticides and PCBs	Heptachlor epoxide	8	1	0.00005	0.0000014	8	1	0.000056	11/02/00	< 0.00003 UJ	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	6	0.01	0.0056	3	1	0.0062	01/26/09	0.0062 JB	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	Volatile Organics	Chloroform	8	2	0.005	0.00022	8	2	0.0015	11/02/00	< 0.001 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-011	Explosives	2,6-Dinitrotoluene	6	3	0.00013	0.000048	6	3	0.0001	11/02/00	< 0.000099 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-011	Explosives	2-Nitrotoluene	6	2	0.0005	0.00031	5	1	0.00033	11/02/00	< 0.0005 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	Explosives	2,6-Dinitrotoluene	5	1	0.00013	0.000048	5	1	0.00011	11/04/00	< 0.0001 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	Explosives	2-Nitrotoluene	5	2	0.00051	0.00031	5	2	0.00049	11/04/00	< 0.00051 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0089	10/10/08	< 0.01 UJ	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-015	Explosives	2-Nitrotoluene	5	1	0.00052	0.00031	5	1	0.0026	11/01/00	< 0.0005 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-015	Explosives	3-Nitrotoluene	5	1	0.00052	0.00017	5	1	0.00031	11/01/00	< 0.0005 U	01/26/09
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-016	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	3	0.01	0.0056	3	1	0.01	07/09/08	0.0011 JB	01/26/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-05 Winklepeck Burning Grounds	**Sharon**	**WBGmw-021**	**Cyanide**	**0.00015**	**0.0042**	**07/23/14**	**28.0**	**J**	**1**	**mg/L**	**1**	**16**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-006**	**2,4-Dinitrotoluene**	**0.00024**	**0.00095**	**11/03/00**	**4.0**	**=**	**1**	**mg/L**	**19**	**265**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	OBG-1	2,4-Dinitrotoluene	0.00024	0.00044	11/05/00	1.8	=	2	mg/L	19	265	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-010	2,4-Dinitrotoluene	0.00024	0.00028	11/02/00	1.2	=	3	mg/L	19	265	3	No	Well has had 4 consecutive ND results since last detection.
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-007**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00066**	**01/23/07**	**13.8**	**J**	**1**	**mg/L**	**8**	**265**	**8**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	2,6-Dinitrotoluene	4.80E-05	0.00025	11/03/00	5.2	=	2	mg/L	8	265	8	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	OBG-1	2,6-Dinitrotoluene	4.80E-05	0.00012	11/05/00	2.5	J	3	mg/L	8	265	8	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-015**	**2-Nitrotoluene**	**0.00031**	**0.0026**	**11/01/00**	**8.4**	**=**	**1**	**mg/L**	**12**	**145**	**4**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-014	2-Nitrotoluene	0.00031	0.00049	11/04/00	1.6	=	2	mg/L	12	145	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-011	2-Nitrotoluene	0.00031	0.00033	11/02/00	1.1	=	3	mg/L	12	145	4	No	Well has had 4 consecutive ND results since last detection.
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-015**	**3-Nitrotoluene**	**0.00017**	**0.00031**	**11/01/00**	**1.8**	**=**	**1**	**mg/L**	**3**	**145**	**1**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	OBG-4	3-Nitrotoluene	0.00017	0.00015	11/05/00	0.9	J	2	mg/L	3	145	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-005	3-Nitrotoluene	0.00017	7.60E-05	05/20/98	0.4	J	3	mg/L	3	145	1	No	Well has had 6 consecutive ND results since last detection.
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-007**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**4.90E-02**	**11/03/00**	**8.8**	**=**	**1**	**mg/L**	**48**	**144**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-016	Bis(2-ethylhexyl)phthalate	0.0056	1.00E-02	07/09/08	1.8	J	2	mg/L	48	144	4	No	The need for characterization of DEHP will be based on confirmation of the constituent at WBGmw-007.
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Bis(2-ethylhexyl)phthalate	0.0056	9.80E-03	05/02/06	1.8	J	3	mg/L	48	144	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-009**	**Cyanide**	**0.00015**	**0.019**	**05/20/98**	**126.7**	**=**	**1**	**mg/L**	**10**	**135**	**10**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-007	Cyanide	0.00015	0.0095	10/10/07	63.3	J	2	mg/L	10	135	10	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-006	Cyanide	0.00015	0.009	04/18/07	60.0	J	3	mg/L	10	135	10	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-006**	**RDX**	**0.0007**	**0.074**	**04/15/05**	**105.7**	**J**	**1**	**mg/L**	**59**	**146**	**48**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	RDX	0.0007	0.013	07/15/05	18.6	=	2	mg/L	59	146	48	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-013	RDX	0.0007	0.00066	09/03/02	0.9	=	3	mg/L	59	146	48	No	Well has had 4 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-05 Winklepeck Burning Grounds	**Sharon**	**WBGmw-021**	**Cyanide**	**0.00015**	**0.0042**	**07/23/14**	**28.0**	**J**	**1**	**mg/L**	**1**	**10**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	**Unconsolidated**	**WBGmw-006**	**RDX**	**0.0007**	**0.041**	**03/11/15**	**58.6**		**1**	**mg/L**	**16**	**17**	**12**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-009	RDX	0.0007	0.0056	07/23/14	8.0		2	mg/L	16	17	12	Yes	Trend analysis to be conducted after RI sampling
RVAAP-05 Winklepeck Burning Grounds	Unconsolidated	WBGmw-018	RDX	0.0007	0.00036	08/21/13	0.5		3	mg/L	16	17	12	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-06 C Block Quarry	Homewood	Miscellaneous	Cyanide	Yes	22	1	0.01	0.01	0.00015	22	1	0.007	0.007	1/24/2013	10/10/2008	1/24/2013	10/10/2008	
RVAAP-06 C Block Quarry	Homewood	Pest/PCBs	PCB-1248	Yes	30	1	0.00019	0.0016	0.0000078	30	1	0.00011	0.00011	1/24/2013	10/9/2008	1/24/2013	10/9/2008	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Benz(a)anthracene	Yes	30	1	0.000095	0.00024	0.000012	30	1	0.00016	0.00016	1/24/2013	1/20/2005	1/24/2013	1/20/2005	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Benzo(a)pyrene	Yes	30	1	0.000095	0.00041	0.0000034	30	1	0.00017	0.00017	1/24/2013	1/20/2005	1/24/2013	1/20/2005	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Benzo(b)fluoranthene	Yes	30	1	0.000095	0.00041	0.000034	30	1	0.00013	0.00013	1/24/2013	1/20/2005	1/24/2013	1/20/2005	
RVAAP-06 C Block Quarry	Homewood	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	30	18	0.00076	0.077	0.0056	12	2	0.00082	0.4	1/24/2013	1/24/2013	4/7/2011	1/12/2005	Potential lab contaminant
RVAAP-06 C Block Quarry	Homewood	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	30	1	0.000095	0.00041	0.000034	30	1	0.00014	0.00014	1/24/2013	1/20/2005	1/24/2013	1/20/2005	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present abov
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime car
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.007	10/10/08	< 0.01 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Benz(a)anthracene	6	1	0.0002	0.000012	6	1	0.00016	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Benzo(a)pyrene	6	1	0.0004	0.0000034	6	1	0.00017	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Benzo(b)fluoranthene	6	1	0.0004	0.000034	6	1	0.00013	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	6	1	0.0004	0.000034	6	1	0.00014	01/20/05	< 0.0002 U	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	6	0.077	0.0056	3	1	0.4	01/12/05	0.0011 B	01/23/13
RVAAP-06 C Block Quarry	Homewood	CBLmw-003	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	5	0.015	0.0056	2	1	0.031	01/12/05	0.0023 JB	01/20/09
RVAAP-06 C Block Quarry	Homewood	CBLmw-004	Pesticides and PCBs	PCB-1248	6	1	0.0016	0.0000078	6	1	0.00011	10/09/08	< 0.0005 UJ	04/07/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-002**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**0.4**	**01/12/05**	**71.4**	**=**	**1**	**mg/L**	**18**	**30**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	Homewood	CBLmw-003	Bis(2-ethylhexyl)phthalate	5.60E-03	0.031	01/12/05	5.5	=	2	mg/L	18	30	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-06 C Block Quarry	Homewood	CBLmw-001	Bis(2-ethylhexyl)phthalate	5.60E-03	0.0037	07/11/08	0.7	J	3	mg/L	18	30	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Benz(a)anthracene**	**1.20E-05**	**0.00016**	**01/20/05**	**13.3**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Benzo(a)pyrene**	**3.40E-06**	**0.00017**	**01/20/05**	**50.0**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.00013**	**01/20/05**	**3.8**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Cyanide**	**0.00015**	**0.007**	**10/10/08**	**46.7**	**J**	**1**	**mg/L**	**1**	**22**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-001**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00014**	**01/20/05**	**4.1**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-06 C Block Quarry	**Homewood**	**CBLmw-004**	**PCB-1248**	**7.80E-06**	**0.00011**	**10/09/08**	**14.1**	**J**	**1**	**mg/L**	**1**	**30**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-08 Load Line 1	Sharon	Explosives	1,3-Dinitrobenzene	Yes	129	47	0.000096	0.003	0.0002	50	33	0.000019	0.00133	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2,4,6-Trinitrotoluene	Yes	129	64	0.000096	0.003	0.00098	51	43	0.00005	0.016	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2,4-Dinitrotoluene	Yes	129	65	0.000096	0.0013	0.00024	52	46	0.000052	0.0079	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2,6-Dinitrotoluene	Yes	129	49	0.000096	0.0089	0.000048	129	49	0.000054	0.0038	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	2-Amino-4,6-Dinitrotoluene	Yes	114	76	0.000096	0.002	0.0039	45	45	0.0001	0.029	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	3-Nitrotoluene	Yes	129	4	0.0001	0.01	0.00017	117	1	0.00012	0.0004	7/20/2015	1/21/2014	8/2/2011	1/17/2011	
RVAAP-08 Load Line 1	Sharon	Explosives	4-Amino-2,6-Dinitrotoluene	Yes	114	77	0.000096	0.002	0.0039	50	50	0.00019	0.036	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Explosives	Nitroglycerin	Yes	97	2	0.0005	0.06	0.0002	97	2	0.0042	0.027	7/20/2015	10/4/2000	7/20/2015	10/4/2000	
RVAAP-08 Load Line 1	Sharon	Explosives	RDX	Yes	129	66	0.00005	0.02	0.0007	44	34	0.000085	0.088	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-08 Load Line 1	Sharon	Miscellaneous	Cyanide	Yes	104	8	0.002	0.01	0.00015	104	8	0.0016	0.019	4/5/2011	1/17/2011	4/5/2011	1/17/2011	
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**4,4'-DDE**	**No**	**120**	**1**	**0.000019**	**0.00096**	**0.000046**	**55**	**1**	**0.013**	**0.013**	**7/20/2015**	**10/3/2000**	**7/20/2015**	**10/3/2000**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Aldrin**	**No**	**120**	**1**	**0.000019**	**0.00096**	**0.00000092**	**120**	**1**	**0.000011**	**0.000011**	**7/20/2015**	**5/2/2006**	**7/20/2015**	**5/2/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**alpha-BHC**	**No**	**120**	**3**	**0.000019**	**0.00096**	**0.0000071**	**120**	**3**	**0.000011**	**0.00018**	**7/20/2015**	**8/1/2011**	**7/20/2015**	**8/1/2011**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**120**	**27**	**0.000019**	**0.00096**	**0.000025**	**111**	**19**	**0.0000088**	**0.00026**	**7/20/2015**	**8/21/2013**	**7/20/2015**	**8/21/2013**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Dieldrin**	**No**	**120**	**1**	**0.000019**	**0.00096**	**0.0000017**	**120**	**1**	**0.000029**	**0.000029**	**7/20/2015**	**5/2/2006**	**7/20/2015**	**5/2/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**120**	**4**	**0.000019**	**0.00096**	**0.0000014**	**120**	**4**	**0.000011**	**0.000044**	**7/20/2015**	**3/10/2015**	**7/20/2015**	**3/10/2015**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**120**	**9**	**0.000019**	**0.00096**	**0.0000014**	**120**	**9**	**0.000066**	**0.0061**	**7/20/2015**	**7/11/2006**	**7/20/2015**	**7/11/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Sharon**	**Pest/PCBs**	**Toxaphene**	**No**	**120**	**1**	**0.00076**	**0.04**	**0.000015**	**120**	**1**	**0.00034**	**0.00034**	**7/20/2015**	**3/6/2006**	**7/20/2015**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	Sharon	SVOCs	2,4-Dinitrotoluene	Yes	107	24	0.0048	0.01	0.00024	107	24	0.00034	0.0036	8/2/2011	8/1/2011	8/2/2011	8/1/2011	
RVAAP-08 Load Line 1	Sharon	SVOCs	2,6-Dinitrotoluene	Yes	107	9	0.0048	0.01	0.000048	107	9	0.00064	0.0024	8/2/2011	10/8/2007	8/2/2011	10/8/2007	
RVAAP-08 Load Line 1	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**120**	**43**	**0.00048**	**0.012**	**0.0056**	**53**	**2**	**0.00082**	**0.021**	**7/20/2015**	**3/10/2015**	**8/2/2011**	**10/11/2010**	**Lab contaminant**
RVAAP-08 Load Line 1	**Sharon**	**VOCs**	**Chloroform**	**No**	**110**	**2**	**0.001**	**0.005**	**0.00022**	**110**	**2**	**0.0011**	**0.0012**	**8/2/2011**	**9/2/1999**	**8/2/2011**	**9/2/1999**	**Lab contaminant**
RVAAP-08 Load Line 1	Unconsolidated	Explosives	Nitroglycerin	Yes	57	1	0.00049	0.0025	0.0002	57	1	0.00033	0.00033	7/23/2015	7/24/2014	7/23/2015	7/24/2014	
RVAAP-08 Load Line 1	Unconsolidated	Miscellaneous	Cyanide	Yes	31	1	0.002	0.01	0.00015	31	1	0.011	0.011	10/21/2014	7/7/2008	10/21/2014	7/7/2008	
RVAAP-08 Load Line 1	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**52**	**1**	**0.0000095**	**0.00015**	**0.0000071**	**52**	**1**	**0.000028**	**0.000028**	**7/21/2015**	**10/21/2014**	**7/21/2015**	**10/21/2014**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**52**	**2**	**0.0000095**	**0.00015**	**0.000025**	**26**	**1**	**0.0000095**	**0.000027**	**7/21/2015**	**1/21/2013**	**7/21/2015**	**7/23/2012**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**52**	**1**	**0.0000095**	**0.00015**	**0.0000014**	**52**	**1**	**0.000029**	**0.000029**	**7/21/2015**	**3/10/2015**	**7/21/2015**	**3/10/2015**	**Pesticide from historical agricultural use**
RVAAP-08 Load Line 1	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**58**	**21**	**0.00048**	**0.01**	**0.0056**	**12**	**3**	**0.0005**	**0.0086**	**7/23/2015**	**3/9/2015**	**8/1/2011**	**7/14/2010**	**Lab contaminant**

Notes

Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer r
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	2,4,6-Trinitrotoluene	6	3	0.003	0.00098	2	1	0.00099	07/07/08	0.00059	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	2,4-Dinitrotoluene	6	5	0.00014	0.00024	1	1	0.00027	07/07/08	0.00021	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	2,6-Dinitrotoluene	6	5	0.00014	0.000048	6	5	0.00064	08/02/11	0.00064	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Explosives	4-Amino-2,6-Dinitrotoluene	5	5	0.00014	0.0039	2	2	0.0064	07/07/08	0.0063	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0029	08/12/96	< 0.01 U	10/08/08
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Pesticides and PCBs	alpha-BHC	6	1	0.00006	0.0000071	6	1	0.000012	10/09/08	< 0.00003 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-063	Pesticides and PCBs	beta-BHC	6	3	0.00006	0.000025	4	1	0.000069	10/09/08	< 0.00003 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-078	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0016	05/02/06	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Sharon	LL1mw-078	Pesticides and PCBs	Heptachlor epoxide	15	2	0.00005	0.0000014	15	2	0.00023	07/11/06	< 0.00003 UJ	07/14/10
RVAAP-08 Load Line 1	Sharon	LL1mw-079	Explosives	2,6-Dinitrotoluene	8	2	0.00013	0.000048	8	2	0.000057	01/28/08	< 0.000099 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-079	Explosives	RDX	8	8	0.0005	0.0007	4	4	0.0022	07/07/08	0.0006	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-079	Volatile Organics	Chloroform	8	2	0.005	0.00022	8	2	0.0012	09/02/99	< 0.001 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	1,3-Dinitrobenzene	17	7	0.002	0.0002	7	5	0.00095	10/04/00	0.00041	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2,4,6-Trinitrotoluene	17	15	0.002	0.00098	3	3	0.0036	10/04/00	0.00056	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2,4-Dinitrotoluene	17	9	0.0013	0.00024	7	6	0.0009	10/04/00	0.00027	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2,6-Dinitrotoluene	17	7	0.0037	0.000048	17	7	0.00089	07/14/10	0.00043	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	2-Amino-4,6-Dinitrotoluene	16	16	0.002	0.0039	8	8	0.01	10/04/00	0.0054 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	4-Amino-2,6-Dinitrotoluene	16	16	0.002	0.0039	11	11	0.011	10/04/05	0.0086 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	Nitroglycerin	7	1	0.025	0.0002	7	1	0.027	10/04/00	< 0.00065 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Explosives	RDX	17	17	0.005	0.0007	17	17	0.088	07/14/10	0.081 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Inorganics	Beryllium	20	3	0.01	0.0025	11	2	0.0048	10/19/09	< 0.001 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Pesticides and PCBs	beta-BHC	16	10	0.0005	0.000025	15	9	0.000063	08/01/11	0.000063 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Pesticides and PCBs	Heptachlor epoxide	16	4	0.0005	0.0000014	16	4	0.0028	10/04/05	< 0.000029 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-080	Semi-Volatile Organics	2,4-Dinitrotoluene	16	1	0.01	0.00024	16	1	0.00034	08/01/11	0.00034 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Explosives	Nitroglycerin	9	1	0.0025	0.0002	9	1	0.0042	10/03/00	< 0.00065 U	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Explosives	RDX	9	8	0.00102	0.0007	6	5	0.0028	10/03/00	0.0016 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Miscellaneous	Cyanide	7	1	0.01	0.00015	7	1	0.0051	09/02/99	< 0.01 U	04/05/11
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	1,3-Dinitrobenzene	23	15	0.001	0.0002	19	12	0.0013	09/01/99	0.00024 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2,4,6-Trinitrotoluene	23	23	0.001	0.00098	23	23	0.011	09/01/99	0.0034 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2,4-Dinitrotoluene	23	23	0.001	0.00024	23	23	0.0052	10/08/07	0.0027 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2,6-Dinitrotoluene	23	22	0.0089	0.000048	23	22	0.0038	09/01/99	0.0016 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	2-Amino-4,6-Dinitrotoluene	22	22	0.001	0.0039	22	22	0.029	10/03/00	0.011 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	4-Amino-2,6-Dinitrotoluene	22	22	0.001	0.0039	22	22	0.036	07/14/10	0.024 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Explosives	RDX	23	13	0.0025	0.0007	1	1	0.0012	10/03/00	< 0.000051 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Miscellaneous	Cyanide	17	2	0.01	0.00015	17	2	0.0033	10/04/05	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	4,4'-DDE	22	1	0.00096	0.000046	15	1	0.013	10/03/00	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Aldrin	22	1	0.00096	0.00000092	22	1	0.000011	05/02/06	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	alpha-BHC	22	1	0.00096	0.0000071	22	1	0.000011	04/16/07	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	beta-BHC	22	6	0.00096	0.000025	21	6	0.00017	04/16/07	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Dieldrin	22	1	0.00096	0.0000017	22	1	0.000029	05/02/06	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Heptachlor	22	1	0.00096	0.0000014	22	1	0.000044	03/10/15	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Heptachlor epoxide	22	2	0.00096	0.0000014	22	2	0.0061	10/04/05	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Pesticides and PCBs	Toxaphene	22	1	0.04	0.000015	22	1	0.00034	03/06/06	< 0.0019 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Semi-Volatile Organics	2,4-Dinitrotoluene	17	16	0.01	0.00024	17	16	0.0036	10/08/07	0.0016 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-083	Semi-Volatile Organics	2,6-Dinitrotoluene	17	9	0.01	0.000048	17	9	0.0024	10/04/05	< 0.0049 UJ	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	1,3-Dinitrobenzene	16	16	0.00104	0.0002	16	16	0.00133	08/02/07	0.00026 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2,4,6-Trinitrotoluene	16	16	0.00104	0.00098	16	16	0.016	10/02/00	0.0058 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2,4-Dinitrotoluene	16	16	0.00104	0.00024	16	16	0.0079	09/04/99	0.0011 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2,6-Dinitrotoluene	16	13	0.0064	0.000048	16	13	0.0013	01/17/11	0.00062 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	2-Amino-4,6-Dinitrotoluene	15	15	0.00104	0.0039	15	15	0.02	10/02/00	0.0075 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	3-Nitrotoluene	16	2	0.00104	0.00017	11	1	0.0004	01/17/11	< 0.0001 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	4-Amino-2,6-Dinitrotoluene	15	15	0.00104	0.0039	15	15	0.036	08/21/13	0.024 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Explosives	RDX	16	12	0.0015	0.0007	9	7	0.00242	08/02/07	0.0013 J	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.0067	01/17/11	< 0.01 UJ	04/05/11
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Pesticides and PCBs	alpha-BHC	15	1	0.00095	0.0000071	15	1	0.00018	08/01/11	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Pesticides and PCBs	beta-BHC	15	3	0.00095	0.000025	15	3	0.00026	07/14/10	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Pesticides and PCBs	Heptachlor	15	3	0.00095	0.0000014	15	3	0.000043	03/10/15	< 0.000048 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Semi-Volatile Organics	2,4-Dinitrotoluene	10	7	0.01	0.00024	10	7	0.003	10/02/00	0.00075 J	08/01/11
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	15	10	0.01	0.0056	2	1	0.0061	10/11/10	< 0.0049 U	07/20/15
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Miscellaneous	Cyanide	9	2	0.01	0.00015	9	2	0.019	04/07/08	< 0.01 U	07/08/10
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Pesticides and PCBs	Heptachlor epoxide	9	1	0.00005	0.0000014	9	1	0.00022	09/19/01	< 0.000029 U	08/02/11
RVAAP-08 Load Line 1	Sharon	LL2mw-060	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.01	0.0056	5	1	0.021	04/07/08	0.00092 J	08/02/11
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-004	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.013	10/12/10	< 0.01 U	04/05/11
RVAAP-66 Facility-wide Groundwater	Unconsolidated	FWGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	4	2	0.00078	0.0056	1	1	0.04	10/15/12	< 0.00078 U	01/21/13
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-064	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.011	07/07/08	< 0.01 U	07/14/10
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-065	Inorganics	Beryllium	23	2	0.004	0.0025	3	1	0.004	10/19/09	< 0.001 U	07/23/15

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-065	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	19	8	0.01	0.0056	9	3	0.0086	07/14/10	< 0.0048 U	07/23/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Explosives	Nitroglycerin	9	1	0.00053	0.0002	9	1	0.00033	07/24/14	< 0.00051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Pesticides and PCBs	beta-BHC	9	2	0.000051	0.000025	3	1	0.000027	07/23/12	< 0.000051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-086	Pesticides and PCBs	Heptachlor	9	1	0.000051	0.0000014	9	1	0.000029	03/10/15	< 0.000051 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-087	Inorganics	Beryllium	9	2	0.001	0.0025	1	1	0.0056	07/23/12	< 0.001 U	07/21/15
RVAAP-08 Load Line 1	Unconsolidated	LL1mw-088	Pesticides and PCBs	alpha-BHC	6	1	0.000053	0.0000071	6	1	0.000028	10/21/14	< 0.000051 U	07/21/15

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**1,3-Dinitrobenzene**	**0.0002**	**0.00133**	**08/02/07**	**6.7**		**1**	**mg/L**	**47**	**129**	**33**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	1,3-Dinitrobenzene	0.0002	0.0013	09/01/99	6.5	=	2	mg/L	47	129	33	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	1,3-Dinitrobenzene	0.0002	0.00095	10/04/00	4.8	J	3	mg/L	47	129	33	Yes	No Mann-Kendall Trend Stable to Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.016**	**10/02/00**	**16.3**	**=**	**1**	**mg/L**	**64**	**129**	**43**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,4,6-Trinitrotoluene	0.00098	0.011	09/01/99	11.2	=	2	mg/L	64	129	43	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2,4,6-Trinitrotoluene	0.00098	0.0036	10/04/00	3.7	=	3	mg/L	64	129	43	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4-Dinitrotoluene**	**0.00024**	**0.0079**	**09/04/99**	**32.9**	**=**	**1**	**mg/L**	**89**	**236**	**70**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,4-Dinitrotoluene	0.00024	0.0052	10/08/07	21.7	J	2	mg/L	89	236	70	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2,4-Dinitrotoluene	0.00024	0.0009	10/04/00	3.8	J	3	mg/L	89	236	70	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Stable (flat) Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0038**	**09/01/99**	**79.2**	**=**	**1**	**mg/L**	**58**	**236**	**58**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,6-Dinitrotoluene	4.80E-05	0.0013	08/01/11	27.1		2	mg/L	58	236	58	Yes	No M-K Trend (decreasing OLS Regression Line and stable Theil-Sen Trend Line); reviewing potential hydrogeology influences on contaminant concentrations
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,6-Dinitrotoluene	4.80E-05	0.0013	01/17/11	27.1	J	2	mg/L	58	236	58	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2,6-Dinitrotoluene	4.80E-05	0.00089	07/14/10	18.5		3	mg/L	58	236	58	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.029**	**10/03/00**	**7.4**	**=**	**1**	**mg/L**	**76**	**114**	**45**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2-Amino-4,6-Dinitrotoluene	0.0039	0.02	03/06/06	5.1	=	2	mg/L	76	114	45	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2-Amino-4,6-Dinitrotoluene	0.0039	0.02	10/02/00	5.1	=	2	mg/L	76	114	45	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-080	2-Amino-4,6-Dinitrotoluene	0.0039	0.01	10/04/00	2.6	=	3	mg/L	76	114	45	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**3-Nitrotoluene**	**0.00017**	**0.0004**	**01/17/11**	**2.4**	**J**	**1**	**mg/L**	**4**	**129**	**1**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-067	3-Nitrotoluene	0.00017	0.00016	10/04/00	0.9	J	2	mg/L	4	129	1	No	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 5 consecutive ND results since last detection.
RVAAP-08 Load Line 1	Sharon	LL1mw-081	3-Nitrotoluene	0.00017	0.00014	09/02/99	0.8	J	3	mg/L	4	129	1	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.036**	**07/14/10**	**9.2**	**J**	**1**	**mg/L**	**77**	**114**	**50**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.036**	**08/21/13**	**9.2**		**1**	**mg/L**	**77**	**114**	**50**	**Yes**	**No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-080	4-Amino-2,6-Dinitrotoluene	0.0039	0.011	10/04/05	2.8	=	2	mg/L	77	114	50	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-063	4-Amino-2,6-Dinitrotoluene	0.0039	0.0064	07/07/08	1.6		3	mg/L	77	114	50	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL2mw-060**	**Cyanide**	**0.00015**	**0.019**	**04/07/08**	**126.7**		**1**	**mg/L**	**8**	**104**	**8**	**No**	**Insufficient data for statistical evaluation, 2 detections out of 9 samples Well has had 6 consecutive ND results since last detection.**
RVAAP-08 Load Line 1	Sharon	LL1mw-084	Cyanide	0.00015	0.0067	01/17/11	44.7	J	2	mg/L	8	104	8	Yes	Insufficient data for statistical evaluation, 1 detection out of 6 samples
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Cyanide	0.00015	0.0051	09/02/99	34.0	J	3	mg/L	8	104	8	Yes	Insufficient data for statistical evaluation, 1 detection out of 6 samples
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-080**	**Nitroglycerin**	**0.0002**	**0.027**	**10/04/00**	**135.0**	**=**	**1**	**mg/L**	**2**	**97**	**2**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-081	Nitroglycerin	0.0002	0.0042	10/03/00	21.0	=	2	mg/L	2	97	2	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-080**	**RDX**	**0.0007**	**0.088**	**07/14/10**	**125.7**	**J**	**1**	**mg/L**	**66**	**129**	**34**	**Yes**	**No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	Sharon	LL1mw-081	RDX	0.0007	0.0028	10/03/00	4.0	=	2	mg/L	66	129	34	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-084	RDX	0.0007	0.00242	08/02/07	3.5		3	mg/L	66	129	34	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Unconsolidated**	**LL1mw-064**	**Cyanide**	**0.00015**	**0.011**	**07/07/08**	**73.3**		**1**	**mg/L**	**1**	**31**	**1**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 8 samples**
RVAAP-08 Load Line 1	**Unconsolidated**	**LL1mw-086**	**Nitroglycerin**	**0.0002**	**0.00033**	**07/24/14**	**1.7**	**J**	**1**	**mg/L**	**1**	**57**	**1**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**1,3-Dinitrobenzene**	**0.0002**	**0.00048**	**03/10/15**	**2.4**	**J**	**1**	**mg/L**	**10**	**10**	**9**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	1,3-Dinitrobenzene	0.0002	0.00028	08/21/13	1.4	J	2	mg/L	10	10	9	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.012**	**08/21/13**	**12.2**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.012**	**01/21/14**	**12.2**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.012**	**03/10/15**	**12.2**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2,4,6-Trinitrotoluene	0.00098	0.0048	03/10/15	4.9	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2,4-Dinitrotoluene**	**0.00024**	**0.0033**	**03/10/15**	**13.8**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,4-Dinitrotoluene	0.00024	0.0016	07/21/14	6.7	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,4-Dinitrotoluene	0.00024	0.0016	03/10/15	6.7	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2,6-Dinitrotoluene**	**0.000048**	**0.0022**	**03/10/15**	**45.8**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2,6-Dinitrotoluene	0.000048	0.001	07/21/14	20.8	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-083**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.014**	**08/21/13**	**3.6**	**J**	**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Tend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	2-Amino-4,6-Dinitrotoluene	0.0039	0.013	03/10/15	3.3	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	Sharon	LL1mw-084	2-Amino-4,6-Dinitrotoluene	0.0039	0.013	08/21/13	3.3	J	2	mg/L	10	10	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.036**	**08/21/13**	**9.2**		**1**	**mg/L**	**10**	**10**	**10**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-08 Load Line 1	Sharon	LL1mw-083	4-Amino-2,6-Dinitrotoluene	0.0039	0.028	08/21/13	7.2		2	mg/L	10	10	10	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-08 Load Line 1	**Sharon**	**LL1mw-084**	**RDX**	**0.0007**	**0.0021**	**08/21/13**	**3.0**	**J**	**1**	**mg/L**	**6**	**10**	**5**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Stable (flat) Theil-Sen Trend Line**
RVAAP-08 Load Line 1	Sharon	LL1mw-083	RDX	0.0007	0.0003	01/21/14	0.4	J	2	mg/L	6	10	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Tend Line
RVAAP-08 Load Line 1	**Unconsolidated**	**LL1mw-086**	**Nitroglycerin**	**0.0002**	**0.00033**	**07/24/14**	**1.7**	**J**	**1**	**mg/L**	**1**	**29**	**1**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-09 Load Line 2	Sharon	Explosives	2,4-Dinitrotoluene	Yes	142	36	0.00005	0.00106	0.00024	29	22	0.00004	0.00086	7/23/2015	7/23/2015	3/24/2015	3/24/2015	
RVAAP-09 Load Line 2	Sharon	Explosives	2,6-Dinitrotoluene	Yes	142	2	0.00005	0.00106	0.000048	142	2	0.000059	0.000092	7/23/2015	4/7/2008	7/23/2015	4/7/2008	
RVAAP-09 Load Line 2	Sharon	Explosives	RDX	Yes	142	19	0.00005	0.02	0.0007	21	12	0.000042	0.0017	7/23/2015	7/23/2015	7/23/2015	7/23/2015	
RVAAP-09 Load Line 2	Sharon	Miscellaneous	Cyanide	Yes	108	7	0.002	0.01	0.00015	108	7	0.0058	0.027	10/22/2014	1/18/2011	10/22/2014	1/18/2011	
RVAAP-09 Load Line 2	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**122**	**11**	**0.0000095**	**0.0003**	**0.000025**	**104**	**2**	**0.000007**	**0.000029**	**10/22/2014**	**7/12/2010**	**10/22/2014**	**7/9/2010**	**Pesticide from historical agricultural use**
RVAAP-09 Load Line 2	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**122**	**2**	**0.0000095**	**0.0003**	**0.0000014**	**122**	**2**	**0.0000065**	**0.00002**	**10/22/2014**	**3/6/2006**	**10/22/2014**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-09 Load Line 2	**Sharon**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**122**	**6**	**0.0000095**	**0.0003**	**0.0000014**	**122**	**6**	**0.000097**	**0.00046**	**10/22/2014**	**3/6/2006**	**10/22/2014**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-09 Load Line 2	Sharon	Pest/PCBs	PCB-1242	Yes	122	2	0.00038	0.001	0.0000078	122	2	0.00072	0.00085	10/22/2014	9/20/2001	10/22/2014	9/20/2001	
RVAAP-09 Load Line 2	Sharon	SVOCs	2,4-Dinitrotoluene	Yes	113	3	0.00077	0.01	0.00024	113	3	0.00063	0.00064	1/30/2012	10/8/2007	1/30/2012	10/8/2007	
RVAAP-09 Load Line 2	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**141**	**47**	**0.00048**	**0.01**	**0.0056**	**59**	**6**	**0.00062**	**0.021**	**7/23/2015**	**8/21/2013**	**1/30/2012**	**7/9/2010**	**Lab contaminant**
RVAAP-09 Load Line 2	Sharon	SVOCs	Pentachlorophenol	Yes	123	2	0.00095	0.025	0.00004	123	2	0.0013	0.0047	10/22/2014	4/7/2008	10/22/2014	4/7/2008	
RVAAP-09 Load Line 2	Sharon	VOCs	Benzene	Yes	128	9	0.00025	0.005	0.00045	104	1	0.00022	0.00049	10/22/2014	10/6/2008	8/2/2011	9/11/2001	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetim
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Explosives	2,4-Dinitrotoluene	25	22	0.00024	0.00024	16	16	0.00086	10/08/07	< 0.0001 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Miscellaneous	Cyanide	16	1	0.01	0.00015	16	1	0.0058	07/08/10	0.0058 J	07/08/10
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	Heptachlor	19	1	0.00005	0.0000014	19	1	0.00002	04/12/05	< 0.00001 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	Heptachlor epoxide	19	4	0.000052	0.0000014	19	4	0.00046	10/04/05	< 0.000052 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Pesticides and PCBs	PCB-1242	19	1	0.001	0.0000078	19	1	0.00085	09/20/01	< 0.00041 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Semi-Volatile Organics	2,4-Dinitrotoluene	16	3	0.01	0.00024	16	3	0.00064	10/08/07	< 0.00078 U	01/30/12
RVAAP-09 Load Line 2	Sharon	LL2mw-059	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	6	0.01	0.0056	9	1	0.0071	05/02/06	< 0.005 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Miscellaneous	Cyanide	9	2	0.01	0.00015	9	2	0.019	04/07/08	< 0.01 U	07/08/10
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Pesticides and PCBs	Heptachlor epoxide	9	1	0.00005	0.0000014	9	1	0.00022	09/19/01	< 0.000029 U	08/02/11
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	5	0.01	0.0056	5	1	0.021	04/07/08	< 0.0048 U	07/20/15
RVAAP-09 Load Line 2	Sharon	LL2mw-262	Pesticides and PCBs	Heptachlor	16	1	0.0000532	0.0000014	16	1	0.0000065	03/06/06	< 0.00003 U	07/09/10
RVAAP-09 Load Line 2	Sharon	LL2mw-262	Pesticides and PCBs	Heptachlor epoxide	16	1	0.0000532	0.0000014	16	1	0.00012	03/06/06	< 0.00003 U	07/09/10
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Explosives	2,6-Dinitrotoluene	19	2	0.00013	0.000048	19	2	0.000092	04/07/08	< 0.0001 U	07/23/14
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Pesticides and PCBs	PCB-1242	16	1	0.00058	0.0000078	16	1	0.00072	09/19/01	< 0.00038 U	01/21/13
RVAAP-09 Load Line 2	Sharon	LL2mw-265	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	20	10	0.01	0.0056	8	2	0.017	10/06/08	< 0.005 U	07/23/14
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0064	01/18/11	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Pesticides and PCBs	beta-BHC	7	1	0.0000556	0.000025	7	1	0.000029	07/09/10	< 0.00003 UJ	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	2	0.01	0.0056	4	1	0.0058	07/09/10	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-266	Volatile Organics	Benzene	7	1	0.005	0.00045	7	1	0.00049	09/11/01	< 0.001 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Explosives	2,4-Dinitrotoluene	14	12	0.00104	0.00024	7	6	0.00036	01/18/11	0.0002 B	07/23/15
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Explosives	RDX	14	12	0.00104	0.0007	13	12	0.0017	01/18/11	0.0013	07/23/15
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Inorganics	Beryllium	16	2	0.01	0.0025	4	2	0.0037	10/12/10	< 0.001 U	07/23/15
RVAAP-09 Load Line 2	Sharon	LL2mw-267	Miscellaneous	Cyanide	8	2	0.01	0.00015	8	2	0.027	10/12/10	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-269	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0084	01/18/11	< 0.01 U	04/07/11
RVAAP-09 Load Line 2	Sharon	LL2mw-270	Pesticides and PCBs	beta-BHC	6	1	0.00005	0.000025	6	1	0.000029	04/07/08	< 0.00003 U	07/15/10
RVAAP-09 Load Line 2	Sharon	LL2mw-270	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.01	0.0056	4	1	0.014	01/28/08	< 0.01 U	07/15/10
RVAAP-09 Load Line 2	Sharon	LL2mw-270	Semi-Volatile Organics	Pentachlorophenol	6	2	0.01	0.00004	6	2	0.0047	04/07/08	< 0.005 U	07/15/10

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-059**	**2,4-Dinitrotoluene**	**0.00024**	**0.00086**	**10/08/07**	**3.6**		**1**	**mg/L**	**39**	**255**	**25**	**Yes**	**No Mann-Kendall Trend Increasing to Stable OLS Regression Line Increasing to Stable Theil-Sen Trend Line**
RVAAP-09 Load Line 2	Sharon	LL2mw-267	2,4-Dinitrotoluene	0.00024	0.00036	01/18/11	1.5		2	mg/L	39	255	25	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-059	2,4-Dinitrotoluene	0.00024	0.00022	07/11/06	0.9	=	3	mg/L	39	255	25	Yes	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Increasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-060	2,4-Dinitrotoluene	0.00024	0.00022	10/01/00	0.9	=	3	mg/L	39	255	25	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 16 consecutive ND results since last detection.
RVAAP-09 Load Line 2	Sharon	LL2mw-267	2,4-Dinitrotoluene	0.00024	0.00022	07/09/10	0.9		3	mg/L	39	255	25	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-265**	**2,6-Dinitrotoluene**	**4.80E-05**	**9.20E-05**	**04/07/08**	**1.9**	**J**	**1**	**mg/L**	**2**	**255**	**2**	**No**	**No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 10 consecutive ND results since last detection.**
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-266**	**Benzene**	**0.00045**	**0.00049**	**09/11/01**	**1.1**	**J**	**1**	**mg/L**	**9**	**128**	**1**	**No**	**Insufficient data for statistical evaluation, 1 detection out of 6 samples. Well has had 5 consecutive ND results since last detection.**
RVAAP-09 Load Line 2	Sharon	LL2mw-268	Benzene	0.00045	0.00044	10/06/08	1.0	JB	2	mg/L	9	128	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 5 samples
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Benzene	0.00045	0.00042	10/06/08	0.9	JB	3	mg/L	9	128	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 9 samples. Well has had 4 consecutive ND results since last detection.
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-267**	**Cyanide**	**0.00015**	**0.027**	**10/12/10**	**180.0**	**J**	**1**	**mg/L**	**7**	**108**	**7**	**Yes**	**Insufficient data for statistical evaluation, 2 detection out of 5 samples**
RVAAP-09 Load Line 2	Sharon	LL2mw-060	Cyanide	0.00015	0.019	04/07/08	126.7		2	mg/L	7	108	7	Yes	Insufficient data for statistical evaluation, 2 detection out of 9 samples.
RVAAP-09 Load Line 2	Sharon	LL2mw-269	Cyanide	0.00015	0.0084	01/18/11	56.0	J	3	mg/L	7	108	7	No	Insufficient data for statistical evaluation, 1 detection out of 5 samples, need for sampling reviewed after free cyanide testing of LL2mw-267
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-059**	**PCB-1242**	**0.0000078**	**0.00085**	**09/20/01**	**109.0**	**=**	**1**	**mg/L**	**2**	**122**	**2**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 19 samples.**
RVAAP-09 Load Line 2	Sharon	LL2mw-265	PCB-1242	0.0000078	0.00072	09/19/01	92.3	=	2	mg/L	2	122	2	No	Insufficient data for statistical evaluation, 1 detection out of 10 samples. Well has had 9 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-270**	**Pentachlorophenol**	**4.00E-05**	**0.0047**	**04/07/08**	**117.5**	**J**	**1**	**mg/L**	**2**	**123**	**2**	**Yes**	**Insufficient data for statistical evaluation, 2 detection out of 6 samples**
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-267**	**RDX**	**0.0007**	**0.0017**	**01/18/11**	**2.4**	**J**	**1**	**mg/L**	**19**	**142**	**12**	**Yes**	**No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line**
RVAAP-09 Load Line 2	Sharon	LL2mw-059	RDX	0.0007	0.0002	10/01/00	0.3	J	2	mg/L	19	142	12	Yes	Decreasing Mann-Kendall Trend Stable (flat) OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-262	RDX	0.0007	0.00018	09/07/01	0.3	J	3	mg/L	19	142	12	No	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Stable (flat) Theil-Sen Trend Line Well has had 5 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-059**	**2,4-Dinitrotoluene**	**0.00024**	**0.00052**	**01/21/14**	**2.2**		**1**	**mg/L**	**9**	**24**	**6**	**Yes**	**No Mann-Kendall Trend** **Increasing to Stable OLS Regression Line** **Increasing to Stable Theil-Sen Trend Line**
RVAAP-09 Load Line 2	Sharon	LL2mw-059	2,4-Dinitrotoluene	0.00024	0.0003	07/23/14	1.3		2	mg/L	9	24	6	Yes	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Increasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	Sharon	LL2mw-267	2,4-Dinitrotoluene	0.00024	0.0003	08/21/13	1.3		2	mg/L	9	24	6	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-09 Load Line 2	**Sharon**	**LL2mw-267**	**RDX**	**0.0007**	**0.0015**	**08/21/13**	**2.1**		**1**	**mg/L**	**5**	**24**	**5**	**Yes**	**No Mann-Kendall Trend** **Increasing OLS Regression Line** **Increasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-10 Load Line 3	Sharon	Explosives	1,3,5-Trinitrobenzene	Yes	144	44	0.00005	0.0056	0.059	1	1	0.000028	0.065	7/21/2015	7/20/2015	7/14/2005	7/14/2005	
RVAAP-10 Load Line 3	Sharon	Explosives	1,3-Dinitrobenzene	Yes	144	4	0.00005	0.0056	0.0002	13	1	0.000051	0.00076	7/21/2015	8/4/2011	8/3/2011	8/3/2011	
RVAAP-10 Load Line 3	Sharon	Explosives	2,4,6-Trinitrotoluene	Yes	144	50	0.00005	0.0056	0.00098	37	35	0.000025	0.13	7/21/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	2,6-Dinitrotoluene	Yes	144	27	0.00005	0.0065	0.000048	144	27	0.000057	0.00092	7/21/2015	7/20/2015	7/21/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	2-Amino-4,6-Dinitrotoluene	Yes	144	75	0.000096	0.0056	0.0039	25	25	0.00012	0.032	7/21/2015	7/21/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	3-Nitrotoluene	Yes	144	2	0.000099	0.028	0.00017	96	1	0.00012	0.00036	7/21/2015	3/11/2015	8/4/2011	1/19/2011	
RVAAP-10 Load Line 3	Sharon	Explosives	4-Amino-2,6-Dinitrotoluene	Yes	144	82	0.00005	0.0056	0.0039	27	27	0.00006	0.059	7/21/2015	7/21/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Explosives	Nitrobenzene	Yes	144	7	0.00005	0.0056	0.00014	29	5	0.000073	0.0015	7/21/2015	3/11/2015	7/23/2014	7/23/2014	
RVAAP-10 Load Line 3	Sharon	Explosives	RDX	Yes	144	77	0.00005	0.0056	0.0007	39	36	0.00014	0.011	7/21/2015	7/21/2015	7/20/2015	7/20/2015	
RVAAP-10 Load Line 3	Sharon	Miscellaneous	Cyanide	Yes	108	6	0.005	0.01	0.00015	108	6	0.0014	0.021	10/22/2014	1/18/2011	10/22/2014	1/18/2011	
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**alpha-BHC**	**No**	**142**	**3**	**0.0000095**	**0.0015**	**0.0000071**	**142**	**3**	**0.000018**	**0.000027**	**7/21/2015**	**8/3/2011**	**7/21/2015**	**8/3/2011**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**beta-BHC**	**No**	**142**	**23**	**0.0000095**	**0.0015**	**0.000025**	**111**	**15**	**0.0000083**	**0.00028**	**7/21/2015**	**3/11/2015**	**7/21/2015**	**3/11/2015**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**Heptachlor**	**No**	**142**	**2**	**0.0000095**	**0.0015**	**0.0000014**	**142**	**2**	**0.000038**	**0.000047**	**7/21/2015**	**3/11/2015**	**7/21/2015**	**3/11/2015**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**142**	**5**	**0.0000095**	**0.0015**	**0.0000014**	**142**	**5**	**0.000038**	**0.013**	**7/21/2015**	**10/5/2005**	**7/21/2015**	**10/5/2005**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	**Sharon**	**Pest/PCBs**	**Toxaphene**	**No**	**142**	**1**	**0.00048**	**0.1**	**0.000015**	**142**	**1**	**0.0021**	**0.0021**	**7/21/2015**	**3/6/2006**	**7/21/2015**	**3/6/2006**	**Pesticide from historical agricultural use**
RVAAP-10 Load Line 3	Sharon	SVOCs	2,6-Dinitrotoluene	Yes	99	1	0.00076	0.01	0.000048	99	1	0.0018	0.0018	1/31/2012	10/5/2005	1/31/2012	10/5/2005	
RVAAP-10 Load Line 3	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**145**	**59**	**0.00048**	**0.01**	**0.0056**	**47**	**6**	**0.00039**	**0.029**	**7/21/2015**	**8/20/2013**	**7/23/2014**	**8/3/2011**	**Lab contaminant**
RVAAP-10 Load Line 3	Sharon	SVOCs	Pentachlorophenol	Yes	111	1	0.00095	0.01	0.00004	111	1	0.003	0.003	10/22/2014	10/4/2005	10/22/2014	10/4/2005	
RVAAP-10 Load Line 3	**Sharon**	**VOCs**	**Chloroform**	**No**	**123**	**7**	**0.00025**	**0.005**	**0.00022**	**122**	**6**	**0.0002**	**0.0012**	**10/22/2014**	**4/7/2011**	**10/22/2014**	**4/7/2011**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present at
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-10 Load Line 3	Sharon	LL3mw-232	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.012	04/08/08	< 0.01 U	07/08/10
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Explosives	2,6-Dinitrotoluene	13	4	0.00013	0.000048	13	4	0.00013	01/29/08	< 0.00011 UJ	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Explosives	RDX	13	11	0.0005	0.0007	1	1	0.00079	09/11/01	0.00053 J	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.021	01/29/08	< 0.01 U	07/08/10
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Pesticides and PCBs	alpha-BHC	13	2	0.000064	0.0000071	13	2	0.000027	07/08/08	0.000018 JB	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-234	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	13	7	0.01	0.0056	8	2	0.01	08/03/11	0.01 B	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-235	Pesticides and PCBs	alpha-BHC	6	1	0.00005	0.0000071	6	1	0.00002	10/08/08	< 0.000029 U	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	2,4,6-Trinitrotoluene	6	4	0.0002	0.00098	3	3	0.0034	01/29/08	0.002	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	2,6-Dinitrotoluene	6	3	0.00013	0.000048	6	3	0.000083	01/29/08	< 0.0001 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	2-Amino-4,6-Dinitrotoluene	6	5	0.0002	0.0039	3	3	0.0078	01/29/08	0.0057	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Explosives	4-Amino-2,6-Dinitrotoluene	6	5	0.0002	0.0039	4	4	0.013	01/29/08	0.01	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-237	Pesticides and PCBs	beta-BHC	6	2	0.0003	0.000025	6	2	0.000061	01/29/08	< 0.0003 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	1,3,5-Trinitrobenzene	19	19	0.0056	0.059	1	1	0.065	07/14/05	0.024 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	1,3-Dinitrobenzene	19	1	0.0056	0.0002	10	1	0.00076	08/03/11	< 0.0001 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	2,4,6-Trinitrotoluene	19	19	0.0056	0.00098	19	19	0.13	07/14/05	0.055 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	2,6-Dinitrotoluene	19	8	0.0065	0.000048	19	8	0.00092	07/14/05	0.00038 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	2-Amino-4,6-Dinitrotoluene	19	19	0.0056	0.0039	18	18	0.032	09/18/01	0.009 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	3-Nitrotoluene	19	2	0.028	0.00017	14	1	0.00036	01/19/11	< 0.0001 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	4-Amino-2,6-Dinitrotoluene	19	19	0.0056	0.0039	19	19	0.059	01/21/14	0.025 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	Nitrobenzene	19	6	0.0056	0.00014	14	5	0.0015	10/03/06	< 0.0001 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Explosives	RDX	19	19	0.0056	0.0007	19	19	0.011	01/19/11	0.0068 J	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0019	05/02/06	< 0.01 UJ	01/19/11
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	beta-BHC	20	10	0.0015	0.000025	19	10	0.00028	07/14/05	< 0.000052 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	Heptachlor	20	1	0.0015	0.0000014	20	1	0.000038	03/11/15	< 0.000052 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	Heptachlor epoxide	20	2	0.0015	0.0000014	20	2	0.013	10/05/05	< 0.000052 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Pesticides and PCBs	Toxaphene	20	1	0.1	0.000015	20	1	0.0021	03/06/06	< 0.0021 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Semi-Volatile Organics	2,6-Dinitrotoluene	15	1	0.01	0.000048	15	1	0.0018	10/05/05	< 0.0048 U	08/03/11
RVAAP-10 Load Line 3	Sharon	LL3mw-238	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	20	7	0.01	0.0056	8	2	0.021	10/05/05	< 0.0049 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Explosives	RDX	6	5	0.00105	0.0007	5	4	0.0017	04/07/11	0.0017	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Pesticides and PCBs	Heptachlor epoxide	6	1	0.0000532	0.0000014	6	1	0.000075	09/18/01	< 0.00003 UJ	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	1	0.01	0.0056	5	1	0.0087	07/08/10	< 0.01 U	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-239	Volatile Organics	Chloroform	6	6	0.005	0.00022	6	6	0.0012	09/18/01	0.00043 JB	04/07/11
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	2,4,6-Trinitrotoluene	14	14	0.00054	0.00098	13	13	0.012	04/08/08	0.006	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	2,6-Dinitrotoluene	14	10	0.00054	0.000048	14	10	0.0003	04/08/08	0.00014	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	2-Amino-4,6-Dinitrotoluene	14	14	0.00054	0.0039	4	4	0.0064	01/29/08	0.0026	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	4-Amino-2,6-Dinitrotoluene	14	14	0.00054	0.0039	4	4	0.0059	01/29/08	0.0027	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Explosives	RDX	14	13	0.0017	0.0007	13	12	0.0018	01/29/08	0.0013	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Pesticides and PCBs	beta-BHC	14	4	0.00011	0.000025	10	3	0.000052	07/07/08	< 0.000048 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-241	Pesticides and PCBs	Heptachlor	14	1	0.00011	0.0000014	14	1	0.000047	03/11/15	< 0.000048 U	07/20/15
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0014	03/09/06	< 0.01 UJ	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Pesticides and PCBs	Heptachlor epoxide	18	2	0.00005	0.0000014	18	2	0.000051	04/12/05	< 0.00001 U	01/21/13
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	18	7	0.01	0.0056	7	1	0.029	01/18/11	< 0.00083 U	01/21/13
RVAAP-10 Load Line 3	Sharon	LL3mw-242	Semi-Volatile Organics	Pentachlorophenol	15	1	0.01	0.00004	15	1	0.003	10/04/05	< 0.005 U	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Explosives	2,6-Dinitrotoluene	7	2	0.00013	0.000048	7	2	0.000079	01/28/08	0.000077 J	01/18/11
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Miscellaneous	Cyanide	7	2	0.01	0.00015	7	2	0.02	01/28/08	0.0056 J	01/18/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-001	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0072	07/10/08	< 0.01 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000073	07/10/08	< 0.000098 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	4,4'-DDD	5	1	0.00003	0.000031	1	1	0.00035	09/04/01	< 0.00003 UJ	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	Endrin	5	1	0.00003	0.00023	1	1	0.00031	09/04/01	< 0.00003 UJ	01/20/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**1,3,5-Trinitrobenzene**	**0.059**	**0.065**	**07/14/05**	**1.1**	**=**	**1**	**mg/L**	**44**	**144**	**1**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-238	1,3,5-Trinitrobenzene	0.059	0.024	07/20/15	0.4	J	2	mg/L	44	144	1	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	1,3,5-Trinitrobenzene	0.059	0.024	04/08/08	0.4		2	mg/L	44	144	1	Yes	No Mann-Kendall Trend Increasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-237	1,3,5-Trinitrobenzene	0.059	0.00042	01/29/08	0.0	J	3	mg/L	44	144	1	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**1,3-Dinitrobenzene**	**0.0002**	**0.00076**	**08/03/11**	**3.8**	**J**	**1**	**mg/L**	**4**	**144**	**1**	**Yes**	**No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	1,3-Dinitrobenzene	0.0002	0.00012	09/21/01	0.6	J	2	mg/L	4	144	1	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-236	1,3-Dinitrobenzene	0.0002	0.0001	08/04/11	0.5	B	3	mg/L	4	144	1	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.13**	**07/14/05**	**132.7**	**=**	**1**	**mg/L**	**50**	**144**	**35**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,4,6-Trinitrotoluene	0.00098	0.012	04/08/08	12.2		2	mg/L	50	144	35	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-237	2,4,6-Trinitrotoluene	0.00098	0.0034	01/29/08	3.5	J	3	mg/L	50	144	35	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,4,6-Trinitrotoluene	0.00098	0.0034	08/04/11	3.5		3	mg/L	50	144	35	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0018**	**10/05/05**	**37.5**	**J**	**1**	**mg/L**	**28**	**243**	**28**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-238	2,6-Dinitrotoluene	4.80E-05	0.0003	07/23/14	6.3	J	2	mg/L	28	243	28	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,6-Dinitrotoluene	4.80E-05	0.0003	04/08/08	6.3	J	2	mg/L	28	243	28	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-234	2,6-Dinitrotoluene	4.80E-05	0.00013	01/29/08	2.7	J	3	mg/L	28	243	28	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.032**	**09/18/01**	**8.2**	**=**	**1**	**mg/L**	**75**	**144**	**25**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-10 Load Line 3	Sharon	LL3mw-237	2-Amino-4,6-Dinitrotoluene	0.0039	0.0078	01/29/08	2.0	J	2	mg/L	75	144	25	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2-Amino-4,6-Dinitrotoluene	0.0039	0.0064	01/29/08	1.6		3	mg/L	75	144	25	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**3-Nitrotoluene**	**0.00017**	**0.00036**	**01/19/11**	**2.1**	**J**	**1**	**mg/L**	**2**	**144**	**1**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing to Stable OLS Regression Line Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.059**	**01/21/14**	**15.1**	**J**	**1**	**mg/L**	**82**	**144**	**27**	**Yes**	**No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-237	4-Amino-2,6-Dinitrotoluene	0.0039	0.013	01/29/08	3.3	J	2	mg/L	82	144	27	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	4-Amino-2,6-Dinitrotoluene	0.0039	0.0059	01/29/08	1.5		3	mg/L	82	144	27	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-234**	**Cyanide**	**0.00015**	**0.021**	**01/29/08**	**140.0**	**J**	**1**	**mg/L**	**6**	**108**	**6**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 6 samples**
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Cyanide	0.00015	0.02	01/28/08	133.3		2	mg/L	6	108	6	Yes	Insufficient data for statistical evaluation, 2 detection out of 6 samples
RVAAP-10 Load Line 3	Sharon	LL3mw-232	Cyanide	0.00015	0.012	04/08/08	80.0	J	3	mg/L	6	108	6	No	Insufficient data for statistical evaluation, 1 detection out of 6 samples, need for sampling reviewed after testing of LL3mw-234 and -243 for free cyanide
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**Nitrobenzene**	**0.00014**	**0.0015**	**10/03/06**	**10.7**	**=**	**1**	**mg/L**	**7**	**243**	**4**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-243	Nitrobenzene	0.00014	7.30E-05	10/07/08	0.5	J	2	mg/L	7	243	4	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-242**	**Pentachlorophenol**	**4.00E-05**	**0.003**	**10/04/05**	**75.0**	**J**	**1**	**mg/L**	**1**	**111**	**1**	**No**	**Insufficient data for statistical evaluation, 1 detection out of 13 samples. Well has had 9 consecutive ND results since last detection.**
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**RDX**	**0.0007**	**0.011**	**01/19/11**	**15.7**	**J**	**1**	**mg/L**	**77**	**144**	**36**	**Yes**	**No Mann-Kendall Trend Stable (flat) OLS Regression Line Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	RDX	0.0007	0.0018	01/29/08	2.6	J	2	mg/L	77	144	36	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-239	RDX	0.0007	0.0017	04/07/11	2.4		3	mg/L	77	144	36	Yes	No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.12**	**01/21/14**	**122.4**	**J**	**1**	**mg/L**	**11**	**35**	**11**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,4,6-Trinitrotoluene	0.00098	0.0071	01/21/13	7.2		2	mg/L	11	35	11	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2,6-Dinitrotoluene**	**0.000048**	**0.00052**	**08/19/13**	**10.8**	**J**	**1**	**mg/L**	**8**	**35**	**8**	**Yes**	**Decreasing Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2,6-Dinitrotoluene	0.000048	0.00014	07/20/15	2.9		2	mg/L	8	35	8	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.019**	**08/19/13**	**4.9**		**1**	**mg/L**	**30**	**35**	**5**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	2-Amino-4,6-Dinitrotoluene	0.0039	0.003	01/21/13	0.8		2	mg/L	30	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-244	2-Amino-4,6-Dinitrotoluene	0.0039	0.00065	08/20/13	0.2		3	mg/L	30	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.059**	**01/21/14**	**15.1**	**J**	**1**	**mg/L**	**32**	**35**	**5**	**Yes**	**No Mann-Kendall Trend** **Decreasing to Stable OLS Regression Line** **Decreasing to Stable Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	4-Amino-2,6-Dinitrotoluene	0.0039	0.0029	01/21/13	0.7		2	mg/L	32	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-241	4-Amino-2,6-Dinitrotoluene	0.0039	0.0029	08/19/13	0.7		2	mg/L	32	35	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-244	4-Amino-2,6-Dinitrotoluene	0.0039	0.0007	01/22/14	0.2		3	mg/L	32	35	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**Nitrobenzene**	**0.00014**	**0.00017**	**08/19/13**	**1.2**	**J**	**1**	**mg/L**	**3**	**35**	**2**	**Yes**	**No Mann-Kendall Trend** **Decreasing OLS Regression Line** **Decreasing Theil-Sen Trend Line**
RVAAP-10 Load Line 3	**Sharon**	**LL3mw-238**	**RDX**	**0.0007**	**0.0072**	**08/19/13**	**10.3**		**1**	**mg/L**	**32**	**35**	**10**	**Yes**	**No Mann-Kendall Trend** **Stable (flat) OLS Regression Line** **Stable (flat) Theil-Sen Trend Line**
RVAAP-10 Load Line 3	Sharon	LL3mw-241	RDX	0.0007	0.0013	07/20/15	1.9		2	mg/L	32	35	10	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-10 Load Line 3	Sharon	LL3mw-244	RDX	0.0007	0.00056	01/22/14	0.8		3	mg/L	32	35	10	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-11 Load Line 4	Sharon	SVOCs	Naphthalene	Yes	4	1	0.000095	0.000097	0.00017	1	1	0.00032	0.00032	1/23/2013	10/17/2012	10/17/2012	10/17/2012	
RVAAP-11 Load Line 4	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	70	4	0.000049	0.00102	0.000048	70	4	0.000051	0.000077	1/23/2013	7/7/2008	1/23/2013	7/7/2008	
RVAAP-11 Load Line 4	Unconsolidated	Miscellaneous	Cyanide	Yes	64	3	0.01	0.01	0.00015	64	3	0.0013	0.01	4/4/2011	4/4/2011	4/4/2011	4/4/2011	
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**70**	**4**	**0.0000095**	**0.000051**	**0.000025**	**65**	**2**	**0.00002**	**0.000043**	**1/23/2013**	**4/8/2008**	**4/4/2011**	**5/2/2006**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**Dieldrin**	**No**	**70**	**1**	**0.0000095**	**0.000051**	**0.0000017**	**70**	**1**	**0.000027**	**0.000027**	**1/23/2013**	**3/7/2006**	**1/23/2013**	**3/7/2006**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**70**	**2**	**0.0000095**	**0.000051**	**0.0000014**	**70**	**2**	**0.0000065**	**0.000013**	**1/23/2013**	**4/13/2005**	**1/23/2013**	**4/13/2005**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**70**	**2**	**0.0000095**	**0.000051**	**0.0000014**	**70**	**2**	**0.000022**	**0.000069**	**1/23/2013**	**10/5/2005**	**1/23/2013**	**10/5/2005**	**Pesticide from historical agricultural use**
RVAAP-11 Load Line 4	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**70**	**19**	**0.00076**	**0.01**	**0.0056**	**39**	**1**	**0.00082**	**0.0082**	**1/23/2013**	**1/23/2013**	**4/4/2011**	**7/8/2010**	**Lab contaminant**
RVAAP-11 Load Line 4	Unconsolidated	VOCs	Benzene	Yes	70	4	0.00025	0.005	0.00045	64	1	0.00031	0.00047	1/23/2013	10/7/2008	4/4/2011	10/7/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above S
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cance
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-11 Load Line 4	Sharon	LL4mw-201	Semi-Volatile Organics	Naphthalene	4	1	0.000097	0.00017	1	1	0.00032	10/17/12	< 0.000096 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-193	Explosives	2,6-Dinitrotoluene	6	2	0.00013	0.000048	6	2	0.000077	07/07/08	< 0.00011 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-193	Volatile Organics	Benzene	6	1	0.001	0.00045	6	1	0.00047	10/07/08	< 0.001 U	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-194	Explosives	2,6-Dinitrotoluene	5	2	0.00013	0.000048	5	2	0.00007	01/29/08	< 0.000095 U	10/07/08
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-196	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	2	0.01	0.0056	4	1	0.0082	07/08/10	0.00082 J	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-197	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0076	04/04/11	0.0076 J	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0013	03/07/06	< 0.01 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Pesticides and PCBs	Heptachlor	14	1	0.00005	0.0000014	14	1	0.0000065	04/13/05	< 0.00003 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Pesticides and PCBs	Heptachlor epoxide	14	1	0.00005	0.0000014	14	1	0.000069	10/05/05	< 0.00003 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Miscellaneous	Cyanide	18	1	0.01	0.00015	18	1	0.01	04/04/11	< 0.01 UJ	04/04/11
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	beta-BHC	21	3	0.00005	0.000025	17	2	0.000043	03/07/06	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Dieldrin	21	1	0.00005	0.0000017	21	1	0.000027	03/07/06	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Heptachlor	21	1	0.00005	0.0000014	21	1	0.000013	04/13/05	< 0.0000095 U	01/23/13
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-199	Pesticides and PCBs	Heptachlor epoxide	21	1	0.00005	0.0000014	21	1	0.000022	10/05/05	< 0.0000095 U	01/23/13

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-11 Load Line 4	**Sharon**	**LL4mw-201**	**Naphthalene**	**0.00017**	**0.00032**	**10/17/12**	**1.9**	**J**	**1**	**mg/L**	**1**	**4**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-11 Load Line 4	**Unconsolidated**	**LL4mw-193**	**2,6-Dinitrotoluene**	**4.80E-05**	**7.70E-05**	**07/07/08**	**1.6**	**J**	**1**	**mg/L**	**4**	**138**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-194	2,6-Dinitrotoluene	4.80E-05	7.00E-05	01/29/08	1.5	J	2	mg/L	4	138	4	Yes	To be sampled under the FWGWMP.
RVAAP-11 Load Line 4	**Unconsolidated**	**LL4mw-199**	**Cyanide**	**0.00015**	**0.01**	**09/06/01**	**66.7**	**=**	**1**	**mg/L**	**3**	**64**	**3**	**No**	**Well has had 12 consecutive ND results since last detection.**
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-197	Cyanide	0.00015	0.0076	04/04/11	50.7	J	2	mg/L	3	64	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-11 Load Line 4	Unconsolidated	LL4mw-198	Cyanide	0.00015	0.0013	03/07/06	8.7	J	3	mg/L	3	64	3	No	Well has had 8 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-12 Load Line 12	Sharon Shale	Explosives	2,4,6-Trinitrotoluene	Yes	49	4	0.00009	0.00046	0.00098	1	1	0.00024	0.0017	8/4/2011	11/1/2000	10/31/2000	10/31/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	2,4-Dinitrotoluene	Yes	49	2	0.00009	0.001	0.00024	7	1	0.000069	0.0012	8/4/2011	11/1/2000	11/5/2004	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	2-Nitrotoluene	Yes	49	6	0.0002	0.0006	0.00031	44	4	0.0001	0.0065	8/4/2011	4/19/2007	8/4/2011	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	Nitrobenzene	Yes	49	3	0.00009	0.00029	0.00014	7	1	0.000091	0.00015	8/4/2011	11/1/2000	11/5/2004	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Explosives	RDX	Yes	49	7	0.00009	0.0005	0.0007	3	3	0.000053	0.002	8/4/2011	7/10/2007	11/1/2000	11/1/2000	
RVAAP-12 Load Line 12	Sharon Shale	Miscellaneous	Cyanide	Yes	41	5	0.01	0.01	0.00015	41	5	0.0013	0.025	7/13/2010	1/30/2008	7/13/2010	1/30/2008	
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Aldrin**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.00000092**	**49**	**1**	**0.000016**	**0.000016**	**8/4/2011**	**3/7/2006**	**8/4/2011**	**3/7/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**alpha-BHC**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.0000071**	**49**	**1**	**0.000065**	**0.000065**	**8/4/2011**	**10/2/2006**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**beta-BHC**	**No**	**49**	**6**	**0.000029**	**0.0003**	**0.000025**	**44**	**1**	**0.000011**	**0.00057**	**8/4/2011**	**7/13/2010**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Dieldrin**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.0000017**	**49**	**1**	**0.0000093**	**0.0000093**	**8/4/2011**	**10/2/2006**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Heptachlor**	**No**	**49**	**4**	**0.000029**	**0.0003**	**0.0000014**	**49**	**4**	**0.0000072**	**0.000027**	**8/4/2011**	**8/2/2011**	**8/4/2011**	**8/2/2011**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**49**	**4**	**0.000029**	**0.0003**	**0.0000014**	**49**	**4**	**0.000007**	**0.00011**	**8/4/2011**	**10/2/2006**	**8/4/2011**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Sharon Shale**	**Pest/PCBs**	**Lindane**	**No**	**49**	**1**	**0.000029**	**0.0003**	**0.000041**	**11**	**1**	**0.0001**	**0.0001**	**8/4/2011**	**10/2/2006**	**10/2/2006**	**10/2/2006**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	Sharon Shale	Pest/PCBs	PCB-1254	Yes	49	1	0.00048	0.0013	0.0000078	49	1	0.000051	0.000051	8/4/2011	10/5/2006	8/4/2011	10/5/2006	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Benz(a)anthracene	Yes	49	2	0.00019	0.01	0.000012	49	2	0.00014	0.00027	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Benzo(a)pyrene	Yes	49	2	0.00019	0.01	0.0000034	49	2	0.00016	0.00029	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Benzo(b)fluoranthene	Yes	49	1	0.00019	0.01	0.000034	49	1	0.0002	0.0002	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	49	18	0.001	0.015	0.0056	27	2	0.00089	0.034	8/4/2011	8/4/2011	8/2/2011	7/9/2008	Potential lab contaminant
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Dibenz(a,h)anthracene	Yes	49	2	0.00019	0.01	0.0000034	49	2	0.0005	0.00095	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	49	2	0.00019	0.01	0.000034	49	2	0.00037	0.00081	8/4/2011	11/1/2004	8/4/2011	11/1/2004	
RVAAP-12 Load Line 12	Sharon Shale	SVOCs	Naphthalene	Yes	49	1	0.00019	0.01	0.00017	49	1	0.00029	0.00029	8/4/2011	7/13/2010	8/4/2011	7/13/2010	
RVAAP-12 Load Line 12	Sharon Shale	VOCs	1,2-Dichloroethane	Yes	49	1	0.001	0.005	0.00017	49	1	0.00046	0.00046	8/4/2011	10/2/2006	8/4/2011	10/2/2006	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2,4,6-Trinitrotoluene	Yes	191	5	0.000049	0.00036	0.00098	1	1	0.00012	0.003	7/22/2015	11/29/2004	11/29/2004	11/29/2004	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2,4-Dinitrotoluene	Yes	191	5	0.000049	0.00068	0.00024	24	5	0.00025	0.00065	7/22/2015	11/7/2000	11/30/2004	11/7/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	191	7	0.000049	0.00074	0.000048	191	7	0.000053	0.0001	7/22/2015	7/8/2008	7/22/2015	7/8/2008	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	2-Nitrotoluene	Yes	191	12	0.000098	0.0014	0.00031	132	8	0.000097	0.0063	7/22/2015	4/19/2007	8/3/2011	11/7/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	3-Nitrotoluene	Yes	191	5	0.000098	0.00072	0.00017	146	2	0.000098	0.00078	7/22/2015	1/30/2008	8/3/2011	11/6/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	Nitrobenzene	Yes	191	17	0.000049	0.00023	0.00014	26	4	0.000051	0.00021	7/22/2015	10/7/2008	11/30/2004	11/6/2000	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	Nitroglycerin	Yes	172	2	0.00049	0.0025	0.0002	171	1	0.00018	0.00038	7/22/2015	7/13/2010	7/22/2015	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	Explosives	RDX	Yes	191	6	0.000049	0.0017	0.0007	6	2	0.000067	0.0015	7/22/2015	7/12/2010	11/29/2004	11/29/2004	
RVAAP-12 Load Line 12	Unconsolidated	Miscellaneous	Cyanide	Yes	120	5	0.01	0.01	0.00015	120	5	0.0016	0.057	1/22/2013	7/12/2010	1/22/2013	7/12/2010	
RVAAP-12 Load Line 12	Unconsolidated	Miscellaneous	Hydrazine	Yes	8	1	0.01	0.01	0.0000011	8	1	0.0192	0.0192	6/5/2009	6/5/2009	6/5/2009	6/5/2009	
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**4,4'-DDD**	**No**	**180**	**2**	**0.0000095**	**0.00095**	**0.000031**	**33**	**1**	**0.000013**	**0.000099**	**7/22/2014**	**4/9/2008**	**4/30/2012**	**11/6/2000**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**4,4'-DDE**	**No**	**180**	**1**	**0.0000095**	**0.00095**	**0.000046**	**29**	**1**	**0.000056**	**0.000056**	**7/22/2014**	**11/6/2000**	**4/30/2012**	**11/6/2000**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**Aldrin**	**No**	**180**	**1**	**0.0000095**	**0.00095**	**0.00000092**	**180**	**1**	**0.000054**	**0.000054**	**7/22/2014**	**11/6/2000**	**7/22/2014**	**11/6/2000**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**180**	**5**	**0.0000095**	**0.00095**	**0.0000071**	**180**	**5**	**0.0000082**	**0.000031**	**7/22/2014**	**8/3/2011**	**7/22/2014**	**8/3/2011**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**180**	**21**	**0.0000095**	**0.00095**	**0.000025**	**135**	**4**	**0.00001**	**0.00018**	**7/22/2014**	**8/20/2013**	**8/20/2013**	**8/20/2013**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**180**	**4**	**0.0000095**	**0.00095**	**0.0000014**	**180**	**4**	**0.000011**	**0.00017**	**7/22/2014**	**8/2/2011**	**7/22/2014**	**8/2/2011**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	**Unconsolidated**	**Pest/PCBs**	**Heptachlor epoxide**	**No**	**180**	**2**	**0.0000095**	**0.00095**	**0.0000014**	**180**	**2**	**0.0000082**	**0.000012**	**7/22/2014**	**4/8/2008**	**7/22/2014**	**4/8/2008**	**Pesticide from historical agricultural use**
RVAAP-12 Load Line 12	Unconsolidated	Pest/PCBs	PCB-1248	Yes	167	1	0.00019	0.0015	0.0000078	167	1	0.00015	0.00015	1/22/2013	1/29/2008	1/22/2013	1/29/2008	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Benz(a)anthracene	Yes	168	1	0.000095	0.01	0.000012	168	1	0.00023	0.00023	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Benzo(b)fluoranthene	Yes	168	1	0.000095	0.01	0.000034	168	1	0.00022	0.00022	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	202	98	0.00048	0.025	0.0056	83	13	0.00055	0.073	7/22/2015	3/10/2015	1/23/2014	8/3/2011	Potential lab contaminant
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Dibenz(a,h)anthracene	Yes	168	1	0.000095	0.01	0.0000034	168	1	0.00021	0.00021	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	168	1	0.000095	0.01	0.000034	168	1	0.00022	0.00022	1/22/2013	7/13/2010	1/22/2013	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	SVOCs	Naphthalene	Yes	168	1	0.000095	0.01	0.00017	149	1	0.0014	0.0014	1/22/2013	7/13/2010	8/3/2011	7/13/2010	
RVAAP-12 Load Line 12	Unconsolidated	VOCs	Benzene	Yes	181	16	0.00025	0.005	0.00045	137	4	0.00022	0.00058	7/22/2014	8/2/2011	8/3/2011	10/7/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer r
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Explosives	Nitroglycerin	17	1	0.0034	0.0002	17	1	0.00037	07/14/10	< 0.00051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	alpha-BHC	18	1	0.00015	0.0000071	18	1	0.000022	04/06/11	< 0.000051 U	07/21/15
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-002	Pesticides and PCBs	Heptachlor	18	1	0.00015	0.0000014	18	1	0.000066	03/10/15	< 0.000051 U	07/21/15
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Common Anions	Nitrate	4	3	0.2	3.2	2	2	16.3	10/31/00	< 0.1 U	06/05/09
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Explosives	2,4,6-Trinitrotoluene	9	2	0.00046	0.00098	1	1	0.0017	10/31/00	< 0.000099 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Explosives	2-Nitrotoluene	9	2	0.00057	0.00031	9	2	0.0017	10/31/00	< 0.0005 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Explosives	RDX	9	2	0.0005	0.0007	2	2	0.00093	10/31/00	< 0.000099 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Inorganics	Beryllium	11	5	0.005	0.0025	4	2	0.0168	10/16/09	0.0011	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Miscellaneous	Cyanide	7	1	0.01	0.00015	7	1	0.0087	01/30/08	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Miscellaneous	Total Phosphorus as P	1	1	0.5	0.00004	1	1	1.3	06/05/09	1.3 =	06/05/09
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Pesticides and PCBs	Heptachlor	9	1	0.00014	0.0000014	9	1	0.000008	08/02/11	0.000008 J	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Miscellaneous	Cyanide	15	1	0.01	0.00015	15	1	0.0013	05/02/06	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Pesticides and PCBs	Heptachlor	17	1	0.00015	0.0000014	17	1	0.000027	07/12/10	< 0.000031 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Pesticides and PCBs	Heptachlor epoxide	17	1	0.00015	0.0000014	17	1	0.000007	05/02/06	< 0.000031 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Pesticides and PCBs	PCB-1254	17	1	0.0013	0.0000078	17	1	0.000051	10/05/06	< 0.00052 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Benz(a)anthracene	17	1	0.01	0.000012	17	1	0.00014	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Benzo(a)pyrene	17	1	0.01	0.0000034	17	1	0.00016	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	17	6	0.015	0.0056	9	1	0.0056	10/09/07	0.00089 J	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Dibenz(a,h)anthracene	17	1	0.01	0.0000034	17	1	0.0005	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	17	1	0.01	0.000034	17	1	0.00037	11/01/04	< 0.00021 U	08/02/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Explosives	2-Nitrotoluene	15	2	0.0006	0.00031	13	1	0.0026	11/01/00	< 0.0005 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Explosives	RDX	15	3	0.0005	0.0007	1	1	0.002	11/01/00	< 0.000099 U	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Miscellaneous	Cyanide	13	3	0.01	0.00015	13	3	0.025	07/10/07	< 0.01 UJ	07/13/10
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Aldrin	15	1	0.0003	0.00000092	15	1	0.000016	03/07/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	alpha-BHC	15	1	0.0003	0.0000071	15	1	0.000065	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	beta-BHC	15	3	0.0003	0.000025	13	1	0.00057	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Dieldrin	15	1	0.0003	0.0000017	15	1	0.0000093	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Heptachlor	15	2	0.0003	0.0000014	15	2	0.00001	03/07/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Heptachlor epoxide	15	3	0.0003	0.0000014	15	3	0.00011	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Pesticides and PCBs	Lindane	15	1	0.0003	0.000041	4	1	0.0001	10/02/06	< 0.000029 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Benz(a)anthracene	15	1	0.01	0.000012	15	1	0.00027	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Benzo(a)pyrene	15	1	0.01	0.0000034	15	1	0.00029	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Benzo(b)fluoranthene	15	1	0.01	0.000034	15	1	0.0002	07/13/10	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Dibenz(a,h)anthracene	15	1	0.01	0.0000034	15	1	0.00095	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	15	1	0.01	0.000034	15	1	0.00081	11/01/04	< 0.00019 UJ	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Volatile Organics	1,2-Dichloroethane	15	1	0.005	0.00017	15	1	0.00046	10/02/06	< 0.001 U	08/03/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Explosives	2,4-Dinitrotoluene	8	1	0.00036	0.00024	2	1	0.0012	11/01/00	< 0.000097 U	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Explosives	2-Nitrotoluene	8	1	0.00054	0.00031	7	1	0.0065	11/01/00	< 0.00048 U	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Explosives	Nitrobenzene	8	1	0.0002	0.00014	2	1	0.00015	11/01/00	< 0.000097 U	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	4	0.015	0.0056	5	1	0.034	07/09/08	0.0013 J	08/04/11
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	Semi-Volatile Organics	Naphthalene	8	1	0.01	0.00017	8	1	0.00029	07/13/10	< 0.00019 U	08/04/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-088	Explosives	2,6-Dinitrotoluene	8	1	0.00074	0.000048	8	1	0.000055	04/08/08	< 0.00011 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-088	Explosives	2-Nitrotoluene	8	1	0.00054	0.00031	7	1	0.0063	11/01/00	< 0.00054 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.015	07/08/08	< 0.01 UJ	07/13/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Pesticides and PCBs	Heptachlor	14	1	0.00015	0.0000014	14	1	0.000011	08/02/11	0.000011 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	14	9	0.025	0.0056	7	2	0.073	01/31/08	0.0012 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	Explosives	RDX	8	1	0.0005	0.0007	1	1	0.00072	10/31/00	< 0.000097 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	Miscellaneous	Total Phosphorus as P	1	1	0.1	0.00004	1	1	0.09	06/03/09	0.09 J	06/03/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.015	0.0056	4	1	0.0095	08/03/11	0.0095 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	2,4-Dinitrotoluene	15	1	0.00036	0.00024	2	1	0.00065	11/06/00	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	2-Nitrotoluene	15	2	0.00059	0.00031	13	1	0.0049	11/06/00	< 0.00051 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	3-Nitrotoluene	15	1	0.00059	0.00017	15	1	0.00078	11/06/00	< 0.00051 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Explosives	Nitrobenzene	15	1	0.0002	0.00014	2	1	0.00021	11/06/00	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	4,4'-DDD	15	1	0.00011	0.000031	2	1	0.000099	11/06/00	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	Aldrin	15	1	0.000098	0.00000092	15	1	0.000054	11/06/00	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	beta-BHC	15	3	0.000098	0.000025	14	2	0.0001	07/12/10	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Pesticides and PCBs	Heptachlor	15	1	0.00015	0.0000014	15	1	0.00017	04/12/05	< 0.00003 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	15	6	0.015	0.0056	8	2	0.012	11/06/00	0.0016 JB	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Explosives	2-Nitrotoluene	8	1	0.0005	0.00031	7	1	0.0039	11/06/00	< 0.0005 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Explosives	Nitrobenzene	8	1	0.0002	0.00014	2	1	0.00019	11/06/00	< 0.000099 UJ	08/03/11

Appendix C
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Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.057	07/08/08	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Pesticides and PCBs	4,4'-DDE	8	1	0.0001	0.000046	2	1	0.000056	11/06/00	< 0.000029 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Pesticides and PCBs	alpha-BHC	8	1	0.00015	0.0000071	8	1	0.00001	08/03/11	0.00001 JB	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Pesticides and PCBs	beta-BHC	8	3	0.0001	0.000025	6	1	0.000026	01/30/08	< 0.000029 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.015	0.0056	5	2	0.0095	08/03/11	0.0095 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Explosives	2,6-Dinitrotoluene	21	3	0.00043	0.000048	21	3	0.000089	05/02/06	< 0.0001 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Miscellaneous	Cyanide	18	2	0.01	0.00015	18	2	0.0035	01/24/07	< 0.01 UJ	07/13/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Pesticides and PCBs	Heptachlor	21	1	0.00014	0.0000014	21	1	0.000021	04/12/05	< 0.000031 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Pesticides and PCBs	Heptachlor epoxide	21	1	0.00014	0.0000014	21	1	0.000012	05/02/06	< 0.000031 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Benz(a)anthracene	21	1	0.01	0.000012	21	1	0.00023	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Benzo(b)fluoranthene	21	1	0.01	0.000034	21	1	0.00022	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	26	13	0.015	0.0056	10	1	0.0063	10/29/04	< 0.00076 U	01/22/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Dibenz(a,h)anthracene	21	1	0.01	0.0000034	21	1	0.00021	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	21	1	0.01	0.000034	21	1	0.00022	07/13/10	< 0.0002 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Explosives	2,4-Dinitrotoluene	8	1	0.00036	0.00024	2	1	0.00058	10/31/00	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Explosives	2-Nitrotoluene	8	1	0.00052	0.00031	7	1	0.004	10/31/00	< 0.0005 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Explosives	Nitrobenzene	8	1	0.0002	0.00014	2	1	0.00016	10/29/04	< 0.0001 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Pesticides and PCBs	Heptachlor epoxide	8	1	0.00014	0.0000014	8	1	0.0000082	04/08/08	< 0.000032 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	5	0.015	0.0056	4	1	0.011	08/03/11	0.011 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	Common Anions	Nitrate	3	3	40	3.2	3	3	185	11/07/00	171 J	06/04/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	Explosives	2,4-Dinitrotoluene	8	1	0.00036	0.00024	2	1	0.00042	11/07/00	< 0.0001 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	Explosives	2-Nitrotoluene	8	1	0.00052	0.00031	7	1	0.003	11/07/00	< 0.0005 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Common Anions	Nitrate	4	4	200	3.2	4	4	1330	06/05/09	1330 J	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Explosives	2,4-Dinitrotoluene	17	2	0.00036	0.00024	3	2	0.00028	10/31/00	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Explosives	2-Nitrotoluene	17	2	0.00058	0.00031	8	2	0.0023	10/31/00	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Explosives	3-Nitrotoluene	17	1	0.00058	0.00017	9	1	0.0002	10/31/00	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Miscellaneous	Hydrazine	1	1	0.01	0.0000011	1	1	0.0192	06/05/09	0.0192 =	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	17	8	0.015	0.0056	6	2	0.059	10/29/04	< 0.0048 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Explosives	2-Nitrotoluene	8	1	0.00056	0.00031	7	1	0.0032	11/06/00	< 0.0005 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Explosives	Nitrobenzene	8	2	0.0002	0.00014	2	1	0.00019	11/06/00	< 0.0001 U	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Pesticides and PCBs	Heptachlor	8	1	0.00015	0.0000014	8	1	0.000017	07/12/10	< 0.000029 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Pesticides and PCBs	PCB-1248	8	1	0.0015	0.0000078	8	1	0.00015	01/29/08	< 0.00048 UJ	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Miscellaneous	Total Phosphorus as P	1	1	0.1	0.00004	1	1	0.4	06/04/09	0.4 =	06/04/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Volatile Organics	Benzene	14	2	0.001	0.00045	8	2	0.00055	01/30/08	< 0.00025 U	07/22/14
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	2,4,6-Trinitrotoluene	7	1	0.00027	0.00098	1	1	0.003	11/29/04	< 0.00011 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	2,6-Dinitrotoluene	7	1	0.00047	0.000048	7	1	0.000059	07/08/08	< 0.00011 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	Nitroglycerin	7	1	0.0011	0.0002	7	1	0.00038	07/13/10	< 0.0007 UJ	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Explosives	RDX	7	1	0.00022	0.0007	1	1	0.0015	11/29/04	< 0.00011 U	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Miscellaneous	Total Phosphorus as P	1	1	0.5	0.00004	1	1	1	06/05/09	1 =	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Pesticides and PCBs	alpha-BHC	7	2	0.00015	0.0000071	7	2	0.000017	08/03/11	0.000017 JB	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	3	0.015	0.0056	5	1	0.011	08/03/11	0.011 B	08/03/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-244	Pesticides and PCBs	alpha-BHC	7	1	0.00015	0.0000071	7	1	0.000031	08/02/11	0.000031 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-244	Volatile Organics	Benzene	7	2	0.001	0.00045	6	1	0.00046	10/07/08	0.00022 J	08/02/11
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Explosives	2,6-Dinitrotoluene	23	2	0.00043	0.000048	23	2	0.0001	07/22/15	< 0.0001 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Miscellaneous	Cyanide	10	1	0.01	0.00015	10	1	0.008	07/12/10	< 0.01 U	07/12/10
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Miscellaneous	Total Phosphorus as P	1	1	0.1	0.00004	1	1	0.09	06/05/09	0.09 J	06/05/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Pesticides and PCBs	alpha-BHC	20	1	0.00015	0.0000071	20	1	0.0000085	07/08/08	< 0.000019 U	07/22/14
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	24	11	0.015	0.0056	8	1	0.01	08/03/11	< 0.0048 U	07/22/15
RVAAP-12 Load Line 12	Unconsolidated	L12mw-246	Miscellaneous	Total Phosphorus as P	2	2	0.1	0.00004	2	2	0.06	06/04/09	0.03 J	06/04/09
RVAAP-12 Load Line 12	Unconsolidated	L12mw-246	Semi-Volatile Organics	Naphthalene	10	1	0.00098	0.00017	7	1	0.0014	07/13/10	< 0.000095 U	01/22/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-246	Volatile Organics	Benzene	10	1	0.001	0.00045	7	1	0.00058	10/07/08	< 0.00025 U	01/22/13
RVAAP-12 Load Line 12	Unconsolidated	L12mw-247	Pesticides and PCBs	beta-BHC	9	1	0.00095	0.000025	2	1	0.00018	08/20/13	< 0.000022 U	07/22/14

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**1,2-Dichloroethane**	**0.00017**	**0.00046**	**10/02/06**	**2.7**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-113**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.0017**	**10/31/00**	**1.7**	**J**	**1**	**mg/L**	**4**	**49**	**1**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	2,4,6-Trinitrotoluene	0.00098	0.00089	11/01/00	0.9	J	2	mg/L	4	49	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	2,4,6-Trinitrotoluene	0.00098	0.00024	10/30/00	0.2	J	3	mg/L	4	49	1	No	Well has had 14 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**2,4-Dinitrotoluene**	**0.00024**	**0.0012**	**11/01/00**	**5.0**	**J**	**1**	**mg/L**	**2**	**98**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	2,4-Dinitrotoluene	0.00024	6.90E-05	10/30/00	0.3	J	2	mg/L	2	98	1	No	Well has had 14 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**2-Nitrotoluene**	**0.00031**	**0.0065**	**11/01/00**	**21.0**	**J**	**1**	**mg/L**	**6**	**49**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	2-Nitrotoluene	0.00031	0.0026	11/01/00	8.4	J	2	mg/L	6	49	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	2-Nitrotoluene	0.00031	0.0017	10/31/00	5.5	J	3	mg/L	6	49	4	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.034**	**07/09/08**	**6.1**		**1**	**mg/L**	**18**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Bis(2-ethylhexyl)phthalate	0.0056	0.0056	10/09/07	1.0	J	2	mg/L	18	49	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Sharon Shale	L12mw-186	Bis(2-ethylhexyl)phthalate	0.0056	0.0033	07/13/10	0.6	JB	3	mg/L	18	49	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Benz(a)anthracene**	**1.20E-05**	**0.00027**	**11/01/04**	**22.5**	**=**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Benz(a)anthracene	1.20E-05	0.00014	11/01/04	11.7	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Benzo(a)pyrene**	**3.40E-06**	**0.00029**	**11/01/04**	**85.3**	**J**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Benzo(a)pyrene	3.40E-06	0.00016	11/01/04	47.1	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.0002**	**11/01/04**	**5.9**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Cyanide**	**0.00015**	**0.025**	**07/10/07**	**166.7**		**1**	**mg/L**	**5**	**41**	**5**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Cyanide	0.00015	0.0087	01/30/08	58.0	J	2	mg/L	5	41	5	No	Well has had 4 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Cyanide	0.00015	0.0013	05/02/06	8.7	J	3	mg/L	5	41	5	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00095**	**11/01/04**	**279.4**	**J**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Dibenz(a,h)anthracene	3.40E-06	0.0005	11/01/04	147.1	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00081**	**11/01/04**	**23.8**	**=**	**1**	**mg/L**	**2**	**49**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-183	Indeno(1,2,3-cd)pyrene	3.40E-05	0.00037	11/01/04	10.9	J	2	mg/L	2	49	2	No	Well has had 13 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**Naphthalene**	**0.00017**	**0.00029**	**07/13/10**	**1.7**		**1**	**mg/L**	**1**	**49**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-189**	**Nitrobenzene**	**0.00014**	**0.00015**	**11/01/00**	**1.1**	**J**	**1**	**mg/L**	**3**	**98**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	Nitrobenzene	0.00014	0.00011	10/31/00	0.8	J	2	mg/L	3	98	1	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-186**	**RDX**	**0.0007**	**0.002**	**11/01/00**	**2.9**	**J**	**1**	**mg/L**	**7**	**49**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Sharon Shale	L12mw-113	RDX	0.0007	0.00093	10/31/00	1.3	J	2	mg/L	7	49	3	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Sharon Shale	L12mw-189	RDX	0.0007	0.00026	11/01/00	0.4	J	3	mg/L	7	49	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-243**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.003**	**11/29/04**	**3.1**	**=**	**1**	**mg/L**	**5**	**191**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	2,4,6-Trinitrotoluene	0.00098	0.00084	10/31/00	0.9	J	2	mg/L	5	191	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	2,4,6-Trinitrotoluene	0.00098	0.00041	10/30/00	0.4	J	3	mg/L	5	191	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-153**	**2,4-Dinitrotoluene**	**0.00024**	**0.00065**	**11/06/00**	**2.7**	**=**	**1**	**mg/L**	**5**	**346**	**5**	**No**	**Well has had 14 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	2,4-Dinitrotoluene	0.00024	0.00058	10/31/00	2.4	J	2	mg/L	5	346	5	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	2,4-Dinitrotoluene	0.00024	0.00042	11/07/00	1.8	=	3	mg/L	5	346	5	Yes	To be sampled uner the FWGWMP.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-245**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.0001**	**04/09/08**	**2.1**	**J**	**1**	**mg/L**	**7**	**346**	**7**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	2,6-Dinitrotoluene	4.80E-05	8.90E-05	05/02/06	1.9	J	2	mg/L	7	346	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-182	2,6-Dinitrotoluene	4.80E-05	5.90E-05	01/24/07	1.2	J	3	mg/L	7	346	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-243	2,6-Dinitrotoluene	4.80E-05	5.90E-05	07/08/08	1.2	J	3	mg/L	7	346	7	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-088**	**2-Nitrotoluene**	**0.00031**	**0.0063**	**11/01/00**	**20.3**	**J**	**1**	**mg/L**	**12**	**191**	**8**	**No**	**Well has had 7 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	2-Nitrotoluene	0.00031	0.0049	11/06/00	15.8	=	2	mg/L	12	191	8	No	Well has had 4 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	2-Nitrotoluene	0.00031	0.004	10/31/00	12.9	J	3	mg/L	12	191	8	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-153**	**3-Nitrotoluene**	**0.00017**	**0.00078**	**11/06/00**	**4.6**	**=**	**1**	**mg/L**	**5**	**191**	**2**	**No**	**Well has had 14 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	3-Nitrotoluene	0.00017	0.0002	10/31/00	1.2	J	2	mg/L	5	191	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	3-Nitrotoluene	0.00017	0.00017	10/30/00	1.0	J	3	mg/L	5	191	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	3-Nitrotoluene	0.00017	0.00017	10/31/00	1.0	J	3	mg/L	5	191	2	No	Well has had 5 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-107**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.073**	**01/31/08**	**13.0**	**J**	**1**	**mg/L**	**98**	**202**	**6**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-187	Bis(2-ethylhexyl)phthalate	0.0056	0.059	10/29/04	10.5	=	2	mg/L	98	202	6	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-12 Load Line 12	Unconsolidated	L12mw-153	Bis(2-ethylhexyl)phthalate	0.0056	0.012	11/06/00	2.1	=	3	mg/L	98	202	6	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Benz(a)anthracene**	**1.20E-05**	**0.00023**	**07/13/10**	**19.2**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-246**	**Benzene**	**0.00045**	**0.00058**	**10/07/08**	**1.3**	**JB**	**1**	**mg/L**	**16**	**181**	**1**	**No**	**Well has had 5 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Benzene	0.00045	0.00055	01/30/08	1.2	J	2	mg/L	16	181	1	Yes	To be sampled uner the FWGWMP.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-244	Benzene	0.00045	0.00046	10/07/08	1.0	JB	3	mg/L	16	181	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.00022**	**07/13/10**	**6.5**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-154**	**Cyanide**	**0.00015**	**0.057**	**07/08/08**	**380.0**		**1**	**mg/L**	**5**	**120**	**5**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-107	Cyanide	0.00015	0.015	07/08/08	100.0		2	mg/L	5	120	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-245	Cyanide	0.00015	0.008	07/12/10	53.3	J	3	mg/L	5	120	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00021**	**07/13/10**	**61.8**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-187**	**Hydrazine**	**1.10E-06**	**0.0192**	**06/05/09**	**17454.5**	**=**	**1**	**mg/L**	**1**	**8**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-182**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00022**	**07/13/10**	**6.5**		**1**	**mg/L**	**1**	**168**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-246**	**Naphthalene**	**0.00017**	**0.0014**	**07/13/10**	**8.2**		**1**	**mg/L**	**1**	**168**	**1**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-153**	**Nitrobenzene**	**0.00014**	**0.00021**	**11/06/00**	**1.5**	**=**	**1**	**mg/L**	**17**	**346**	**4**	**No**	**Well has had 14 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-154	Nitrobenzene	0.00014	0.00019	11/06/00	1.4	J	2	mg/L	17	346	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-188	Nitrobenzene	0.00014	0.00019	11/06/00	1.4	J	2	mg/L	17	346	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-12 Load Line 12	Unconsolidated	L12mw-184	Nitrobenzene	0.00014	0.00016	10/31/00	1.1	J	3	mg/L	17	346	4	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-243**	**Nitroglycerin**	**0.0002**	**0.00038**	**07/13/10**	**1.9**	**J**	**1**	**mg/L**	**2**	**172**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-242	Nitroglycerin	0.0002	0.00018	11/30/04	0.9	J	2	mg/L	2	172	1	Yes	To be sampled uner the FWGWMP.
RVAAP-12 Load Line 12	**Sharon Shale**	**L12mw-183**	**PCB-1254**	**0.0000078**	**0.000051**	**10/05/06**	**6.5**	**J**	**1**	**mg/L**	**1**	**49**	**1**	**No**	**Well has had 5 consecutive ND results since last detection.**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-188**	**PCB-1248**	**0.0000078**	**0.00015**	**01/29/08**	**19.2**	**J**	**1**	**mg/L**	**1**	**167**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	**Unconsolidated**	**L12mw-243**	**RDX**	**0.0007**	**0.0015**	**11/29/04**	**2.1**	**=**	**1**	**mg/L**	**6**	**191**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-12 Load Line 12	Unconsolidated	L12mw-128	RDX	0.0007	0.00072	10/31/00	1.0	J	2	mg/L	6	191	2	No	Well has had 7 consecutive ND results since last detection.
RVAAP-12 Load Line 12	Unconsolidated	L12mw-185	RDX	0.0007	0.00034	11/07/00	0.5	J	3	mg/L	6	191	2	Yes	To be sampled uner the FWGWMP.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-13 Building 1200	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**25**	**16**	**0.00076**	**0.016**	**0.0056**	**9**	**1**	**0.00096**	**0.011**	**1/23/2013**	**1/23/2013**	**4/5/2011**	**1/19/2009**	**Lab contaminant**
RVAAP-13 Building 1200	Sharon	SVOCs	Di-n-octylphthalate	Yes	25	1	0.00076	0.01	0.02	1	1	0.025	0.025	1/23/2013	7/25/2012	7/25/2012	7/25/2012	
RVAAP-13 Building 1200	Sharon	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	25	1	0.000095	0.0004	0.000034	25	1	0.00072	0.00072	1/23/2013	4/10/2008	1/23/2013	4/10/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, exce
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-13 Building 1200	Sharon	B12mw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.015	0.0056	3	1	0.011	01/19/09	< 0.01 U	04/05/11
RVAAP-13 Building 1200	Sharon	B12mw-010	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	6	1	0.0004	0.000034	6	1	0.00072	04/10/08	< 0.0002 U	04/05/11
RVAAP-13 Building 1200	Sharon	B12mw-012	Semi-Volatile Organics	Di-n-octylphthalate	9	1	0.0093	0.02	1	1	0.025	07/25/12	< 0.00076 U	01/23/13
Site-wide Background Areas	Sharon	BKGmw-010	Miscellaneous	Cyanide	13	1	0.01	0.00015	13	1	0.0021	03/09/06	< 0.01 U	04/05/11
Site-wide Background Areas	Sharon	BKGmw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	4	0.015	0.0056	6	1	0.024	04/19/07	< 0.01 U	04/05/11

Notes
COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).
DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-13 Building 1200	Sharon	B12mw-012	Di-n-octylphthalate	0.02	0.025	07/25/12	1.3		1	mg/L	1	25	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-13 Building 1200	Sharon	B12mw-010	Indeno(1,2,3-cd)pyrene	3.40E-05	0.00072	04/10/08	21.2		1	mg/L	1	25	1	No	Well has had 4 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2,4,6-Trinitrotoluene	Yes	62	16	0.000095	0.001	0.00098	13	12	0.000048	0.062	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2,4-Dinitrotoluene	Yes	63	10	0.000095	0.001	0.00024	20	9	0.000057	0.0006	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2,6-Dinitrotoluene	Yes	63	5	0.000095	0.001	0.000048	63	5	0.000052	0.00014	7/20/2015	1/20/2014	7/20/2015	1/20/2014	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	2-Amino-4,6-Dinitrotoluene	Yes	62	16	0.000095	0.001	0.0039	12	12	0.00019	0.028	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	4-Amino-2,6-Dinitrotoluene	Yes	62	19	0.000095	0.001	0.0039	12	12	0.000063	0.039	7/20/2015	7/20/2015	7/20/2015	7/20/2015	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Explosives	Nitrobenzene	Yes	63	2	0.000095	0.001	0.00014	14	1	0.000054	0.00017	7/20/2015	4/14/2008	1/27/2009	11/20/2003	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	Miscellaneous	Cyanide	Yes	41	3	0.01	0.01	0.00015	41	3	0.005	0.0062	1/19/2011	7/11/2008	1/19/2011	7/11/2008	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**Pest/PCBs**	**Aldrin**	**No**	**63**	**1**	**0.00002**	**0.0024**	**0.00000092**	**63**	**1**	**0.000029**	**0.000029**	**7/20/2015**	**1/27/2009**	**7/20/2015**	**1/27/2009**	**Pesticide from historical agricultural use**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**Pest/PCBs**	**beta-BHC**	**No**	**63**	**2**	**0.00002**	**0.0024**	**0.000025**	**62**	**2**	**0.00021**	**0.00024**	**7/20/2015**	**3/23/2015**	**7/20/2015**	**3/23/2015**	**Pesticide from historical agricultural use**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**VOCs**	**Methylene chloride**	**No**	**56**	**8**	**0.002**	**0.002**	**0.005**	**10**	**8**	**0.0051**	**0.0075**	**10/11/2011**	**11/19/2003**	**11/20/2003**	**11/19/2003**	**Lab contaminant**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	VOCs	Trichloroethene	Yes	58	2	0.001	0.001	0.00028	58	2	0.0071	0.012	10/11/2011	11/12/2003	10/11/2011	11/12/2003	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	19	2	0.000097	0.00011	0.000048	19	2	0.000064	0.000094	1/27/2009	10/8/2008	1/27/2009	10/8/2008	
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	18	11	0.01	0.01	0.0056	8	2	0.001	0.0087	1/27/2009	1/27/2009	1/27/2009	7/11/2008	Potential lab contaminant
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Unconsolidated**	**VOCs**	**Methylene chloride**	**No**	**17**	**2**	**0.002**	**0.002**	**0.005**	**3**	**2**	**0.0061**	**0.0066**	**1/27/2009**	**11/18/2003**	**11/20/2003**	**11/18/2003**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-168	Volatile Organics	Methylene chloride	5	1	0.002	0.005	1	1	0.0058	11/19/03	< 0.002 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-169	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0057	11/18/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-170	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0051	11/12/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-170	Volatile Organics	Trichloroethene	7	1	0.001	0.00028	7	1	0.012	11/12/03	< 0.001 U	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Explosives	2,6-Dinitrotoluene	6	1	0.00011	0.000048	6	1	0.000052	04/14/08	< 0.00011 U	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0055	07/11/08	< 0.01 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Volatile Organics	Methylene chloride	6	1	0.002	0.005	1	1	0.0064	11/12/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Volatile Organics	Trichloroethene	6	1	0.001	0.00028	6	1	0.0071	11/12/03	< 0.001 U	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Explosives	2,6-Dinitrotoluene	7	1	0.0001	0.000048	7	1	0.000063	04/14/08	< 0.000097 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.005	07/11/08	< 0.01 UJ	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Pesticides and PCBs	Aldrin	7	1	0.00003	0.00000092	7	1	0.000029	01/27/09	< 0.00003 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Volatile Organics	Methylene chloride	7	2	0.002	0.005	2	2	0.0075	11/19/03	< 0.002 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	Explosives	Nitrobenzene	6	1	0.0001	0.00014	1	1	0.00017	11/20/03	< 0.000096 U	01/18/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2,4,6-Trinitrotoluene	12	12	0.001	0.00098	12	12	0.062	04/14/08	0.021	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2,4-Dinitrotoluene	12	10	0.001	0.00024	11	9	0.0006	07/20/15	0.0006 J	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2,6-Dinitrotoluene	12	3	0.001	0.000048	12	3	0.00014	01/19/11	< 0.0001 U	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	2-Amino-4,6-Dinitrotoluene	12	12	0.001	0.0039	12	12	0.028	01/27/09	0.02	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Explosives	4-Amino-2,6-Dinitrotoluene	12	12	0.001	0.0039	12	12	0.039	01/19/11	0.028	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Pesticides and PCBs	beta-BHC	12	2	0.0024	0.000025	11	2	0.00024	04/14/08	< 0.000048 U	07/20/15
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0058	11/18/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-175	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0062	07/11/08	< 0.01 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-175	Volatile Organics	Methylene chloride	7	1	0.002	0.005	1	1	0.0066	11/19/03	< 0.002 UJ	10/11/11
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-166	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000094	10/08/08	< 0.000099 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-166	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	4	3	0.01	0.0056	2	1	0.0062	07/11/08	0.0017 JB	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-167	Volatile Organics	Methylene chloride	6	2	0.002	0.005	2	2	0.0066	11/18/03	< 0.002 U	01/27/09
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-176	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	3	0.01	0.0056	6	1	0.0087	07/11/08	< 0.01 U	01/27/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.062**	**04/14/08**	**63.3**		**1**	**mg/L**	**17**	**63**	**13**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	2,4,6-Trinitrotoluene	0.00098	0.0019	11/20/03	1.9		2	mg/L	17	63	13	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2,4-Dinitrotoluene**	**0.00024**	**0.0006**	**07/20/15**	**2.5**	**J**	**1**	**mg/L**	**10**	**121**	**9**	**Yes**	**No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00014**	**01/19/11**	**2.9**		**1**	**mg/L**	**5**	**121**	**5**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	2,6-Dinitrotoluene	4.80E-05	6.30E-05	04/14/08	1.3	J	2	mg/L	5	121	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	2,6-Dinitrotoluene	4.80E-05	5.20E-05	04/14/08	1.1	J	3	mg/L	5	121	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Stable (flat) Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**2-Amino-4,6-Dinitrotoluene**	**0.0039**	**0.028**	**01/27/09**	**7.2**		**1**	**mg/L**	**17**	**63**	**12**	**Yes**	**Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	2-Amino-4,6-Dinitrotoluene	0.0039	0.0029	11/20/03	0.7		2	mg/L	17	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-168	2-Amino-4,6-Dinitrotoluene	0.0039	0.00031	01/27/09	0.1	J	3	mg/L	17	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	2-Amino-4,6-Dinitrotoluene	0.0039	0.00031	04/14/08	0.1		3	mg/L	17	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-174**	**4-Amino-2,6-Dinitrotoluene**	**0.0039**	**0.039**	**01/19/11**	**10.0**		**1**	**mg/L**	**20**	**63**	**12**	**Yes**	**No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-173	4-Amino-2,6-Dinitrotoluene	0.0039	0.0027	11/20/03	0.7		2	mg/L	20	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-168	4-Amino-2,6-Dinitrotoluene	0.0039	0.00036	01/27/09	0.1	J	3	mg/L	20	63	12	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Unconsolidated**	**FBQmw-176**	**Bis(2-ethylhexyl)phthalate**	**0.0056**	**0.0087**	**07/11/08**	**1.6**	**J**	**1**	**mg/L**	**12**	**19**	**2**	**Yes**	**No Mann-Kendall Trend Increasing OLS Regression Line Increasing Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-166	Bis(2-ethylhexyl)phthalate	0.0056	0.0062	07/11/08	1.1	J	2	mg/L	12	19	2	Yes	No Mann-Kendall Trend Stable (flat) OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Unconsolidated	FBQmw-167	Bis(2-ethylhexyl)phthalate	0.0056	0.0026	11/18/03	0.5	J	3	mg/L	12	19	2	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-175**	**Cyanide**	**0.00015**	**0.0062**	**07/11/08**	**41.3**	**JB**	**1**	**mg/L**	**3**	**41**	**1**	**Yes**	**Insufficient data for statistical evaluation, 1 detection out of 4 samples**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Cyanide	0.00015	0.0055	07/11/08	36.7	JB	2	mg/L	3	41	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 4 samples

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-172	Cyanide	0.00015	0.005	07/11/08	33.3	J	3	mg/L	3	41	1	Yes	Insufficient data for statistical evaluation, 1 detection out of 5 samples
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-173**	**Nitrobenzene**	**0.00014**	**0.00017**	**11/20/03**	**1.2**		**1**	**mg/L**	**2**	**121**	**1**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-170	Nitrobenzene	0.00014	5.40E-05	04/14/08	0.4	J	2	mg/L	2	121	1	No	No Mann-Kendall Trend Decreasing OLS Regression Line Increasing to Stable Theil-Sen Trend Line Well has had 4 consecutive ND results since last detection.
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Homewood**	**FBQmw-170**	**Trichloroethene**	**0.00028**	**0.012**	**11/12/03**	**42.9**	**=**	**1**	**mg/L**	**2**	**58**	**2**	**No**	**Insufficient data for statistical evaluation, 1 detection out of 6 samples. Well has had 5 consecutive ND results since last detection.**
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-171	Trichloroethene	0.00028	0.0071	11/12/03	25.4	=	2	mg/L	2	58	2	Yes	Insufficient data for statistical evaluation, 1 detection out of 6 samples
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	**Unconsolidated**	**FBQmw-166**	**2,6-Dinitrotoluene**	**4.80E-05**	**9.40E-05**	**10/08/08**	**2.0**	**J**	**1**	**mg/L**	**2**	**38**	**2**	**Yes**	**No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2,4,6-Trinitrotoluene	0.00098	0.022	03/23/15	22.4		1	mg/L	5	5	5	Yes	No Mann-Kendall Trend Decreasing OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2,4-Dinitrotoluene	0.00024	0.0006	07/20/15	2.5	J	1	mg/L	5	5	5	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2,6-Dinitrotoluene	0.000048	0.00011	01/20/14	2.3	J	1	mg/L	1	5	1	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	2-Amino-4,6-Dinitrotoluene	0.0039	0.02	07/20/15	5.1		1	mg/L	5	5	5	Yes	Decreasing Mann-Kendall Trend Decreasing OLS Regression Line Decreasing Theil-Sen Trend Line
RVAAP-16 Fuze and Booster Quarry Landfill/Pond	Homewood	FBQmw-174	4-Amino-2,6-Dinitrotoluene	0.0039	0.028	07/20/15	7.2		1	mg/L	5	5	5	Yes	No Mann-Kendall Trend Decreasing to Stable OLS Regression Line Decreasing to Stable Theil-Sen Trend Line

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	26	2	0.000095	0.00062	0.000048	26	2	0.000057	0.00007	1/19/2011	1/27/2009	1/19/2011	1/27/2009	
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	Miscellaneous	Cyanide	Yes	21	1	0.01	0.01	0.00015	21	1	0.0099	0.0099	1/19/2011	7/9/2008	1/19/2011	7/9/2008	
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	26	16	0.01	0.015	0.0056	11	1	0.00081	0.015	1/19/2011	1/19/2011	10/8/2008	1/12/2005	Potential lab contaminant

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-025	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0099	07/09/08	< 0.01 UJ	01/19/11
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-025	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	6	0.015	0.0056	1	1	0.015	01/12/05	0.00081 J	01/19/11
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-026	Explosives	2,6-Dinitrotoluene	6	2	0.00058	0.000048	6	2	0.00007	10/08/08	0.000057 J	01/27/09

Notes
COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).
DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-19 Landfill North of Winklepeck Burning Grounds	**Unconsolidated**	**LNWmw-026**	**2,6-Dinitrotoluene**	**4.80E-05**	**7.00E-05**	**10/08/08**	**1.5**	**J**	**1**	**mg/L**	**2**	**52**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-19 Landfill North of Winklepeck Burning Grounds	**Unconsolidated**	**LNWmw-025**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**1.50E-02**	**01/12/05**	**2.7**	**=**	**1**	**mg/L**	**16**	**26**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-027	Bis(2-ethylhexyl)phthalate	5.60E-03	4.50E-03	01/27/09	0.8	JB	2	mg/L	16	26	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at LNWmw-025.
RVAAP-19 Landfill North of Winklepeck Burning Grounds	Unconsolidated	LNWmw-024	Bis(2-ethylhexyl)phthalate	5.60E-03	4.10E-03	10/08/08	0.7	J	3	mg/L	16	26	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at LNWmw-025.
RVAAP-19 Landfill North of Winklepeck Burning Grounds	**Unconsolidated**	**LNWmw-025**	**Cyanide**	**0.00015**	**0.0099**	**07/09/08**	**66.0**	**J**	**1**	**mg/L**	**1**	**21**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	25	1	0.000095	0.00012	0.000048	25	1	0.000062	0.000062	1/18/2011	10/14/2008	1/18/2011	10/14/2008	
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	Miscellaneous	Cyanide	Yes	25	1	0.01	0.01	0.00015	25	1	0.0075	0.0075	1/18/2011	7/15/2008	1/18/2011	7/15/2008	
RVAAP-28 Suspected Mustard Agent Burial Site	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**25**	**19**	**0.01**	**0.01**	**0.0056**	**7**	**1**	**0.00083**	**0.011**	**1/18/2011**	**1/28/2009**	**1/18/2011**	**7/15/2008**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-006	2,6-Dinitrotoluene	4.80E-05	6.20E-05	10/14/08	1.3	J	1	mg/L	1	50	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-004	Cyanide	0.00015	0.0075	07/15/08	50.0	J	1	mg/L	1	25	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	39	2	0.000096	0.00012	0.000048	39	2	0.000054	0.000073	1/20/2011	7/10/2008	1/20/2011	7/10/2008	
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	Miscellaneous	Cyanide	Yes	39	1	0.01	0.01	0.00015	39	1	0.0072	0.0072	1/20/2011	7/10/2008	1/20/2011	7/10/2008	
RVAAP-29 Upper and Lower Cobbs Ponds	**Unconsolidated**	**Pest/PCBs**	**4,4'-DDD**	**No**	**39**	**1**	**0.00003**	**0.00003**	**0.000031**	**1**	**1**	**0.00035**	**0.00035**	**1/20/2011**	**9/4/2001**	**9/4/2001**	**9/4/2001**	**Pesticide from historical agricultural use**
RVAAP-29 Upper and Lower Cobbs Ponds	**Unconsolidated**	**Pest/PCBs**	**Endrin**	**No**	**39**	**1**	**0.00003**	**0.00003**	**0.00023**	**1**	**1**	**0.00031**	**0.00031**	**1/20/2011**	**9/4/2001**	**9/4/2001**	**9/4/2001**	**Pesticide from historical agricultural use**
RVAAP-29 Upper and Lower Cobbs Ponds	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**39**	**19**	**0.01**	**0.012**	**0.0056**	**22**	**2**	**0.0012**	**0.016**	**1/20/2011**	**1/20/2011**	**1/20/2011**	**7/9/2008**	**Lab contaminant**
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	SVOCs	Naphthalene	Yes	39	1	0.0002	0.00024	0.00017	39	1	0.00034	0.00034	1/20/2011	1/20/2009	1/20/2011	1/20/2009	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1)
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-001	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0072	07/10/08	< 0.01 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.01	0.0056	4	1	0.016	07/09/08	< 0.01 U	01/20/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Explosives	2,6-Dinitrotoluene	5	2	0.00011	0.000048	5	2	0.000073	07/10/08	< 0.000098 U	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	4,4'-DDD	5	1	0.00003	0.000031	1	1	0.00035	09/04/01	< 0.00003 UJ	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	Pesticides and PCBs	Endrin	5	1	0.00003	0.00023	1	1	0.00031	09/04/01	< 0.00003 UJ	01/20/09
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	7	0.012	0.0056	6	1	0.016	07/27/01	< 0.01 UJ	01/20/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Naphthalene	12	1	0.00024	0.00017	12	1	0.00034	01/20/09	< 0.0002 U	01/20/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-003	2,6-Dinitrotoluene	4.80E-05	7.30E-05	07/10/08	1.5	J	1	mg/L	2	71	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-001	Cyanide	0.00015	0.0072	07/10/08	48.0	J	1	mg/L	1	39	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Naphthalene	0.00017	0.00034	01/20/09	2.0	J	1	mg/L	1	39	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-33 Load Line 6	Homewood	Explosives	Nitroglycerin	Yes	27	1	0.0005	0.00074	0.0002	27	1	0.00035	0.00035	1/23/2013	7/15/2008	1/23/2013	7/15/2008	
RVAAP-33 Load Line 6	Homewood	SVOCs	4-Nitrobenzenamine	Yes	27	1	0.00076	0.002	0.0038	1	1	0.0041	0.0041	1/23/2013	12/15/2003	12/15/2003	12/15/2003	
RVAAP-33 Load Line 6	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**32**	**16**	**0.00076**	**0.04**	**0.0056**	**12**	**2**	**0.00092**	**0.069**	**1/23/2013**	**1/23/2013**	**10/12/2011**	**4/22/2009**	**Lab contaminant**
RVAAP-33 Load Line 6	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	20	1	0.000097	0.00011	0.000048	20	1	0.00009	0.00009	1/23/2013	10/12/2009	1/23/2013	10/12/2009	
RVAAP-33 Load Line 6	Unconsolidated	Miscellaneous	Cyanide	Yes	20	1	0.01	0.01	0.00015	20	1	0.0073	0.0073	1/23/2013	7/15/2008	1/23/2013	7/15/2008	
RVAAP-33 Load Line 6	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	24	11	0.00076	0.012	0.0056	12	4	0.00076	0.022	1/23/2013	7/25/2012	7/25/2012	7/25/2012	Potential lab contaminant

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present abo
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime c
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-33 Load Line 6	Homewood	LL6mw-003	Explosives	Nitroglycerin	5	1	0.0007	0.0002	5	1	0.00035	07/15/08	< 0.00063 U	01/21/09
RVAAP-33 Load Line 6	Homewood	LL6mw-004	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.04	0.0056	2	1	0.069	04/22/09	0.002 J	10/12/10
RVAAP-33 Load Line 6	Homewood	LL6mw-005	Semi-Volatile Organics	4-Nitrobenzenamine	7	1	0.002	0.0038	1	1	0.0041	12/15/03	< 0.002 U	10/12/10
RVAAP-33 Load Line 6	Homewood	LL6mw-005	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	11	3	0.01	0.0056	6	1	0.0091	12/15/03	< 0.00078 U	01/23/13
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-001	Miscellaneous	Cyanide	6	1	0.01	0.00015	6	1	0.0073	07/15/08	< 0.01 U	10/12/10
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-001	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.012	0.0056	4	1	0.014	12/17/03	< 0.01 U	10/13/10
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-002	Inorganics	Beryllium	11	2	0.001	0.0025	1	1	0.0027	10/21/09	< 0.00009 U	01/23/13
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	4	0.011	0.0056	3	1	0.022	07/25/12	< 0.00076 U	01/23/13
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-006	Explosives	2,6-Dinitrotoluene	5	1	0.00011	0.000048	5	1	0.00009	10/12/09	0.00009 J	10/12/09
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	2	0.01	0.0056	5	2	0.014	12/17/03	< 0.01 U	10/12/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-33 Load Line 6	**Homewood**	**LL6mw-005**	**4-Nitrobenzenamine**	**0.0038**	**0.0041**	**12/15/03**	**1.1**	**J**	**1**	**mg/L**	**1**	**27**	**1**	**No**	**Well has had 5 consecutive ND results since last detection.**
RVAAP-33 Load Line 6	**Homewood**	**LL6mw-004**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**6.90E-02**	**04/22/09**	**12.3**	**B**	**1**	**mg/L**	**16**	**32**	**1**	**No**	**The need for characterization of DEHP will be based on confirmation of the constituent at LL6mw-007.**
RVAAP-33 Load Line 6	Homewood	LL6mw-005	Bis(2-ethylhexyl)phthalate	5.60E-03	9.10E-03	12/15/03	1.6	=	2	mg/L	16	32	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at LL6mw-007.
RVAAP-33 Load Line 6	Homewood	LL6mw-007	Bis(2-ethylhexyl)phthalate	5.60E-03	2.00E-03	04/22/09	0.4	JB	3	mg/L	16	32	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	**Homewood**	**LL6mw-003**	**Nitroglycerin**	**0.0002**	**0.00035**	**07/15/08**	**1.8**	**J**	**1**	**mg/L**	**1**	**27**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-33 Load Line 6	**Unconsolidated**	**LL6mw-006**	**2,6-Dinitrotoluene**	**4.80E-05**	**9.00E-05**	**10/12/09**	**1.9**	**J**	**1**	**mg/L**	**1**	**35**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-33 Load Line 6	**Unconsolidated**	**LL6mw-002**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**2.20E-02**	**07/25/12**	**3.9**		**1**	**mg/L**	**11**	**24**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-001	Bis(2-ethylhexyl)phthalate	5.60E-03	1.40E-02	12/17/03	2.5	=	2	mg/L	11	24	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-006	Bis(2-ethylhexyl)phthalate	5.60E-03	1.40E-02	12/17/03	2.5	=	2	mg/L	11	24	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	Unconsolidated	LL6mw-008	Bis(2-ethylhexyl)phthalate	5.60E-03	1.10E-03	07/25/12	0.2		3	mg/L	11	24	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-33 Load Line 6	**Unconsolidated**	**LL6mw-001**	**Cyanide**	**0.00015**	**0.0073**	**07/15/08**	**48.7**	**J**	**1**	**mg/L**	**1**	**20**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-38 NACA Test Area	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	77	4	0.000096	0.00077	0.000048	77	4	0.000052	0.000077	7/20/2015	10/14/2008	7/20/2015	10/14/2008	
RVAAP-38 NACA Test Area	Unconsolidated	Miscellaneous	Cyanide	Yes	58	4	0.01	0.01	0.00015	58	4	0.0056	0.0076	1/24/2013	7/15/2008	1/24/2013	7/15/2008	
RVAAP-38 NACA Test Area	**Unconsolidated**	**Pest/PCBs**	**alpha-BHC**	**No**	**72**	**1**	**0.0000095**	**0.00019**	**0.0000071**	**72**	**1**	**0.0000072**	**0.0000072**	**1/24/2013**	**10/14/2008**	**1/24/2013**	**10/14/2008**	**Pesticide from historical agricultural use**
RVAAP-38 NACA Test Area	Unconsolidated	Pest/PCBs	PCB-1248	Yes	74	1	0.00019	0.0015	0.0000078	74	1	0.00025	0.00025	1/24/2013	10/14/2008	1/24/2013	10/14/2008	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Benz(a)anthracene	Yes	80	1	0.000095	0.0002	0.000012	80	1	0.00014	0.00014	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Benzo(a)pyrene	Yes	80	1	0.000095	0.00041	0.0000034	80	1	0.00012	0.00012	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Benzo(b)fluoranthene	Yes	80	1	0.000095	0.00041	0.000034	80	1	0.0001	0.0001	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**80**	**43**	**0.0005**	**0.015**	**0.0056**	**33**	**2**	**0.00042**	**0.0076**	**7/20/2015**	**8/21/2013**	**1/18/2011**	**7/15/2008**	**Lab contaminant**
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Dibenz(a,h)anthracene	Yes	80	1	0.000095	0.00041	0.0000034	80	1	0.00024	0.00024	7/20/2015	12/1/2004	7/20/2015	12/1/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Indeno(1,2,3-cd)pyrene	Yes	80	2	0.000095	0.00041	0.000034	80	2	0.00009	0.00021	7/20/2015	12/14/2004	7/20/2015	12/14/2004	
RVAAP-38 NACA Test Area	Unconsolidated	SVOCs	Naphthalene	Yes	80	6	0.000095	0.001	0.00017	70	2	0.00011	0.00026	7/20/2015	1/23/2014	10/16/2012	10/16/2012	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-001	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	3	0.01	0.0056	3	1	0.011	07/15/08	< 0.01 U	01/18/11
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-004	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0075	07/15/08	< 0.01 U	01/28/09
RVAAP-28 Suspected Mustard Agent Burial Site	Unconsolidated	MBSmw-006	Explosives	2,6-Dinitrotoluene	4	1	0.00011	0.000048	4	1	0.000062	10/14/08	< 0.0001 U	01/28/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-109	Pesticides and PCBs	PCB-1248	7	1	0.0015	0.0000078	7	1	0.00025	10/14/08	< 0.00019 U	01/24/13
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Explosives	2,6-Dinitrotoluene	8	1	0.00043	0.000048	8	1	0.000074	10/14/08	< 0.000098 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Pesticides and PCBs	alpha-BHC	8	1	0.00015	0.0000071	8	1	0.0000072	10/14/08	< 0.00003 UJ	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Benz(a)anthracene	8	1	0.0002	0.000012	8	1	0.00014	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Benzo(a)pyrene	8	1	0.0004	0.0000034	8	1	0.00012	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Benzo(b)fluoranthene	8	1	0.0004	0.000034	8	1	0.0001	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	8	4	0.015	0.0056	5	1	0.0076	07/15/08	0.003 JB	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	8	1	0.0004	0.000034	8	1	0.00009	12/14/04	< 0.0002 U	01/18/11
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-114	Explosives	2,6-Dinitrotoluene	6	1	0.00073	0.000048	6	1	0.000052	04/15/08	< 0.0001 UJ	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-115	Explosives	2,6-Dinitrotoluene	5	1	0.00077	0.000048	5	1	0.000077	04/15/08	< 0.0001 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-115	Miscellaneous	Cyanide	4	2	0.01	0.00015	4	2	0.0076	04/15/08	< 0.01 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0058	07/15/08	< 0.01 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.015	0.0056	4	1	0.0061	12/01/04	< 0.01 UJ	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Semi-Volatile Organics	Dibenz(a,h)anthracene	6	1	0.0004	0.0000034	6	1	0.00024	12/01/04	< 0.0002 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Semi-Volatile Organics	Indeno(1,2,3-cd)pyrene	6	1	0.0004	0.000034	6	1	0.00021	12/01/04	< 0.0002 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-117	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0056	04/15/08	< 0.01 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-118	Explosives	2,6-Dinitrotoluene	5	1	0.00071	0.000048	5	1	0.000058	04/15/08	< 0.0001 U	01/27/09
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-119	Semi-Volatile Organics	Naphthalene	9	6	0.0001	0.00017	2	2	0.00026	10/16/12	< 0.000095 U	07/20/15

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-115**	**2,6-Dinitrotoluene**	**4.80E-05**	**7.70E-05**	**04/15/08**	**1.6**	**J**	**1**	**mg/L**	**4**	**151**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	2,6-Dinitrotoluene	4.80E-05	7.40E-05	10/14/08	1.5	J	2	mg/L	4	151	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-118	2,6-Dinitrotoluene	4.80E-05	5.80E-05	04/15/08	1.2	J	3	mg/L	4	151	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-113**	**Benz(a)anthracene**	**1.20E-05**	**0.00014**	**12/14/04**	**11.7**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-113**	**Benzo(a)pyrene**	**3.40E-06**	**0.00012**	**12/14/04**	**35.3**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-113**	**Benzo(b)fluoranthene**	**3.40E-05**	**0.0001**	**12/14/04**	**2.9**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-115**	**Cyanide**	**0.00015**	**0.0076**	**04/15/08**	**50.7**	**J**	**1**	**mg/L**	**4**	**58**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-116	Cyanide	0.00015	0.0058	07/15/08	38.7	J	2	mg/L	4	58	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-117	Cyanide	0.00015	0.0056	04/15/08	37.3	J	3	mg/L	4	58	4	No	Need for additional sampling to be connducted after free cyanide testing at NTAmw-115 and -116
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-116**	**Dibenz(a,h)anthracene**	**3.40E-06**	**0.00024**	**12/01/04**	**70.6**	**J**	**1**	**mg/L**	**1**	**80**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-116**	**Indeno(1,2,3-cd)pyrene**	**3.40E-05**	**0.00021**	**12/01/04**	**6.2**	**J**	**1**	**mg/L**	**2**	**80**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	Unconsolidated	NTAmw-113	Indeno(1,2,3-cd)pyrene	3.40E-05	9.00E-05	12/14/04	2.6	J	2	mg/L	2	80	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-119**	**Naphthalene**	**0.00017**	**0.00026**	**10/16/12**	**1.5**		**1**	**mg/L**	**6**	**80**	**2**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-38 NACA Test Area	**Unconsolidated**	**NTAmw-109**	**PCB-1248**	**0.0000078**	**0.00025**	**10/14/08**	**32.1**	**J**	**1**	**mg/L**	**1**	**74**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-39 Load Line 5	Homewood	Miscellaneous	Cyanide	Yes	24	1	0.01	0.01	0.00015	24	1	0.0079	0.0079	1/22/2009	10/10/2008	1/22/2009	10/10/2008	
RVAAP-39 Load Line 5	Homewood	Pest/PCBs	PCB-1248	Yes	30	1	0.0005	0.0015	0.0000078	30	1	0.00041	0.00041	1/22/2009	10/10/2008	1/22/2009	10/10/2008	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Resi
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-39 Load Line 5	Homewood	LL5mw-001	Pesticides and PCBs	PCB-1248	5	1	0.0014	0.0000078	5	1	0.00041	10/10/08	< 0.0005 UJ	01/21/09
RVAAP-39 Load Line 5	Homewood	LL5mw-002	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0079	10/10/08	< 0.01 U	01/21/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft. For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-39 Load Line 5	Homewood	LL5mw-002	Cyanide	0.00015	0.0079	10/10/08	52.7	J	1	mg/L	1	24	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-39 Load Line 5	Homewood	LL5mw-001	PCB-1248	0.0000078	0.00041	10/10/08	52.6	J	1	mg/L	1	30	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
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Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-40 Load Line 7	Homewood	Explosives	RDX	Yes	40	9	0.00005	0.00023	0.0007	2	2	0.00018	0.00081	7/23/2015	10/12/2009	10/12/2009	10/12/2009	
RVAAP-40 Load Line 7	Homewood	Miscellaneous	Cyanide	Yes	31	1	0.01	0.01	0.00015	31	1	0.025	0.025	10/13/2010	10/12/2010	10/13/2010	10/12/2010	
RVAAP-40 Load Line 7	**Homewood**	**Pest/PCBs**	**beta-BHC**	**No**	**38**	**5**	**0.00003**	**0.0001**	**0.000025**	**34**	**1**	**0.0000087**	**0.000027**	**10/13/2010**	**10/12/2009**	**10/13/2010**	**7/13/2009**	**Pesticide from historical agricultural use**
RVAAP-40 Load Line 7	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**39**	**24**	**0.005**	**0.015**	**0.0056**	**15**	**1**	**0.00096**	**0.0058**	**7/23/2015**	**10/13/2010**	**10/13/2010**	**7/13/2009**	**Lab contaminant**
RVAAP-40 Load Line 7	Homewood	VOCs	1,1-Dichloroethane	Yes	40	8	0.0005	0.001	0.0027	4	4	0.0016	0.0035	7/23/2015	7/23/2015	10/12/2009	10/12/2009	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer preser
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifet
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-40 Load Line 7	Homewood	LL7mw-001	Inorganics	Beryllium	9	1	0.002	0.0025	1	1	0.0054	10/12/09	< 0.001 U	07/23/15
RVAAP-40 Load Line 7	Homewood	LL7mw-001	Volatile Organics	1,1-Dichloroethane	8	8	0.001	0.0027	4	4	0.0035	01/22/09	0.0016	07/23/15
RVAAP-40 Load Line 7	Homewood	LL7mw-001	Volatile Organics	1,1-Dichloroethene	8	8	0.001	0.007	2	2	0.0084	10/12/09	0.0043	07/23/15
RVAAP-40 Load Line 7	Homewood	LL7mw-002	Pesticides and PCBs	beta-BHC	5	1	0.0001	0.000025	5	1	0.000027	07/13/09	< 0.00003 UJ	10/12/09
RVAAP-40 Load Line 7	Homewood	LL7mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	2	0.015	0.0056	4	1	0.0058	07/13/09	< 0.01 U	10/12/09
RVAAP-40 Load Line 7	Homewood	LL7mw-005	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.025	10/12/10	0.025 J	10/12/10
RVAAP-40 Load Line 7	Homewood	LL7mw-006	Explosives	RDX	9	9	0.0002	0.0007	2	2	0.00081	10/12/09	0.00078 J	10/12/09
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-001	Explosives	Nitroglycerin	8	1	0.0033	0.0002	8	1	0.00054	01/18/11	< 0.00069 U	04/06/11
Sharon Conglomerate Formation Wells	Sharon Cong.	SCFmw-001	Miscellaneous	Cyanide	8	1	0.01	0.00015	8	1	0.0076	01/18/10	< 0.01 U	04/06/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-40 Load Line 7	Homewood	LL7mw-001	1,1-Dichloroethane	0.0027	0.0035	01/22/09	1.3		1	mg/L	8	40	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-40 Load Line 7	Homewood	LL7mw-001	1,1-Dichloroethene	0.007	0.0084	10/12/09	1.2		1	mg/L	8	40	2	Yes	Trend analysis to be conducted after RI sampling
RVAAP-40 Load Line 7	Homewood	LL7mw-005	Cyanide	0.00015	0.025	10/12/10	166.7	J	1	mg/L	1	31	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-40 Load Line 7	Homewood	LL7mw-006	RDX	0.0007	0.00081	10/12/09	1.2	J	1	mg/L	9	40	2	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-41 Load Line 8	Unconsolidated	Miscellaneous	Cyanide	Yes	17	1	0.01	0.01	0.00015	17	1	0.0057	0.0057	10/13/2010	4/27/2009	10/13/2010	4/27/2009	
RVAAP-41 Load Line 8	**Unconsolidated**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**22**	**11**	**0.01**	**0.016**	**0.0056**	**12**	**1**	**0.001**	**0.03**	**10/13/2010**	**7/14/2009**	**10/13/2010**	**1/22/2009**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present abov
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime ca
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-41 Load Line 8	Unconsolidated	LL8mw-001	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0057	04/27/09	< 0.01 U	10/13/09
RVAAP-41 Load Line 8	Unconsolidated	LL8mw-003	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.015	0.0056	4	1	0.03	01/22/09	< 0.01 U	10/13/10

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-41 Load Line 8	Unconsolidated	LL8mw-001	Cyanide	0.00015	0.0057	04/27/09	38.0	J	1	mg/L	1	17	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

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Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-42 Load Line 9	Homewood	Explosives	2,6-Dinitrotoluene	Yes	41	4	0.000095	0.00011	0.000048	41	4	0.000061	0.000085	10/13/2010	10/13/2009	10/13/2010	10/13/2009	
RVAAP-42 Load Line 9	**Homewood**	**Pest/PCBs**	**beta-BHC**	**No**	**41**	**8**	**0.00003**	**0.00003**	**0.000025**	**34**	**1**	**0.0000086**	**0.00015**	**10/13/2010**	**7/14/2009**	**10/13/2010**	**7/14/2009**	**Pesticide from historical agricultural use**
RVAAP-42 Load Line 9	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**41**	**26**	**0.01**	**0.01**	**0.0056**	**10**	**2**	**0.00087**	**0.02**	**10/13/2010**	**10/13/2009**	**10/13/2010**	**10/13/2009**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer pre:
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lif
DL - laboratory method detection limit
J - data qualifier indicating estimated results
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Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-42 Load Line 9	Homewood	LL9mw-002	Explosives	2,6-Dinitrotoluene	6	1	0.0001	0.000048	6	1	0.000061	01/22/09	< 0.0001 U	10/13/10
RVAAP-42 Load Line 9	Homewood	LL9mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.01	0.0056	3	2	0.02	01/22/09	< 0.01 U	10/13/10
RVAAP-42 Load Line 9	Homewood	LL9mw-003	Explosives	2,6-Dinitrotoluene	5	1	0.0001	0.000048	5	1	0.000085	04/29/09	< 0.0001 U	10/13/09
RVAAP-42 Load Line 9	Homewood	LL9mw-006	Pesticides and PCBs	beta-BHC	5	2	0.00003	0.000025	4	1	0.00015	07/14/09	< 0.00003 UJ	10/13/09
RVAAP-42 Load Line 9	Homewood	LL9mw-007	Explosives	2,6-Dinitrotoluene	6	2	0.0001	0.000048	6	2	0.000085	10/13/09	0.000085 JB	10/13/09

Notes
COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).
DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

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AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-42 Load Line 9	**Homewood**	**LL9mw-003**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.50E-05**	**04/29/09**	**1.8**	**J**	**1**	**mg/L**	**4**	**74**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-42 Load Line 9	**Homewood**	**LL9mw-007**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.50E-05**	**10/13/09**	**1.8**	**JB**	**1**	**mg/L**	**4**	**74**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-42 Load Line 9	Homewood	LL9mw-002	2,6-Dinitrotoluene	4.80E-05	6.10E-05	01/22/09	1.3	J	2	mg/L	4	74	3	No	Well has had 4 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

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Site-Specific Summary of Groundwater COPCs with Results Statistics
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Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-43 Load Line 10	Homewood	Explosives	2,4,6-Trinitrotoluene	Yes	28	2	0.000096	0.00048	0.00098	1	1	0.00017	0.0012	10/13/2010	1/10/2005	1/10/2005	1/10/2005	
RVAAP-43 Load Line 10	Homewood	Explosives	2,6-Dinitrotoluene	Yes	28	1	0.000096	0.00082	0.000048	28	1	0.000089	0.000089	10/13/2010	1/22/2009	10/13/2010	1/22/2009	
RVAAP-43 Load Line 10	Homewood	Miscellaneous	Cyanide	Yes	28	1	0.01	0.01	0.00015	28	1	0.0071	0.0071	10/13/2010	4/28/2009	10/13/2010	4/28/2009	
RVAAP-43 Load Line 10	**Homewood**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**30**	**14**	**0.0048**	**0.016**	**0.0056**	**15**	**1**	**0.00083**	**0.0081**	**7/23/2015**	**10/13/2009**	**10/13/2010**	**10/13/2009**	**Lab contaminant**
RVAAP-43 Load Line 10	Homewood	VOCs	Carbon tetrachloride	Yes	36	18	0.00025	0.001	0.00045	36	18	0.00047	0.0061	7/23/2015	7/23/2015	7/23/2015	7/23/2015	
RVAAP-43 Load Line 10	**Homewood**	**VOCs**	**Chloroform**	**No**	**36**	**11**	**0.00025**	**0.001**	**0.00022**	**35**	**10**	**0.00022**	**0.00064**	**7/23/2015**	**3/11/2015**	**7/23/2015**	**3/11/2015**	**Lab contaminant**
RVAAP-43 Load Line 10	Unconsolidated	Miscellaneous	Cyanide	Yes	9	1	0.01	0.01	0.00015	9	1	0.007	0.007	10/14/2009	4/27/2009	10/14/2009	4/27/2009	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present ab
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-43 Load Line 10	Homewood	L10mw-001	Explosives	2,4,6-Trinitrotoluene	5	1	0.00033	0.00098	1	1	0.0012	01/10/05	< 0.000098 U	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-001	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.0071	04/28/09	< 0.01 U	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-001	Volatile Organics	Carbon tetrachloride	5	4	0.001	0.00045	5	4	0.0016	10/13/09	0.0016 J	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-001	Volatile Organics	Chloroform	5	2	0.001	0.00022	4	1	0.00026	10/13/09	0.00026 J	10/13/09
RVAAP-43 Load Line 10	Homewood	L10mw-002	Explosives	2,6-Dinitrotoluene	6	1	0.00043	0.000048	6	1	0.000089	01/22/09	< 0.000096 U	10/13/10
RVAAP-43 Load Line 10	Homewood	L10mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.015	0.0056	4	1	0.0081	10/13/09	< 0.01 U	10/13/10
RVAAP-43 Load Line 10	Homewood	L10mw-003	Volatile Organics	Carbon tetrachloride	14	14	0.001	0.00045	14	14	0.0061	07/24/14	0.0013	07/23/15
RVAAP-43 Load Line 10	Homewood	L10mw-003	Volatile Organics	Chloroform	14	9	0.001	0.00022	14	9	0.00064	03/11/15	< 0.001 U	07/23/15
RVAAP-43 Load Line 10	Unconsolidated	L10mw-006	Miscellaneous	Cyanide	9	1	0.01	0.00015	9	1	0.007	04/27/09	< 0.01 U	10/14/09

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-43 Load Line 10	**Homewood**	**L10mw-001**	**2,4,6-Trinitrotoluene**	**0.00098**	**0.0012**	**01/10/05**	**1.2**		**1**	**mg/L**	**2**	**28**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-43 Load Line 10	Homewood	L10mw-002	2,4,6-Trinitrotoluene	0.00098	0.00017	01/10/05	0.2	J	2	mg/L	2	28	1	No	Well has had 5 consecutive ND results since last detection.
RVAAP-43 Load Line 10	**Homewood**	**L10mw-002**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.90E-05**	**01/22/09**	**1.9**	**J**	**1**	**mg/L**	**1**	**58**	**1**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-43 Load Line 10	**Homewood**	**L10mw-003**	**Carbon tetrachloride**	**0.00045**	**0.0061**	**07/24/14**	**13.6**		**1**	**mg/L**	**18**	**36**	**18**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-43 Load Line 10	Homewood	L10mw-001	Carbon tetrachloride	0.00045	0.0016	10/13/09	3.6	J	2	mg/L	18	36	18	Yes	Trend analysis to be conducted after RI sampling
RVAAP-43 Load Line 10	Homewood	L10mw-003	Carbon tetrachloride	0.00045	0.0016	01/17/05	3.6	=	2	mg/L	18	36	18	Yes	Trend analysis to be conducted after RI sampling
RVAAP-43 Load Line 10	**Homewood**	**L10mw-001**	**Cyanide**	**0.00015**	**0.0071**	**04/28/09**	**47.3**	**J**	**1**	**mg/L**	**1**	**28**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-43 Load Line 10	**Unconsolidated**	**L10mw-006**	**Cyanide**	**0.00015**	**0.007**	**04/27/09**	**46.7**	**J**	**1**	**mg/L**	**1**	**9**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Monitoring Well Summary of
2013-2015 Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-43 Load Line 10	Homewood	L10mw-003	Carbon tetrachloride	0.00045	0.0061	07/24/14	13.6		1	mg/L	6	6	6	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration well for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-44 Load Line 11	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	84	4	0.000049	0.00013	0.000048	84	4	0.000084	0.00011	1/24/2013	4/23/2009	1/24/2013	4/23/2009	
RVAAP-44 Load Line 11	Unconsolidated	Miscellaneous	Cyanide	Yes	81	1	0.01	0.01	0.00015	81	1	0.0015	0.0015	1/24/2013	3/8/2006	1/24/2013	3/8/2006	
RVAAP-44 Load Line 11	**Unconsolidated**	**Pest/PCBs**	**beta-BHC**	**No**	**84**	**6**	**0.0000095**	**0.00003**	**0.000025**	**64**	**3**	**0.000012**	**0.00021**	**1/24/2013**	**10/14/2009**	**10/13/2010**	**7/15/2009**	**Pesticide from historical agricultural use**
RVAAP-44 Load Line 11	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**84**	**2**	**0.0000095**	**0.00003**	**0.0000014**	**84**	**2**	**0.000024**	**0.000087**	**1/24/2013**	**5/3/2006**	**1/24/2013**	**5/3/2006**	**Pesticide from historical agricultural use**
RVAAP-44 Load Line 11	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	84	39	0.00076	0.1	0.0056	42	6	0.00083	0.35	1/24/2013	1/24/2013	10/13/2010	10/14/2009	Potential lab contaminant
RVAAP-44 Load Line 11	Unconsolidated	VOCs	Trichloroethene	Yes	84	2	0.00025	0.001	0.00028	77	2	0.002	0.003	1/24/2013	12/20/2000	10/13/2010	12/20/2000	

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer r
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-001	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	4	0.1	3	1	0.35	10/14/09	< 0.01 U	10/13/10	0.01
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Explosives	2,6-Dinitrotoluene	16	1	0.00012	16	1	0.000084	07/11/06	< 0.0001 U	10/13/10	0.0001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Pesticides and PCBs	beta-BHC	16	3	0.00003	14	2	0.00021	04/17/07	< 0.00003 UJ	10/13/10	0.00003
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Pesticides and PCBs	Heptachlor	16	2	0.00003	16	2	0.000087	04/13/05	< 0.00003 UJ	10/13/10	0.00003
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	16	3	0.01	10	1	0.03	12/14/00	0.0028 J	10/13/10	0.0028
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-003	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	4	0.01	2	1	0.0086	10/14/09	0.0086 J	10/14/09	0.0086
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-006	Explosives	2,6-Dinitrotoluene	5	1	0.00012	5	1	0.000084	04/23/09	< 0.0001 U	10/14/09	0.0001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-007	Miscellaneous	Cyanide	14	1	0.01	14	1	0.0015	03/08/06	< 0.01 U	10/13/10	0.01
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-008	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	5	4	0.01	2	1	0.0094	01/23/09	0.00083 J	10/14/09	0.00083
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-008	Volatile Organics	Trichloroethene	5	1	0.001	5	1	0.003	12/20/00	< 0.001 U	10/14/09	0.001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Pesticides and PCBs	beta-BHC	6	1	0.00003	5	1	0.000029	07/15/09	< 0.00003 UJ	10/13/10	0.00003
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	2	0.01	5	1	0.0059	07/15/09	< 0.01 U	10/13/10	0.01
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Volatile Organics	Trichloroethene	6	1	0.001	6	1	0.002	12/15/00	< 0.001 U	10/13/10	0.001
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-010	Explosives	2,6-Dinitrotoluene	9	2	0.00012	9	2	0.00011	04/23/09	< 0.000098 UJ	10/14/09	0.000098
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-010	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	9	5	0.01	5	1	0.0057	10/14/09	0.0057 J	10/14/09	0.0057

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-010**	**2,6-Dinitrotoluene**	**4.80E-05**	**0.00011**	**04/23/09**	**2.3**	**J**	**1**	**mg/L**	**4**	**151**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	2,6-Dinitrotoluene	4.80E-05	8.40E-05	07/11/06	1.8	J	2	mg/L	4	151	4	Yes	Well has had 6 consecutive ND results since last detection. Well will be sampled to confirm current conditions still support delineation to below MDLs.
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-006	2,6-Dinitrotoluene	4.80E-05	8.40E-05	04/23/09	1.8	J	2	mg/L	4	151	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-001**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**3.50E-01**	**10/14/09**	**62.5**		**1**	**mg/L**	**39**	**84**	**4**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-002	Bis(2-ethylhexyl)phthalate	5.60E-03	3.00E-02	12/14/00	5.4	=	2	mg/L	39	84	4	Yes	Trend analysis to be conducted after RI sampling
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-008	Bis(2-ethylhexyl)phthalate	5.60E-03	9.40E-03	01/23/09	1.7	JB	3	mg/L	39	84	4	No	The need for characterization of DEHP will be based on confirmation of the constituent at LL11mw-001.
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-007**	**Cyanide**	**0.00015**	**0.0015**	**03/08/06**	**10.0**	**J**	**1**	**mg/L**	**1**	**81**	**1**	**No**	**Well has had 8 consecutive ND results since last detection.**
RVAAP-44 Load Line 11	**Unconsolidated**	**LL11mw-008**	**Trichloroethene**	**0.00028**	**0.003**	**12/20/00**	**10.7**	**=**	**1**	**mg/L**	**2**	**84**	**2**	**No**	**Well has had 4 consecutive ND results since last detection.**
RVAAP-44 Load Line 11	Unconsolidated	LL11mw-009	Trichloroethene	0.00028	0.002	12/15/00	7.1	=	2	mg/L	2	84	2	No	Well has had 5 consecutive ND results since last detection.

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-49 Central Burn Pits	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**7**	**7**	**0.00076**	**0.00083**	**0.0056**	**1**	**1**	**0.00081**	**0.032**	**1/23/2013**	**1/23/2013**	**5/1/2012**	**5/1/2012**	**Lab contaminant**
RVAAP-49 Central Burn Pits	Unconsolidated	Explosives	2,6-Dinitrotoluene	Yes	62	5	0.000095	0.00011	0.000048	62	5	0.000053	0.000082	1/20/2011	7/10/2008	1/20/2011	7/10/2008	
RVAAP-49 Central Burn Pits	Unconsolidated	Explosives	Nitroglycerin	Yes	45	1	0.00062	0.00073	0.0002	45	1	0.00038	0.00038	1/20/2011	1/21/2009	1/20/2011	1/21/2009	
RVAAP-49 Central Burn Pits	Unconsolidated	Miscellaneous	Cyanide	Yes	62	3	0.01	0.01	0.00015	62	3	0.0018	0.011	1/20/2011	10/9/2008	1/20/2011	10/9/2008	
RVAAP-49 Central Burn Pits	**Unconsolidated**	**Pest/PCBs**	**Heptachlor**	**No**	**65**	**2**	**0.0000095**	**0.00003**	**0.0000014**	**65**	**2**	**0.000014**	**0.000085**	**1/22/2013**	**10/10/2008**	**1/22/2013**	**10/10/2008**	**Pesticide from historical agricultural use**
RVAAP-49 Central Burn Pits	Unconsolidated	Pest/PCBs	PCB-1248	Yes	65	3	0.00019	0.001	0.0000078	65	3	0.0001	0.00022	1/22/2013	10/9/2008	1/22/2013	10/9/2008	
RVAAP-49 Central Burn Pits	Unconsolidated	SVOCs	Bis(2-ethylhexyl)phthalate	Yes	65	28	0.00076	0.01	0.0056	30	1	0.00091	0.008	1/22/2013	7/24/2012	1/20/2011	10/10/2008	Potential lab contaminant

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present above SLs
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk o
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
RVAAP-49 Central Burn Pits	Sharon	CBPmw-009	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	7	0.00083	0.0056	1	1	0.032	05/01/12	0.001 J	01/23/13
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-001	Explosives	Nitroglycerin	6	1	0.00072	0.0002	6	1	0.00038	01/21/09	< 0.00072 U	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-001	Pesticides and PCBs	PCB-1248	6	1	0.0005	0.0000078	6	1	0.00011	10/09/08	< 0.0005 UJ	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-002	Explosives	2,6-Dinitrotoluene	5	1	0.000099	0.000048	5	1	0.000075	07/10/08	< 0.000099 U	01/21/09
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-002	Pesticides and PCBs	PCB-1248	8	1	0.0005	0.0000078	8	1	0.00022	10/09/08	< 0.00019 UJ	01/22/13
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-003	Explosives	2,6-Dinitrotoluene	5	1	0.00011	0.000048	5	1	0.000063	07/09/08	< 0.00011 U	01/21/09
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Explosives	2,6-Dinitrotoluene	10	1	0.00011	0.000048	10	1	0.000065	04/09/08	< 0.00011 U	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Miscellaneous	Cyanide	10	1	0.01	0.00015	10	1	0.0065	10/09/08	< 0.01 UJ	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Pesticides and PCBs	PCB-1248	10	1	0.0005	0.0000078	10	1	0.0001	10/09/08	< 0.0005 UJ	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-005	Miscellaneous	Cyanide	11	1	0.01	0.00015	11	1	0.0018	03/08/06	< 0.01 UJ	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-005	Pesticides and PCBs	Heptachlor	11	1	0.00003	0.0000014	11	1	0.000085	07/14/05	< 0.00003 UJ	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-006	Inorganics	Beryllium	7	2	0.001	0.0025	1	1	0.0037	10/21/09	0.0037	10/21/09
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-006	Miscellaneous	Cyanide	5	1	0.01	0.00015	5	1	0.011	04/17/07	< 0.01 UJ	04/09/08
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-007	Explosives	2,6-Dinitrotoluene	14	1	0.0001	0.000048	14	1	0.000082	10/03/05	< 0.0001 U	01/20/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-008	Explosives	2,6-Dinitrotoluene	6	1	0.0001	0.000048	6	1	0.000053	04/09/08	< 0.000096 U	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-008	Pesticides and PCBs	Heptachlor	6	1	0.00003	0.0000014	6	1	0.000014	10/10/08	< 0.00003 U	01/19/11
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-008	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	6	3	0.01	0.0056	4	1	0.008	10/10/08	< 0.01 U	01/19/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	12	7	0.012	0.0056	6	1	0.016	07/27/01	< 0.01 UJ	01/20/11
RVAAP-29 Upper and Lower Cobbs Ponds	Unconsolidated	ULCPmw-006	Semi-Volatile Organics	Naphthalene	12	1	0.00024	0.00017	12	1	0.00034	01/20/09	< 0.0002 U	01/20/11

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).
DL – laboratory method detection limit
J – data qualifier indicating estimated results
mg/L – milligrams per liter
Monitored Zone – well-specific screened interval aquifer formation
SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-49 Central Burn Pits	**Sharon**	**CBPmw-009**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**3.20E-02**	**05/01/12**	**5.7**	**J**	**1**	**mg/L**	**7**	**7**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-007**	**2,6-Dinitrotoluene**	**4.80E-05**	**8.20E-05**	**10/03/05**	**1.7**	**J**	**1**	**mg/L**	**5**	**116**	**5**	**No**	**Well has had 9 consecutive ND results since last detection.**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-002	2,6-Dinitrotoluene	4.80E-05	7.50E-05	07/10/08	1.6	J	2	mg/L	5	116	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	2,6-Dinitrotoluene	4.80E-05	6.50E-05	04/09/08	1.4	J	3	mg/L	5	116	5	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-008**	**Bis(2-ethylhexyl)phthalate**	**5.60E-03**	**8.00E-03**	**10/10/08**	**1.4**	**J**	**1**	**mg/L**	**28**	**65**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-007	Bis(2-ethylhexyl)phthalate	5.60E-03	4.30E-03	07/10/07	0.8	J	2	mg/L	28	65	1	No	The need for characterization of DEHP will be based on confirmation of the constituent at CBPmw-008.
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Bis(2-ethylhexyl)phthalate	5.60E-03	3.70E-03	07/10/08	0.7	J	3	mg/L	28	65	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-006**	**Cyanide**	**0.00015**	**0.011**	**04/17/07**	**73.3**	**J**	**1**	**mg/L**	**3**	**62**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	Cyanide	0.00015	0.0065	10/09/08	43.3	J	2	mg/L	3	62	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-005	Cyanide	0.00015	0.0018	03/08/06	12.0	J	3	mg/L	3	62	3	No	Well has had 5 consecutive ND results since last detection.
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-001**	**Nitroglycerin**	**0.0002**	**0.00038**	**01/21/09**	**1.9**	**J**	**1**	**mg/L**	**1**	**45**	**1**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	**Unconsolidated**	**CBPmw-002**	**PCB-1248**	**0.0000078**	**0.00022**	**10/09/08**	**28.2**	**J**	**1**	**mg/L**	**3**	**65**	**3**	**Yes**	**Trend analysis to be conducted after RI sampling**
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-001	PCB-1248	0.0000078	0.00011	10/09/08	14.1	J	2	mg/L	3	65	3	Yes	Trend analysis to be conducted after RI sampling
RVAAP-49 Central Burn Pits	Unconsolidated	CBPmw-004	PCB-1248	0.0000078	0.0001	10/09/08	12.8	J	3	mg/L	3	65	3	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

Appendix C
Site-Specific Summary of Groundwater COPCs with Results Statistics
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

Site ID	Monitored Zone	Chemical Group	Chemical	SRC?	Sample Count	Detected Results Count	Min DL (mgL)	Max DL (mgL)	SL (mg/L)	Exceed Count (w/ ND)	Exceed Count (w/out ND)	Min Detected Results (mg/L)	Max Detected Results (mg/L)	Latest Date Sampled	Most Recent Detection Date	Most Recent SL Exceed Date w/ ND	Most Recent SL Exceed Date w/out ND	Comments
RVAAP-50 Atlas Scrap Yard	Sharon	Explosives	2,6-Dinitrotoluene	Yes	38	1	0.000096	0.00082	0.000048	38	1	0.00006	0.00006	4/7/2011	1/20/2010	4/7/2011	1/20/2010	
RVAAP-50 Atlas Scrap Yard	Sharon	Miscellaneous	Cyanide	Yes	30	1	0.01	0.02	0.00015	30	1	0.0059	0.0059	4/7/2011	4/28/2009	4/7/2011	4/28/2009	
RVAAP-50 Atlas Scrap Yard	**Sharon**	**SVOCs**	**Bis(2-ethylhexyl)phthalate**	**No**	**38**	**23**	**0.01**	**0.015**	**0.0056**	**16**	**1**	**0.0009**	**0.058**	**4/7/2011**	**1/21/2010**	**4/7/2011**	**12/1/2004**	**Lab contaminant**

Notes
Bold - Indicates constituent not considered to be site related based on documented historical site use, status as common laboratory cross-contaminant, or no longer present a
COPC - chemical of potential concern (one or more detections above the lower of the constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetim
DL - laboratory method detection limit
J - data qualifier indicating estimated results
mg/L - milligrams per liter
Monitored Zone - well-specific screened interval aquifer formation
SRC - site related constituent

Appendix C
Site-Specific Monitoring Well Summary of Groundwater COPC Results
Facility Wide Groundwater RI Work Plan
Former RVAAP, OH
June 2016

Site ID	Monitored Zone	Monitoring Well ID	Chemical Group	Chemical	Sample Count	Detected Results Count	Max DL (mg/L)	Screening Level (mg/L)	Exceed Count (w/ NonDetects)	Exceed Count (Detects Only)	Max Detected Concentration (mg/L)	Max Detected Concentration Date	Most Recent Result (mg/L)	Most Recent Result Date
Sharon	ASYmw-003	RVAAP-50 Atlas Scrap Yard	Semi-Volatile Organics	Bis(2-ethylhexyl)phthalate	7	3	0.015	0.0056	5	1	0.058	12/01/04	< 0.01 UJB	04/07/11
Sharon	ASYmw-004	RVAAP-50 Atlas Scrap Yard	Miscellaneous	Cyanide	4	1	0.01	0.00015	4	1	0.0059	04/28/09	< 0.01 UJ	01/21/10
Sharon	ASYmw-005	RVAAP-50 Atlas Scrap Yard	Explosives	2,6-Dinitrotoluene	5	1	0.00049	0.000048	5	1	0.00006	01/20/10	0.00006 J	01/20/10
Unconsolidated	ASYmw-008	RVAAP-50 Atlas Scrap Yard	Inorganics	Beryllium	10	3	0.002	0.0025	2	2	0.0046	10/15/09	< 0.001 U	01/20/10

Notes

COPC – chemical of potential concern (one or more detections above the lower of constituent-specific MCL or most recent USEPA Residential Tapwater RSL, excess lifetime cancer risk of 1E-06, HQ of 0.1).

DL – laboratory method detection limit

J – data qualifier indicating estimated results

mg/L – milligrams per liter

Monitored Zone – well-specific screened interval aquifer formation

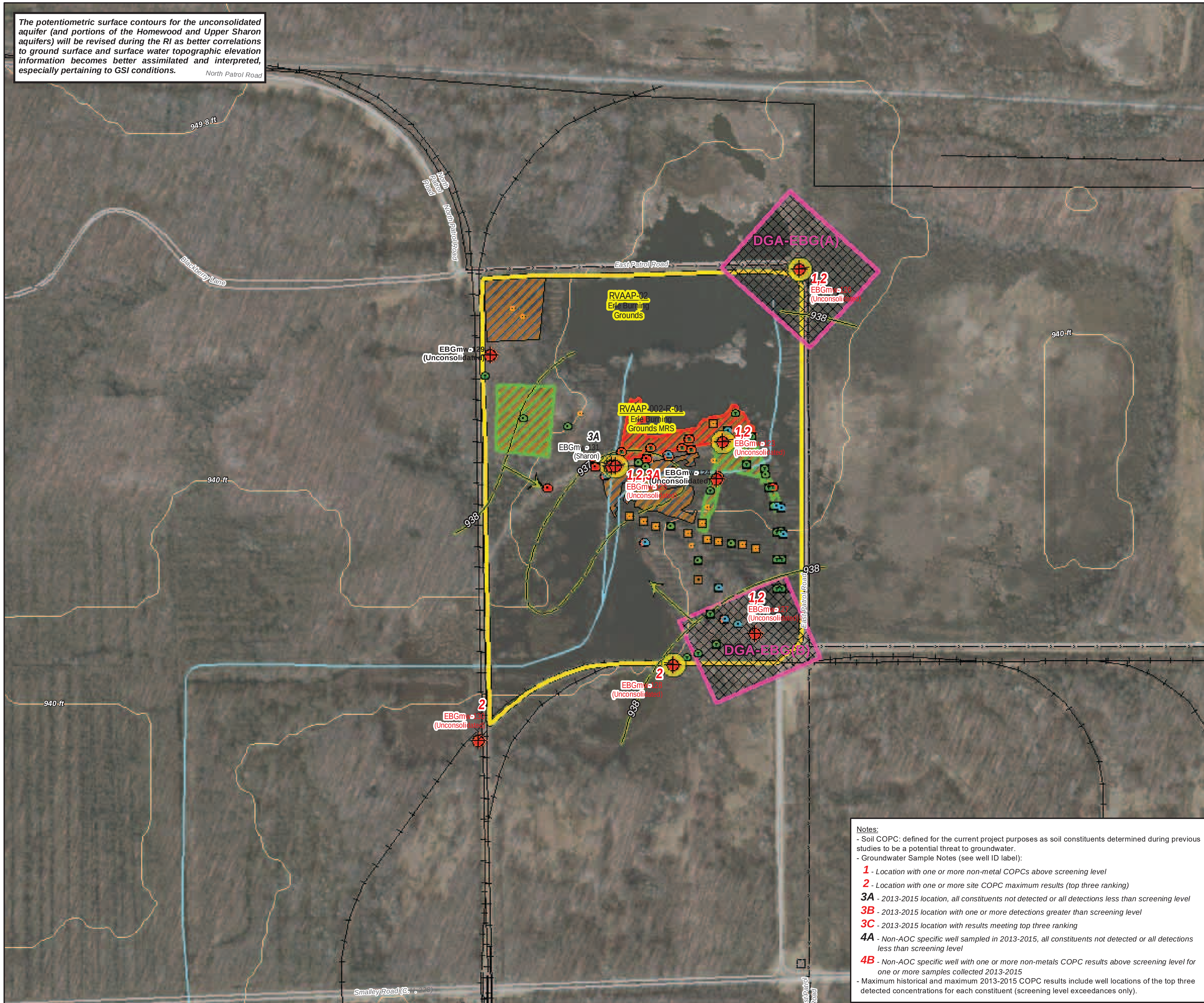
SL – screening level (MCL or USEPA Residential Tapwater RSL

Appendix C
Site-Specific Monitoring Well Summary of
Historical Maximum Groundwater COPC Results (Top 3 Rankings)
Facility Wide Groundwater RI Work Plan
Camp Ravenna, OH
May 2016
Preliminary Draft - For Discussion Only

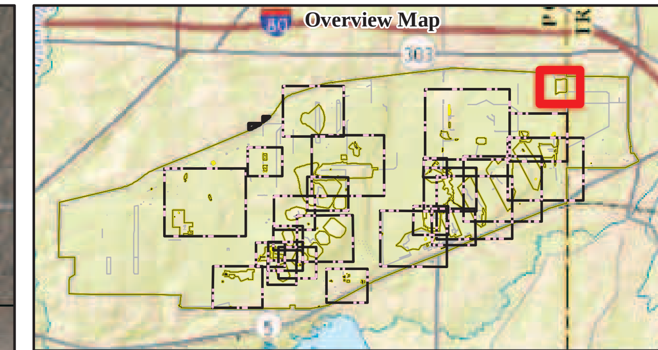
AOC	Monitored Zone	Well ID	Constituent	Screening Level (mg/L)	Historical Max Results (mg/L)	Max Results Sample Date	COPC Risk Ratio	Data qual	RANK	Units	Total Detections	Total Samples	Number of SL Exceedances	To Be Sampled For RI	Individual Well COPC Concentration Trend Analysis
RVAAP-50 Atlas Scrap Yard	Sharon	ASYmw-005	2,6-Dinitrotoluene	4.80E-05	6.00E-05	01/20/10	1.3	J	1	mg/L	1	76	1	Yes	Trend analysis to be conducted after RI sampling
RVAAP-50 Atlas Scrap Yard	Sharon	ASYmw-004	Cyanide	0.00015	0.0059	04/28/09	39.3	J	1	mg/L	1	30	1	Yes	Trend analysis to be conducted after RI sampling

Bold text indicates AOC-specific maximum results for the indicated constituent. Shaded lines indicate AOC-specific "risk driver" COPCs or No.1 ranked COPC concentration for non risk driver constituents.

The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed) * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 175 350 525 700 Feet

1 " = 350 ft
NAD83 UTM Zone 17N

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RVAAP-02 AND RVAAP-002-R-01
(ERIE BURNING GROUNDS AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-1
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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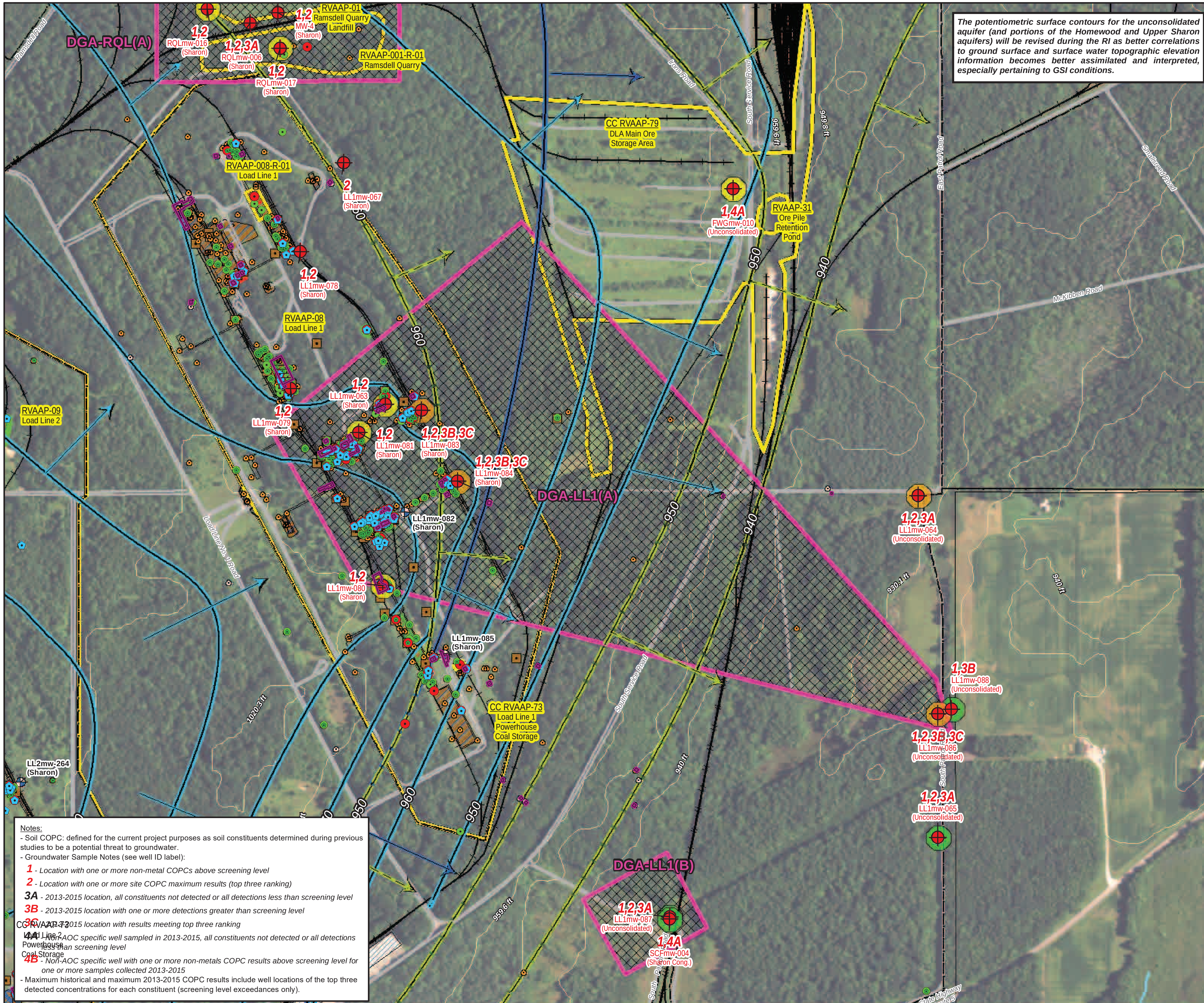

The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information become better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

See notes on map
Proposed FWGWMP Well Location
Proposed RI Well Location
Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

N
0 330 660 990 1,320 Feet
1 " = 650 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-08 WITH RVAAP-31 AND CC RVAAP-79 (LOAD LINE 1 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-2

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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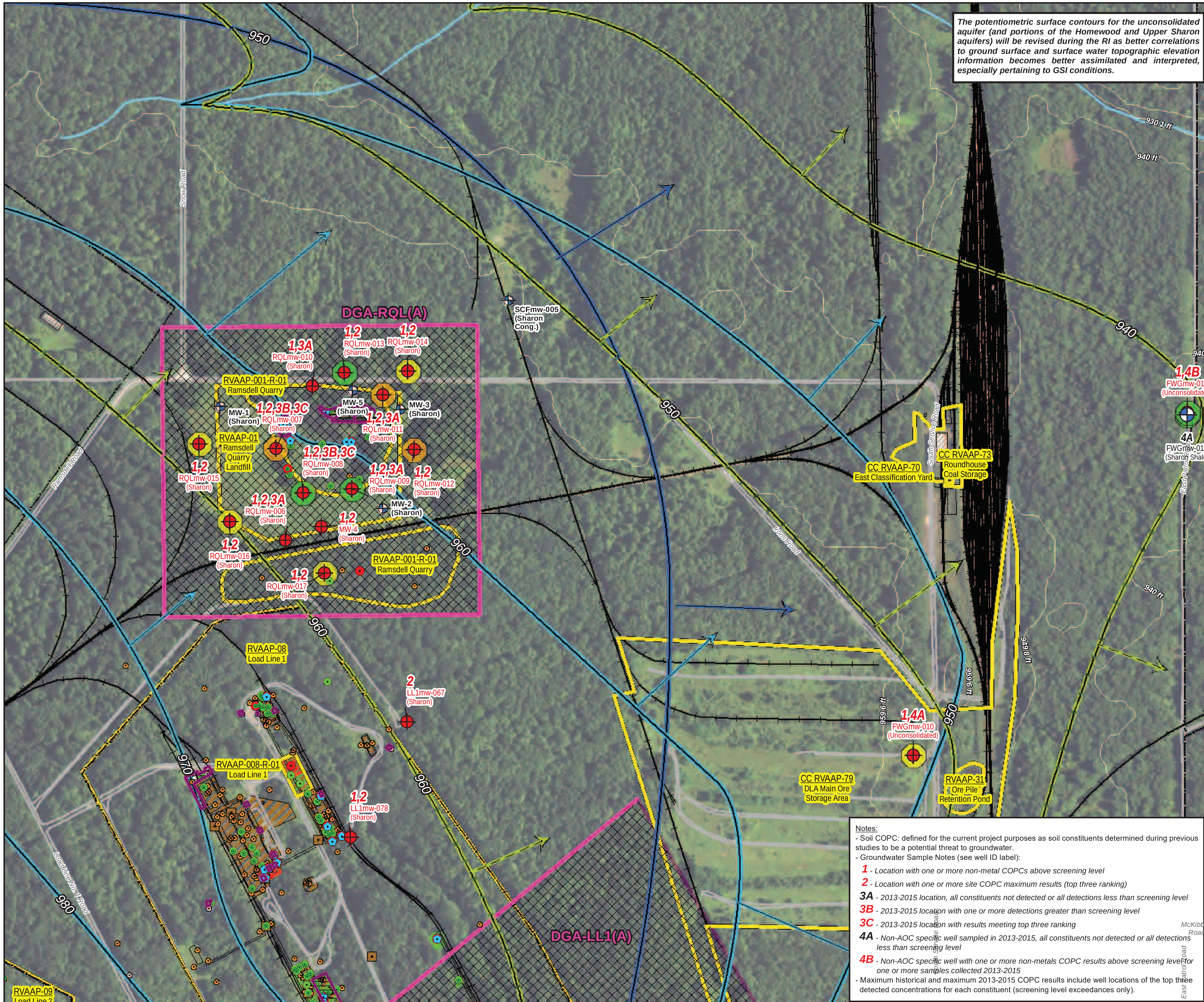

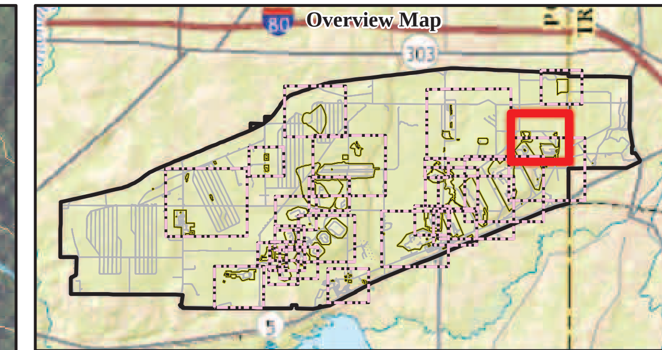

Soil Sample Location with Groundwater COPC Detected Greater than the Mean

Soil Sample Location with Detected Groundwater COPC

Soil Sample with Soil COPC Detected Greater than the Mean

Soil Sample with Soil COPC Detected

ISM Location with Soil COPC Detected Greater than the Mean

ISM Location with detected Soil COPC

Data Gap Areas

Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed FWGWMP Well Location

Proposed RI Well Location

Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)

Soil, Subsurface Stations (white = metals only analyzed)

Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown

Groundwater Station

Potentiometric Surface Contour: Unconsolidated (July 2015)

Potentiometric Surface Contour: Upper Sharon (July 2015)

Potentiometric Surface Contour: Sharon Conglomerate (July 2015)

Excavation Areas

AOCs

Buildings

Streams

Elevation Contour Line (0.5m from USDA)

N

0 250 500 750 1,000 Feet

1 " = 500 ft
NAD83 UTM Zone 17N

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
1 - Location with one or more non-metal COPCs above screening level
2 - Location with one or more site COPC maximum results (top three ranking)
3A - 2013-2015 location, all constituents not detected or all detections less than screening level
3B - 2013-2015 location with one or more detections greater than screening level
3C - 2013-2015 location with results meeting top three ranking
4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

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RVAAP-01 AND RVAAP-001-R-01
(RAMSDELL QUARRY AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-3

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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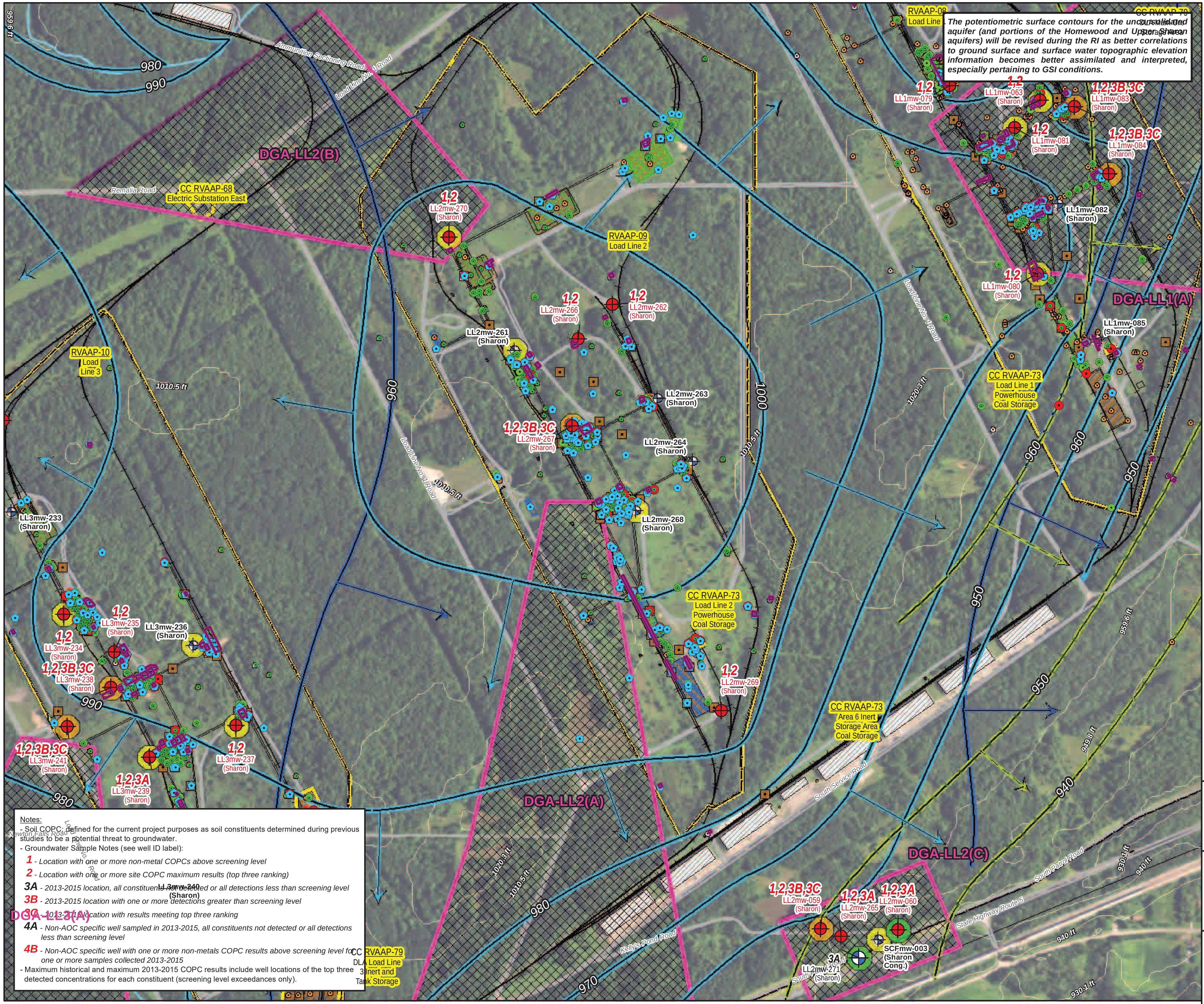

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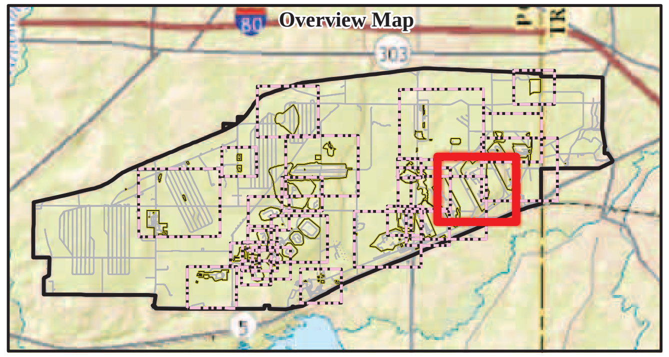

- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 340 680 1,020 1,360 Feet

1 " = 675 ft
NAD83 UTM Zone 17N

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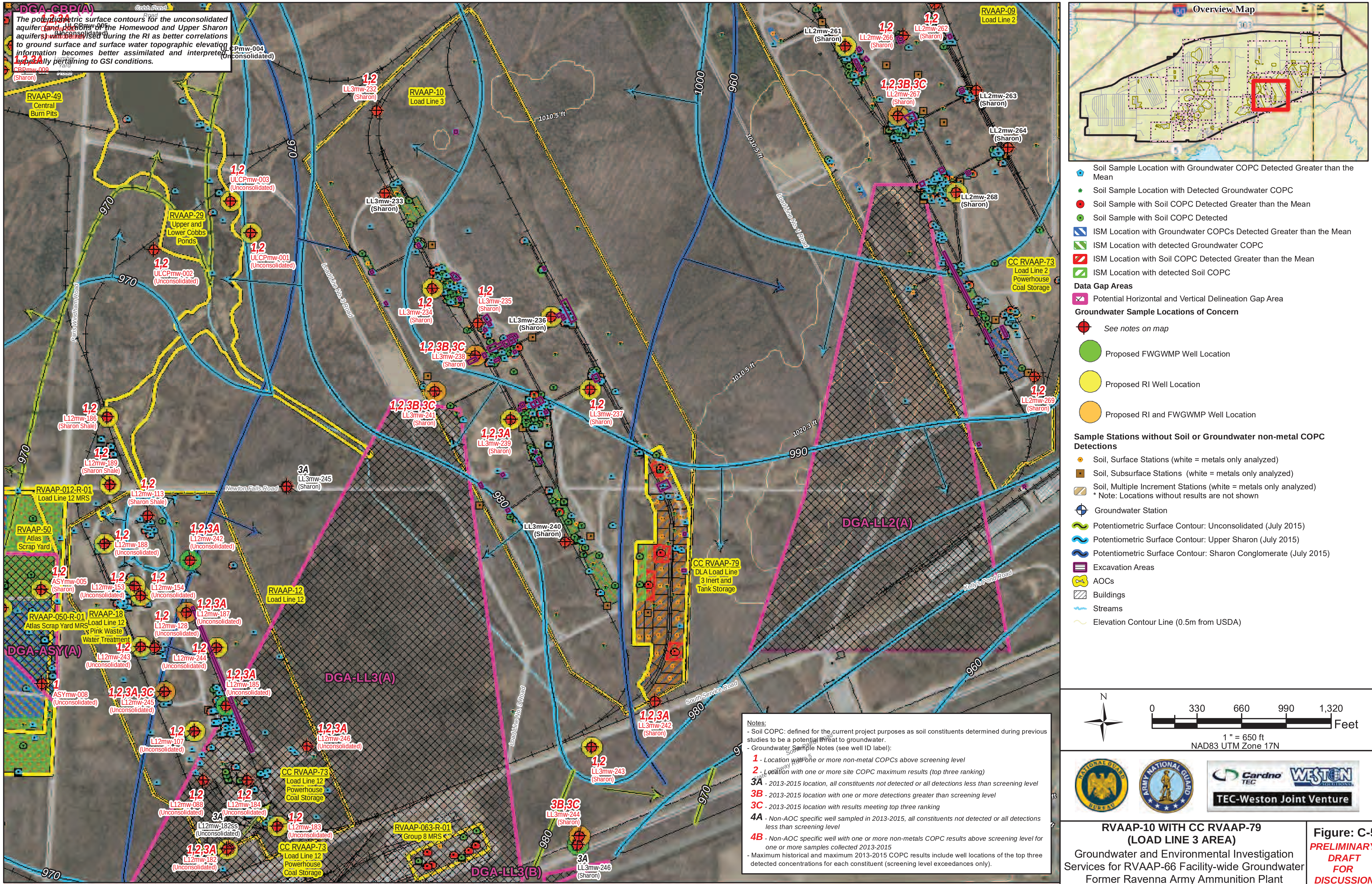
RVAAP-09 WITH CC RVAAP-68 (LOAD LINE 2 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-4

PRELIMINARY DRAFT FOR DISCUSSION ONLY



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 330 660 990 1,320 Feet

1 " = 650 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-10 WITH CC RVAAP-79
(LOAD LINE 3 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-5
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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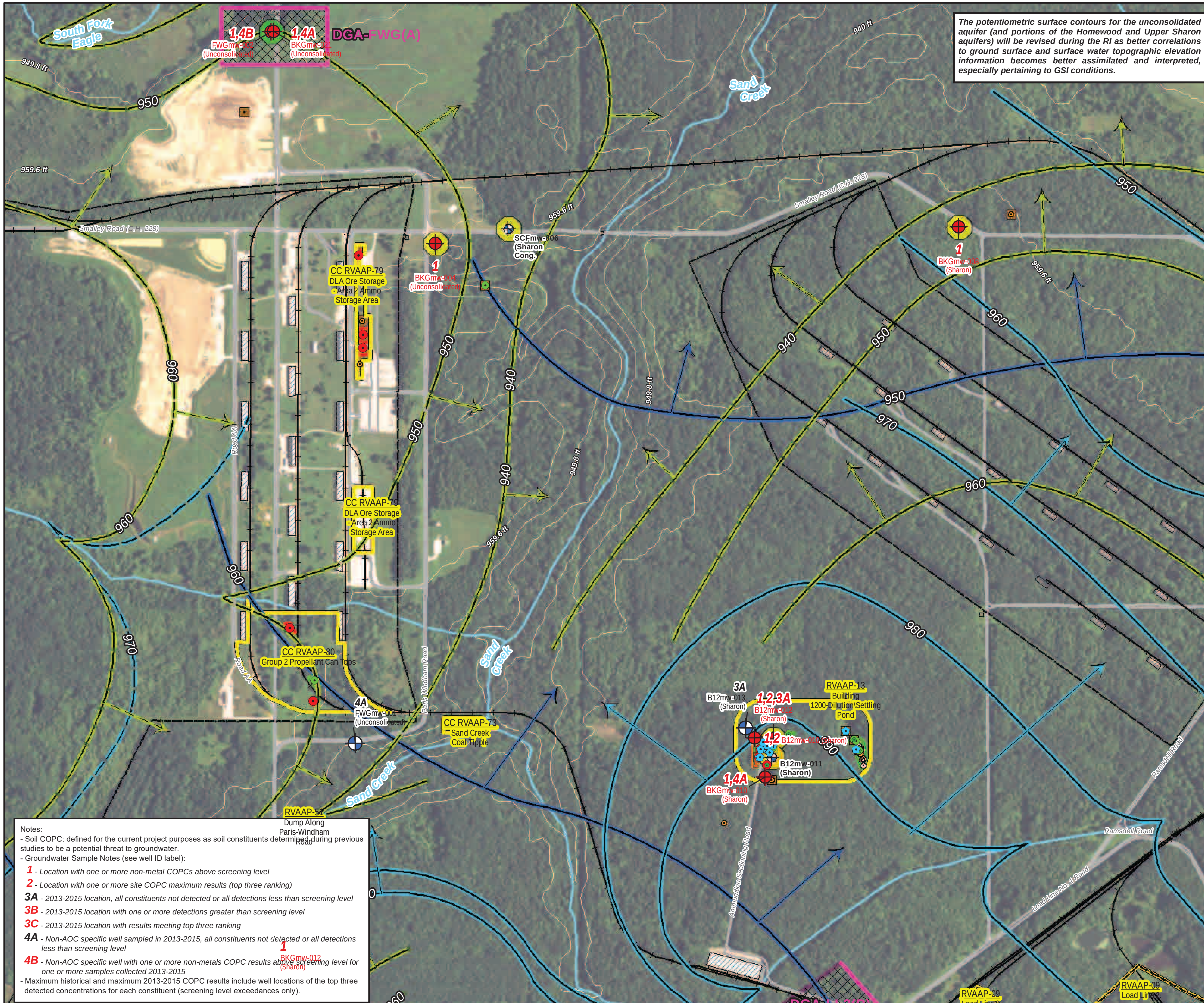

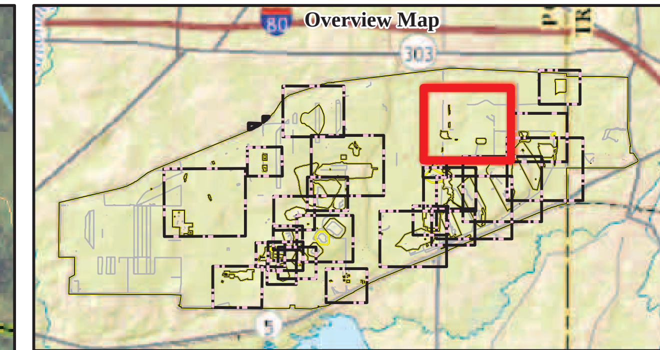

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed FWGWMP Well Location
Proposed RI Well Location
Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

N

0 380 760 1,140 1,520 Feet

1 " = 750 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-13 WITH RVAAP-51, CC RVAAP-79, AND CC RVAAP-80 - (BUILDING 1200 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-6

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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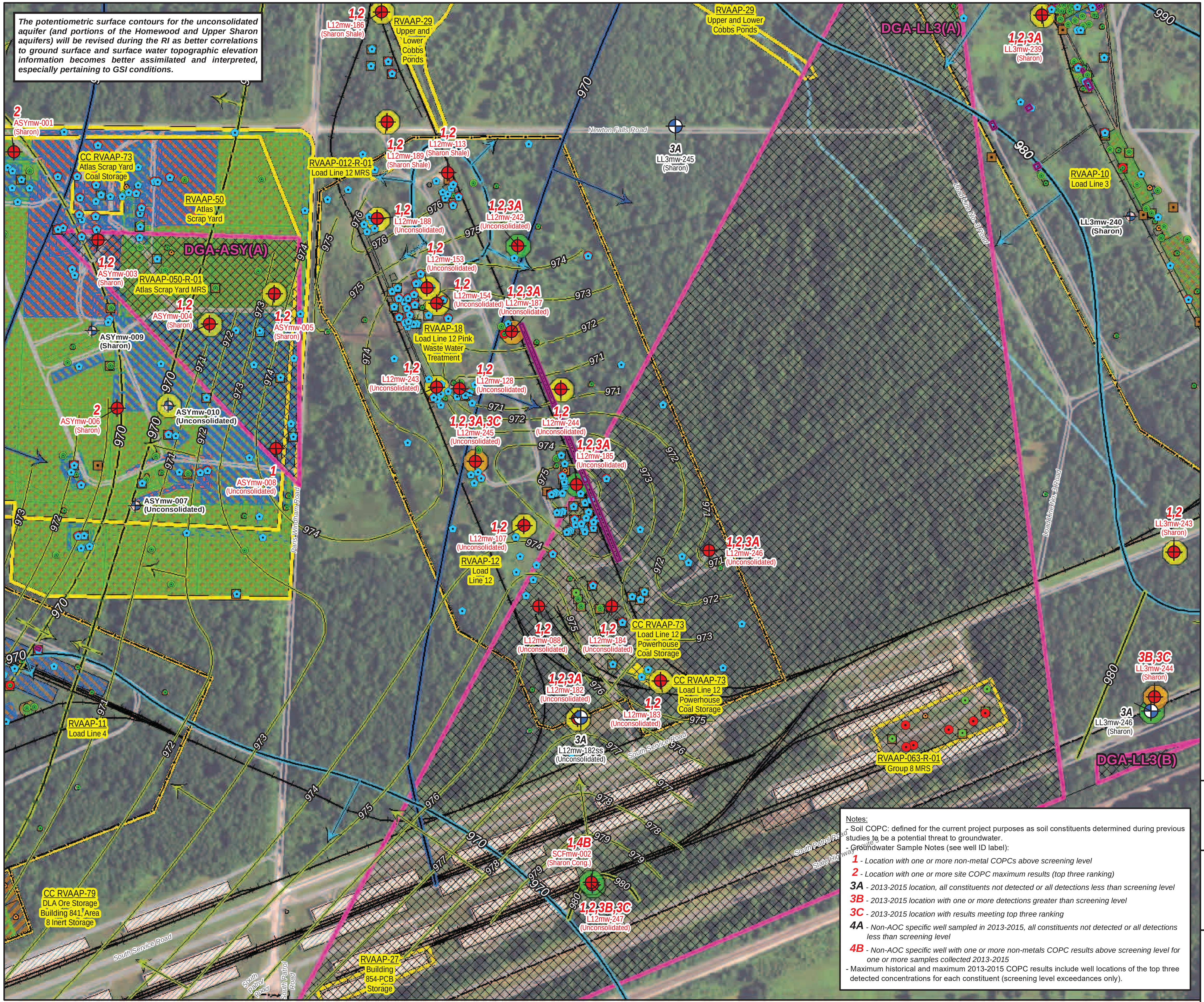

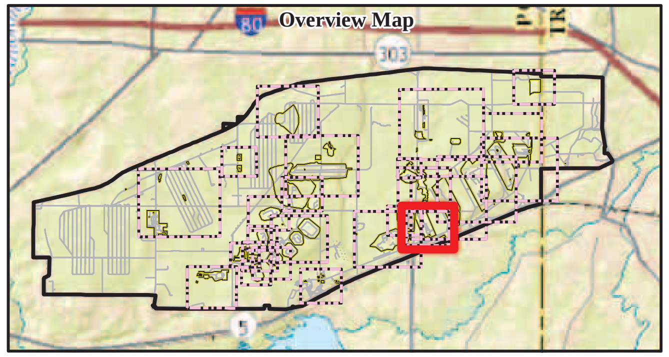

Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

See notes on map

Proposed FWGWMP Well Location
Proposed RI Well Location
Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
Excavation Areas
AOCs
Buildings
Streams

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):

1 - *Location with one or more non-metal COPCs above screening level*
2 - *Location with one or more site COPC maximum results (top three ranking)*
3A - *2013-2015 location, all constituents not detected or all detections less than screening level*
3B - *2013-2015 location with one or more detections greater than screening level*
3C - *2013-2015 location with results meeting top three ranking*
4A - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
4B - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*

- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

N

0 230 460 690 920 Feet

1 " = 450 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-12 WITH RVAAP-063-R-01 (LOAD LINE 12 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-7

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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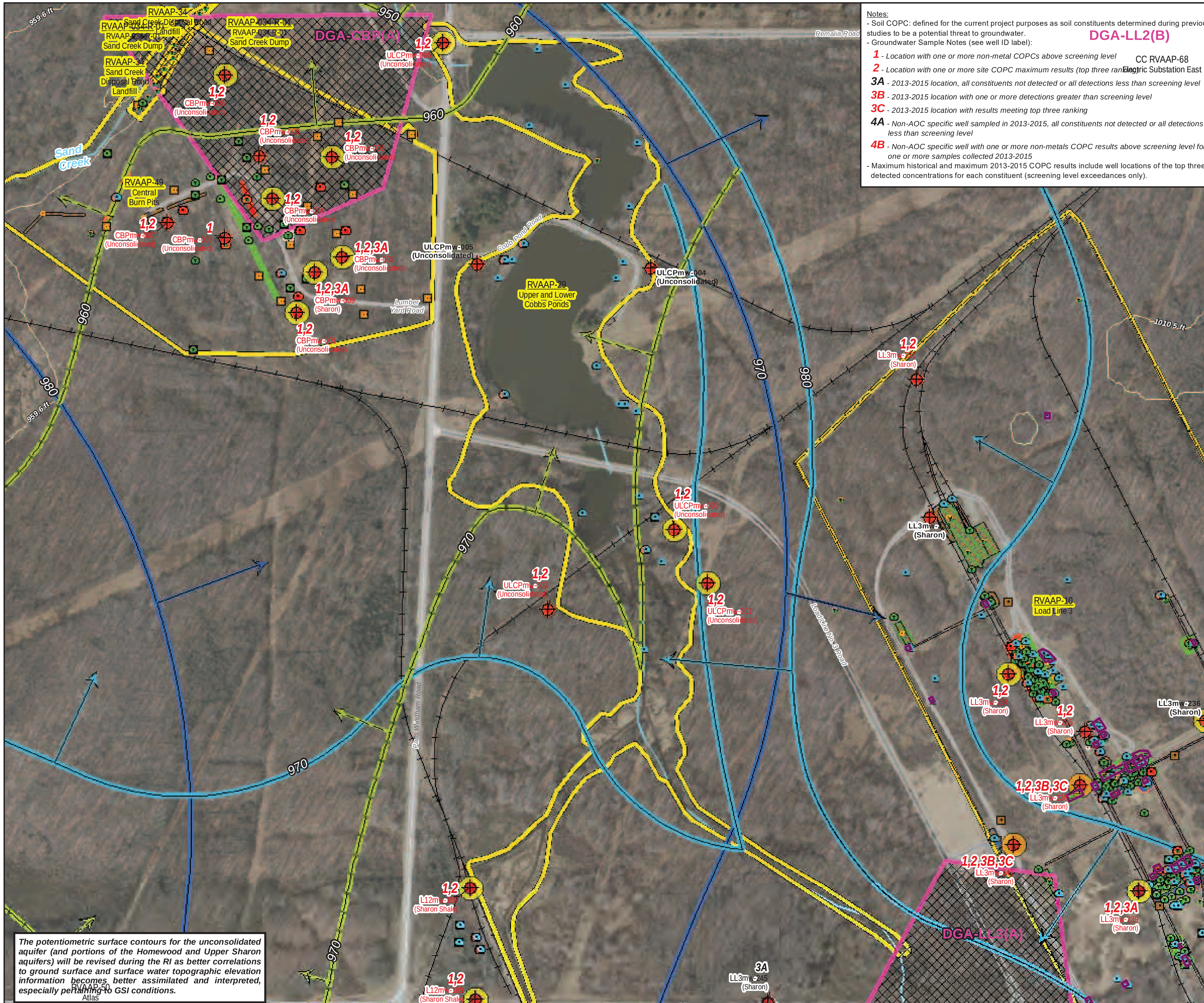


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):

1 - Location with one or more non-metal COPCs above screening level

2 - Location with one or more site COPC maximum results (top three ranking)

3A - 2013-2015 location, all constituents not detected or all detections less than screening level

3B - 2013-2015 location with one or more detections greater than screening level

3C - 2013-2015 location with results meeting top three ranking

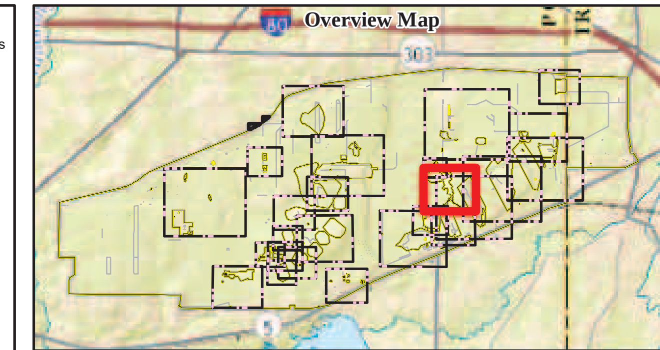
4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level

4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015

- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

DGA-LL2(B)

CC RVAAP-68
Electric Substation East



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 230 460 690 920 Feet

1 " = 450 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-29
(UPPER AND LOWER COBBS PONDS)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-8
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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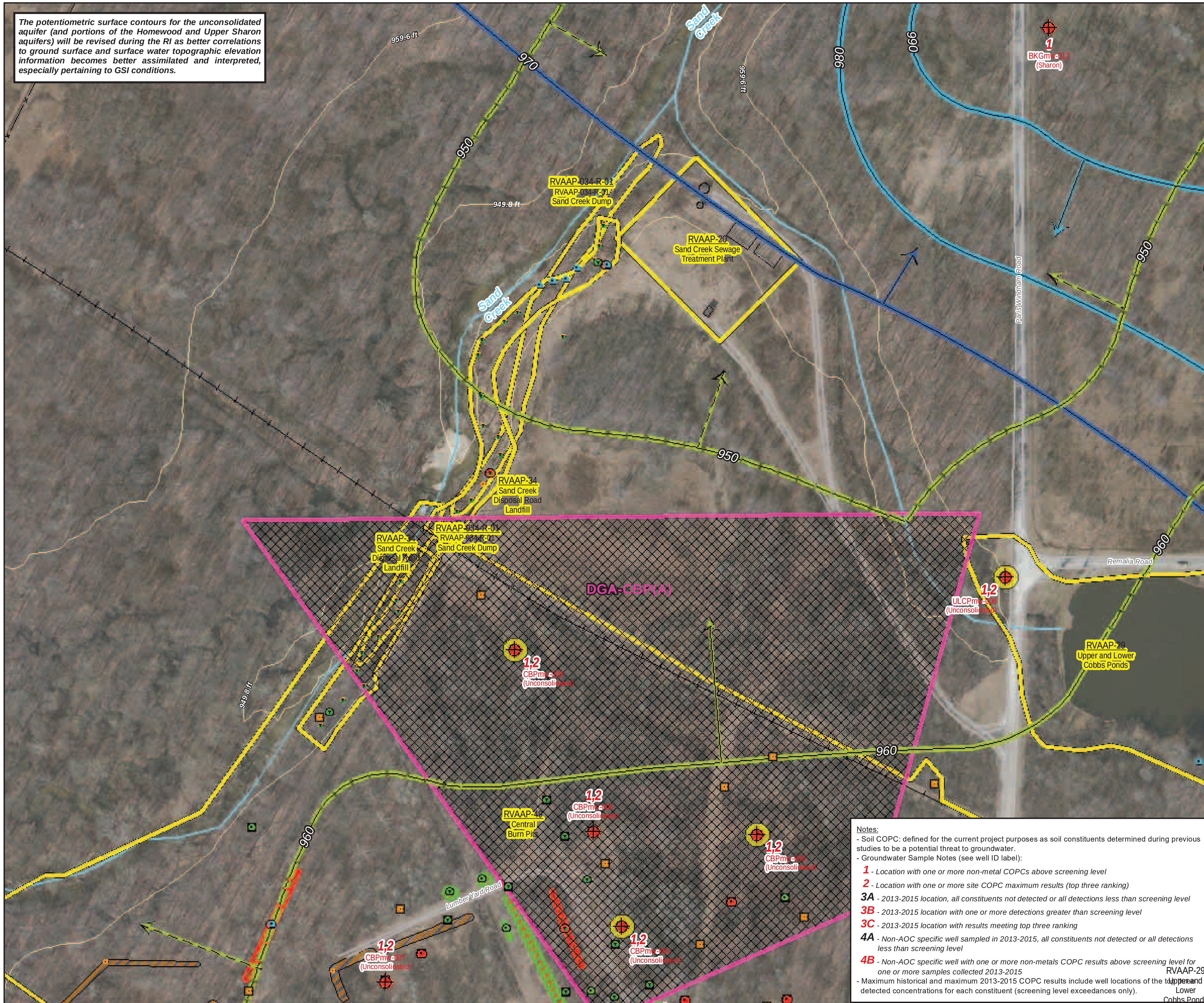
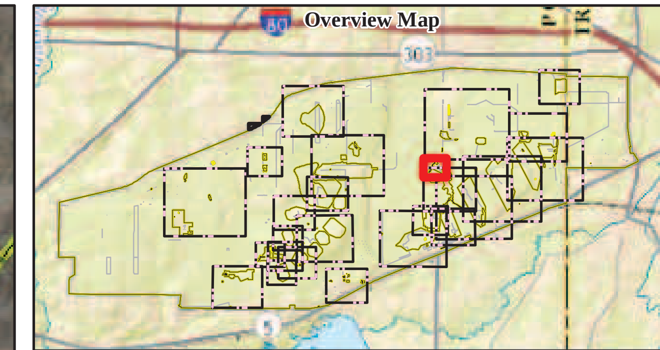


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N
0 100 200 300 400 Feet
1 " = 200 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP 34/RVAAP 34-R
(SAND CREEK DISPOSAL AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-9
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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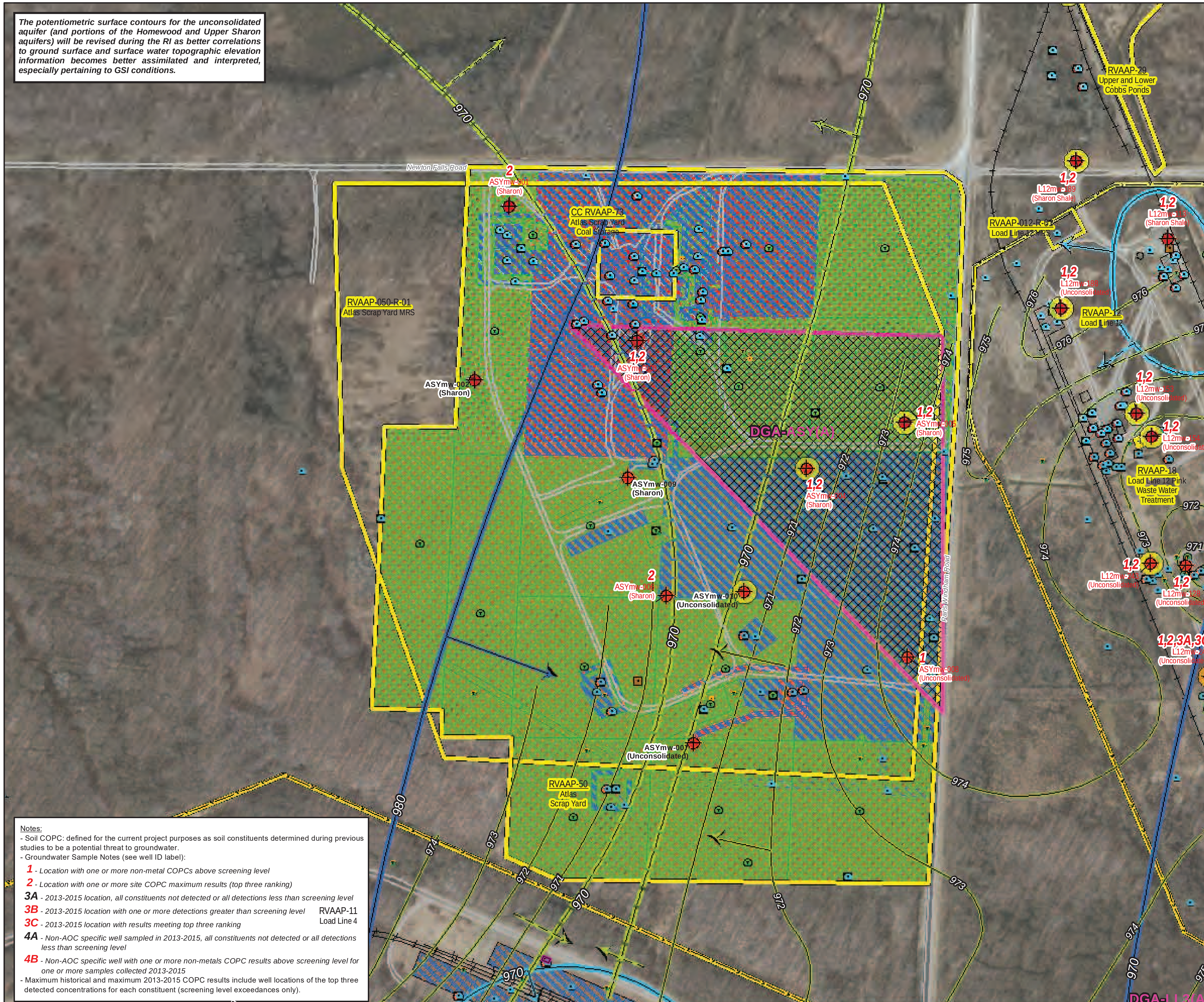
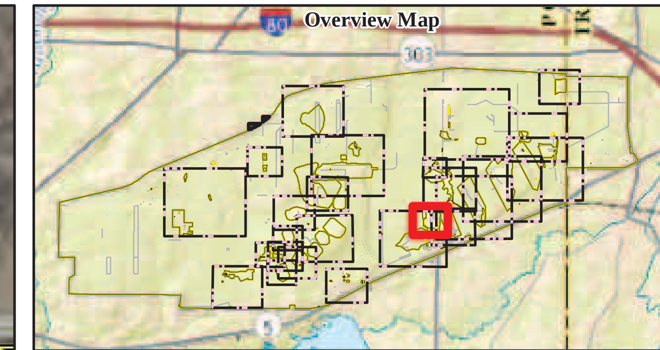


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
1 - Location with one or more non-metal COPCs above screening level
2 - Location with one or more site COPC maximum results (top three ranking)
3A - 2013-2015 location, all constituents not detected or all detections less than screening level
3B - 2013-2015 location with one or more detections greater than screening level
3C - 2013-2015 location with results meeting top three ranking
4A - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
4B - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings

N
0 150 300 450 600 Feet
1 " = 300 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-50 AND RVAAP-050-R-01 (ATLAS SCRAP YARD AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-10
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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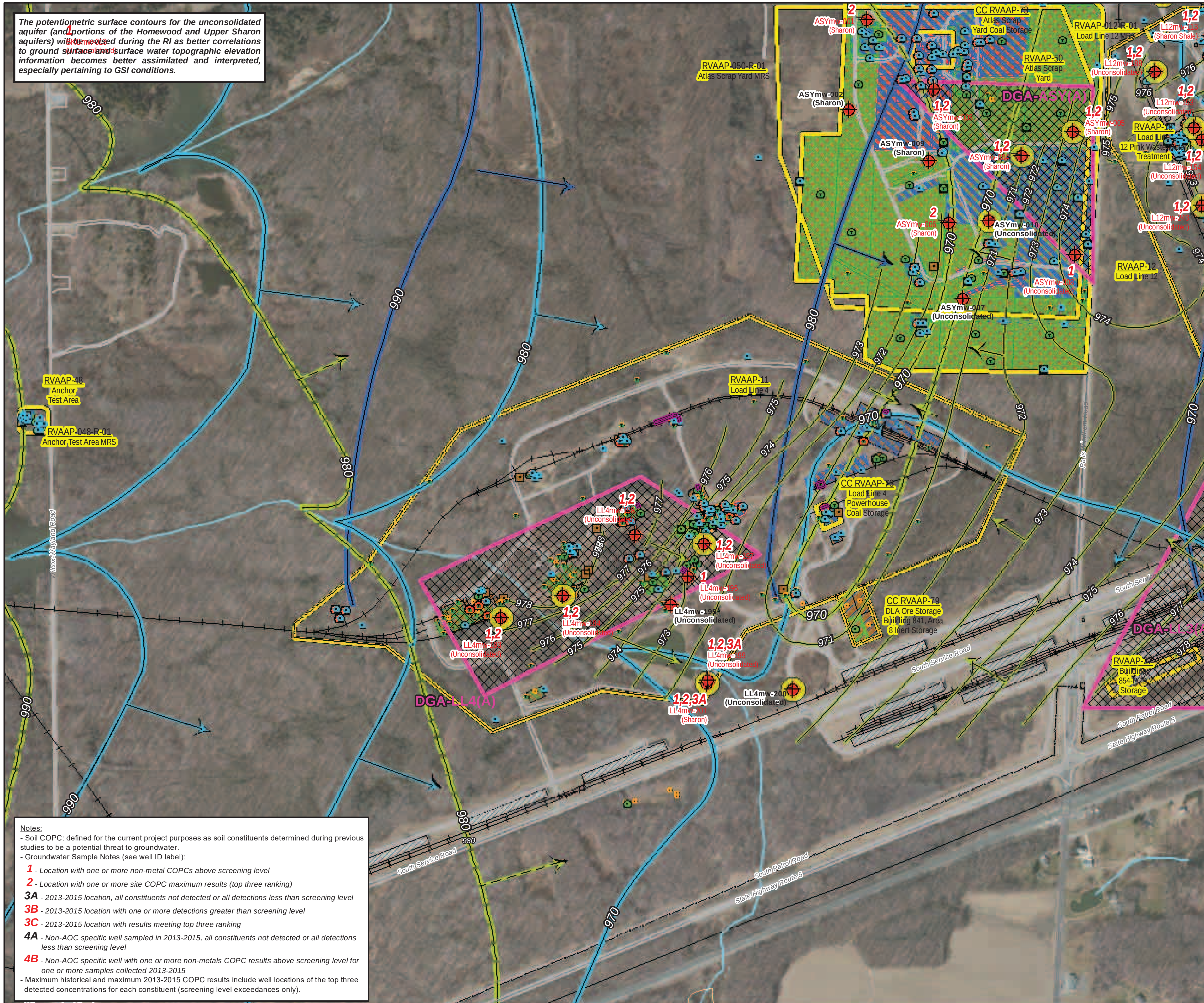

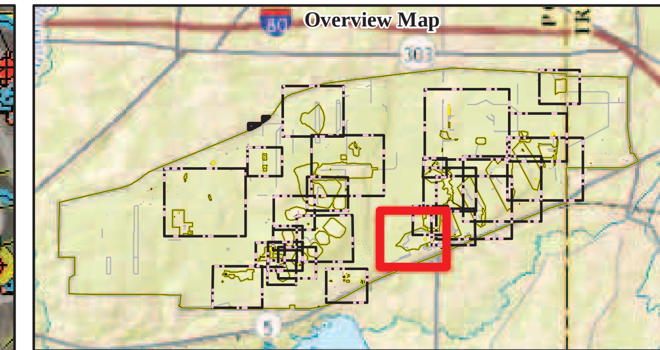

- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 290 580 870 1,160 Feet

1 " = 575 ft

NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-11 WITH RVAAP-27, RVAAP-48, AND RVAAP-048-R-01 - (LOAD LINE 4 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater

Former Ravenna Army Ammunition Plant

Ravenna, Ohio

Figure: C-11

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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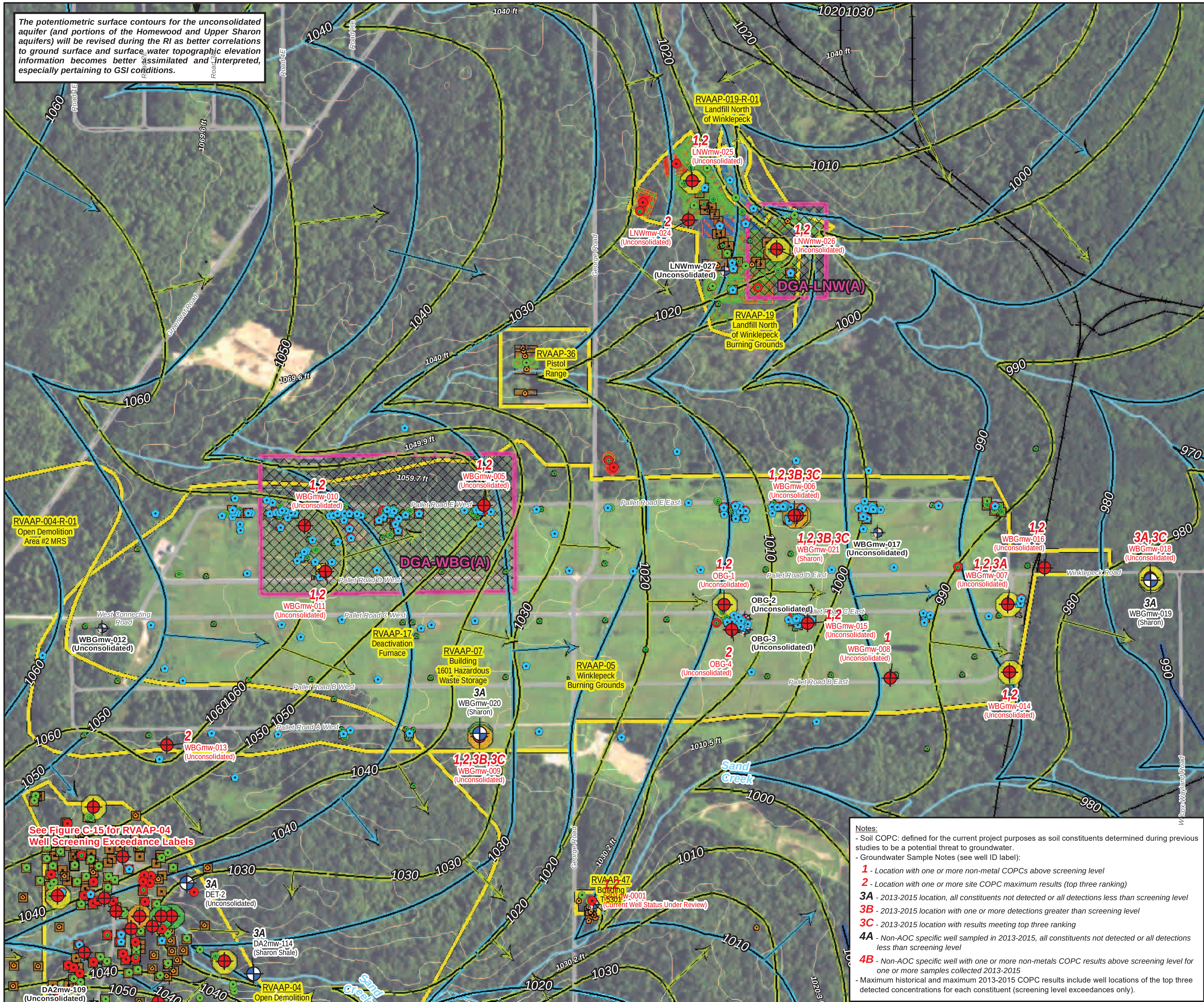
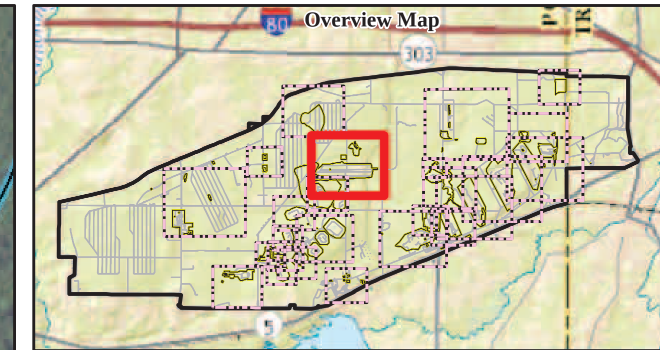


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 310 620 930 1,240 Feet

1 " = 625 ft

NAD83 UTM Zone 17N

Cardno TEC WESTON

TEC-Weston Joint Venture

RVAAP-05 AND RVAAP-19 (WINKLEPECK BURNING GROUNDS AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-12

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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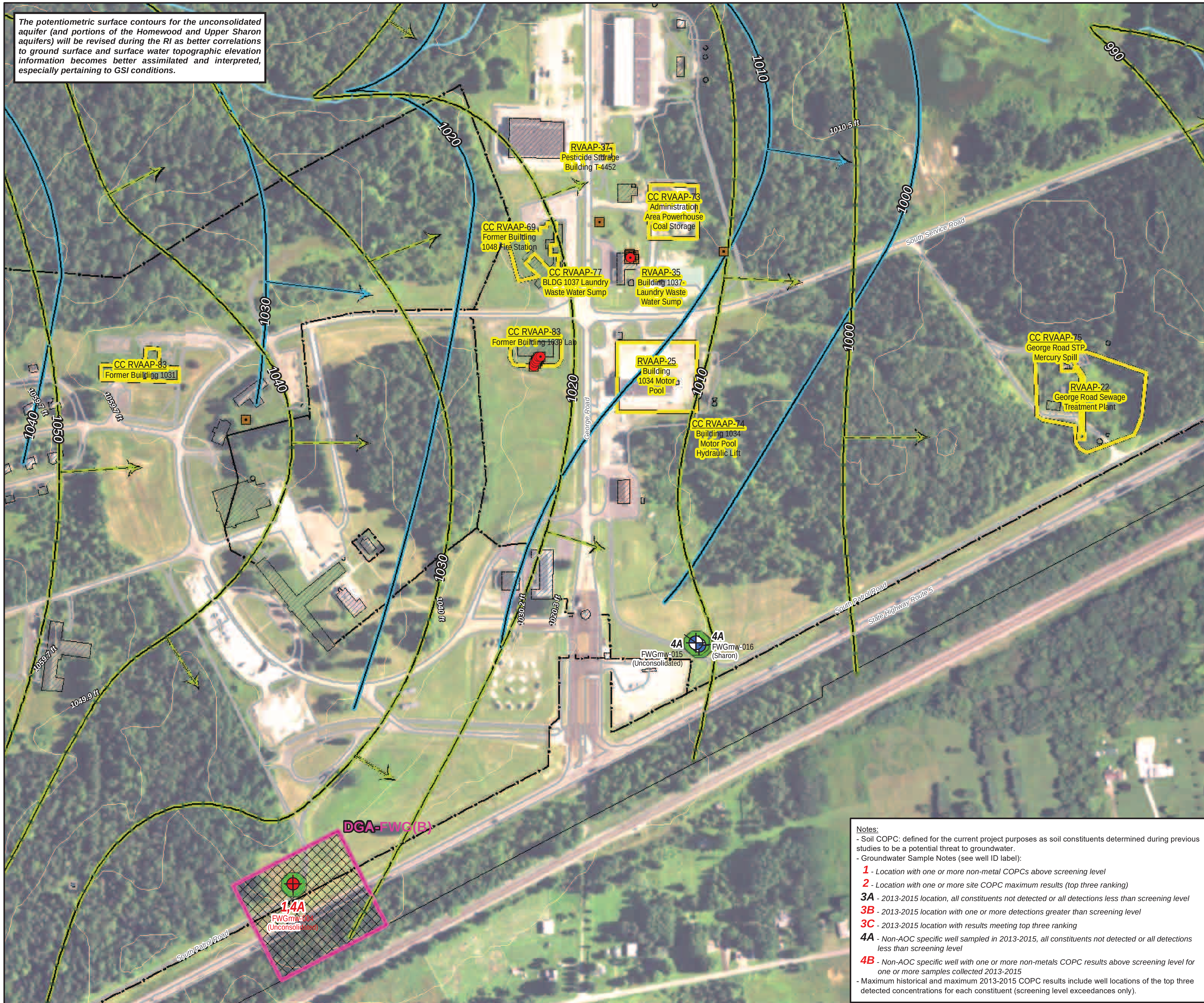
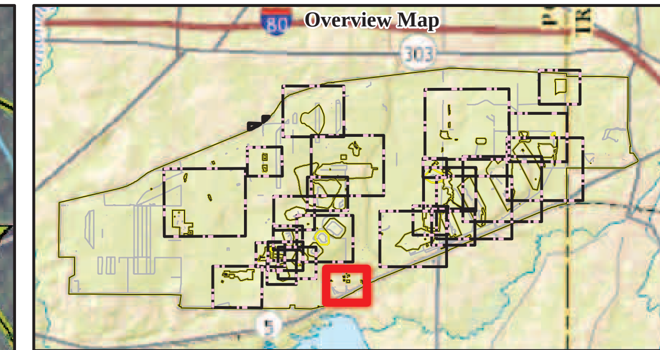


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 175 350 525 700 Feet

1 " = 350 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

MOTOR POOL AREA
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-13

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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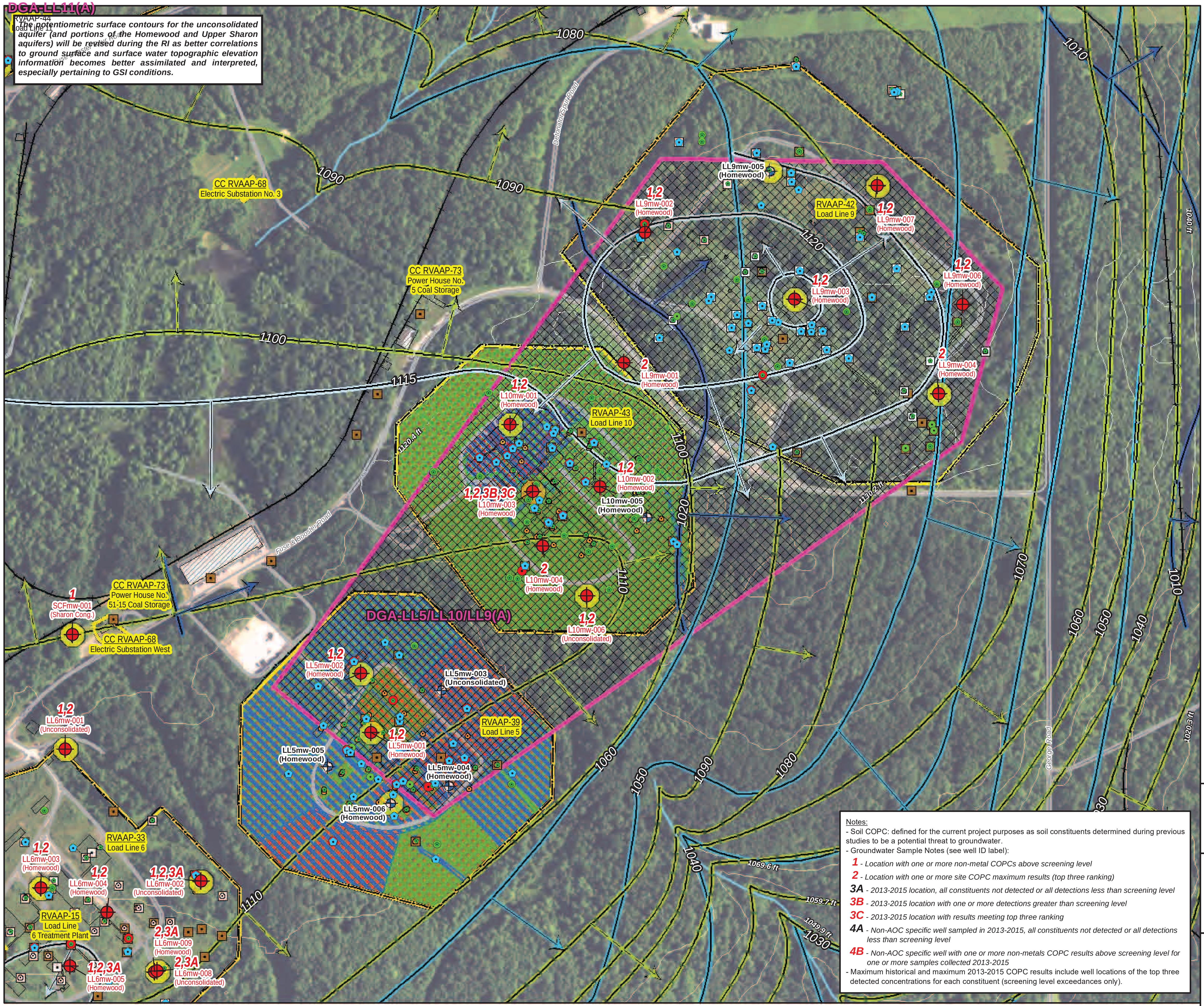
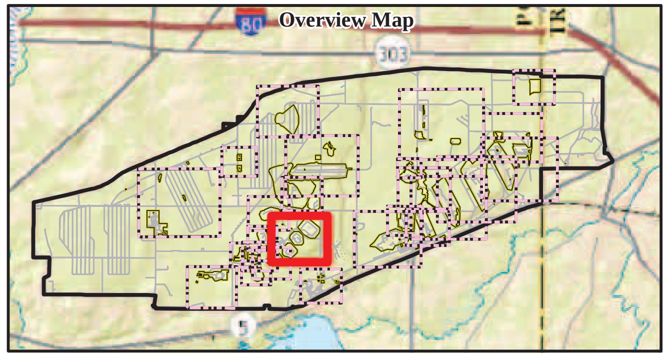


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 240 480 720 960 Feet

1 " = 481 ft
NAD83 UTM Zone 17N

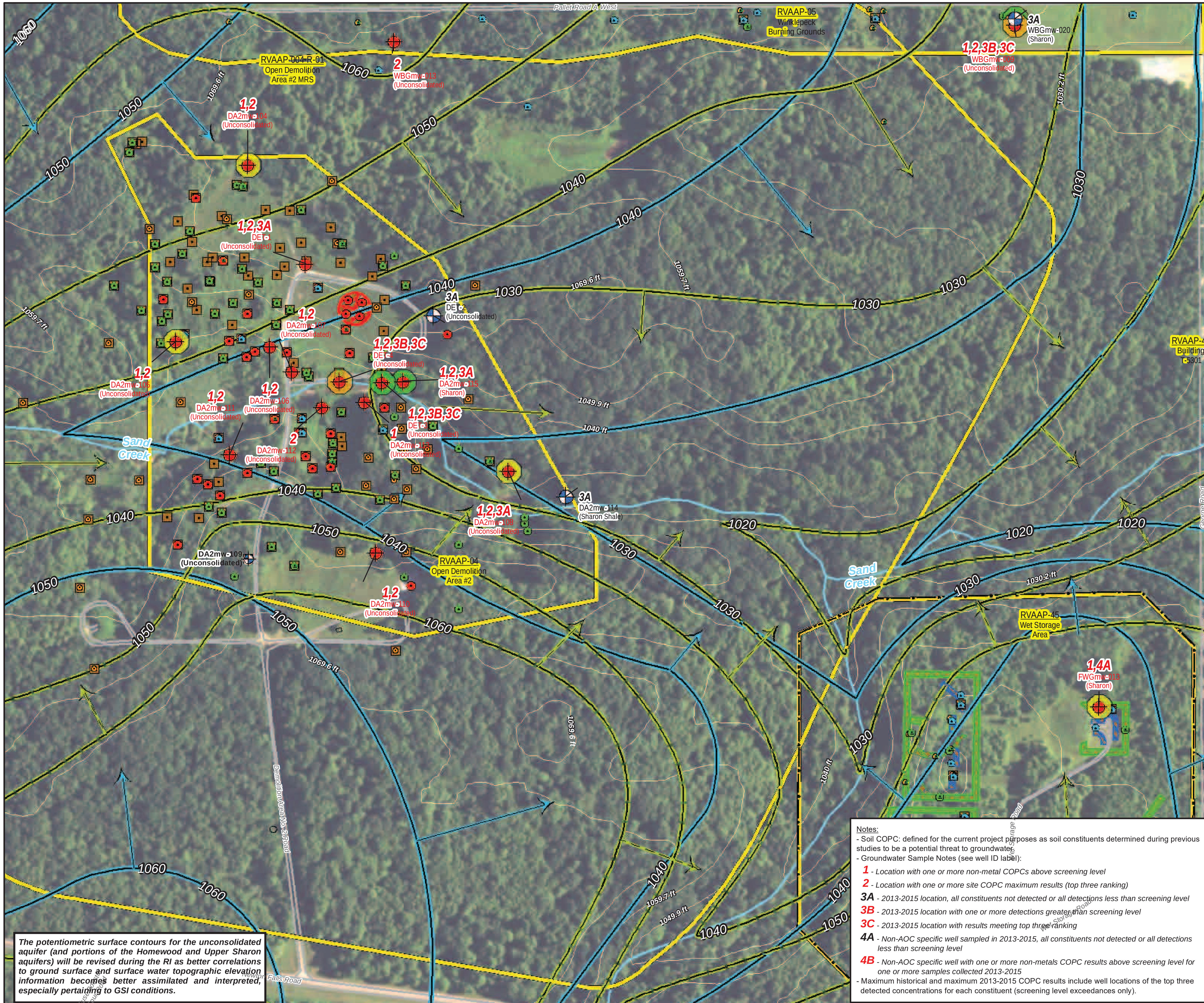
Cardno TEC | WESTON
TEC-Weston Joint Venture

RVAAP-39, RVAAP-42, AND RVAAP-43 (LOAD LINES 5, 9, AND 10 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-14

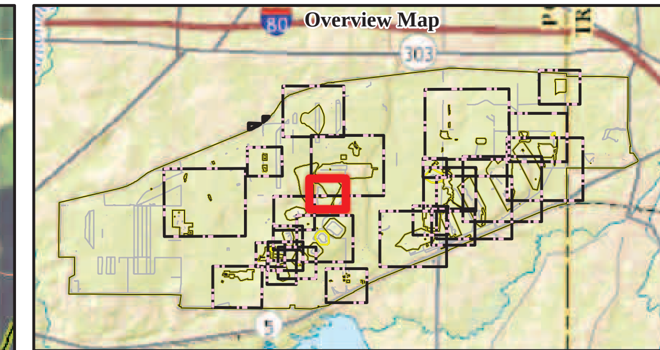
PRELIMINARY DRAFT FOR DISCUSSION ONLY

Path: I:\GIS Project Files\15363_Cardno Weston Services\Ravenna\GIS\MXDs\Work_Plans\RI_WP_FINAL\Appendix_C_AOC_Eval_v20160603.mxd, 6/15/2016 6:29:05 PM, wilderj



The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 160 320 480 640 Feet

1 " = 315 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-04 WITH RVAAP-004-R-01, RVAAP-45, AND RVAAP-47 (OPEN DEMOLITION AREA #2)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-15

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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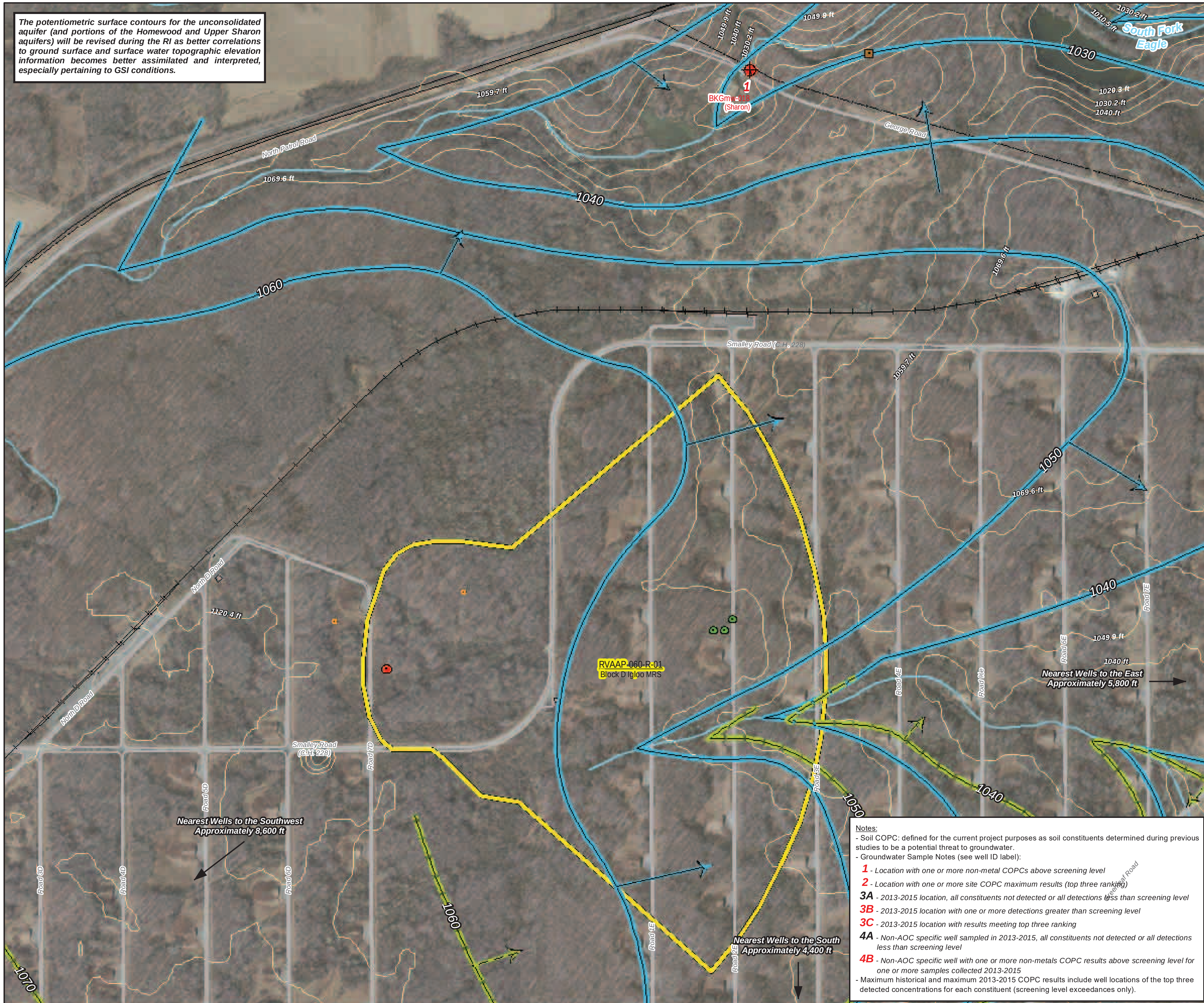
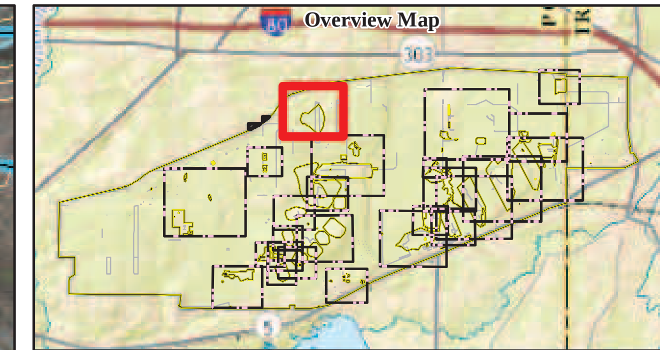
The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 260 520 780 1,040 Feet

1 " = 525 ft
NAD83 UTM Zone 17N

Cardno TEC | WESTON
TEC-Weston Joint Venture

RVAAP-060-R-01
(BLOCK D IGLOO MRS)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-16

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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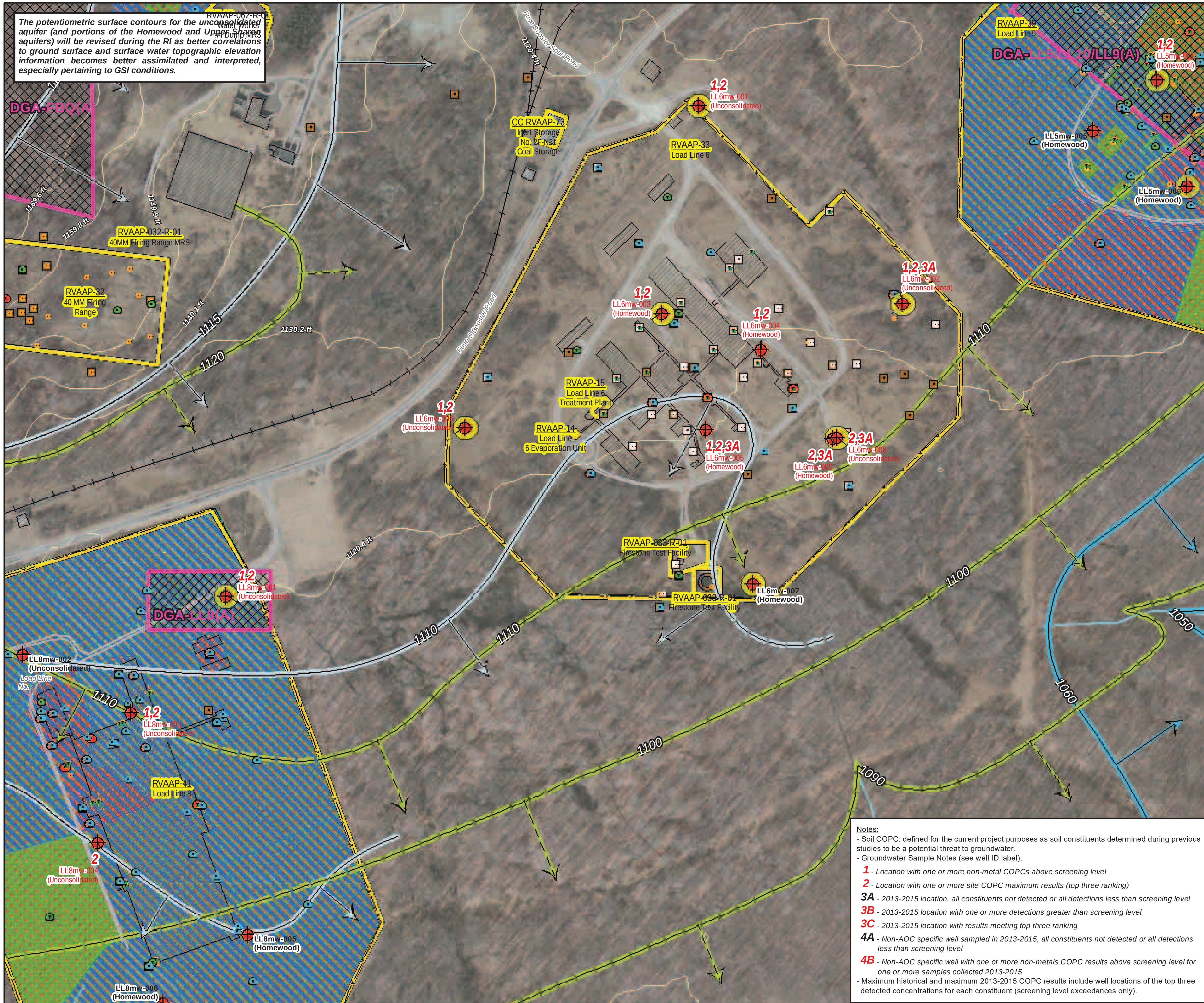
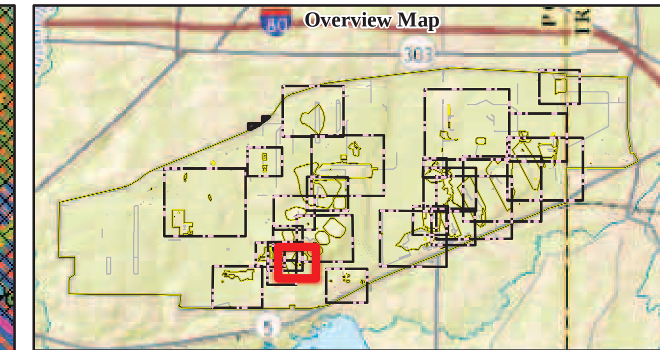


Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 160 320 480 640 Feet

1 " = 325 ft
NAD83 UTM Zone 17N

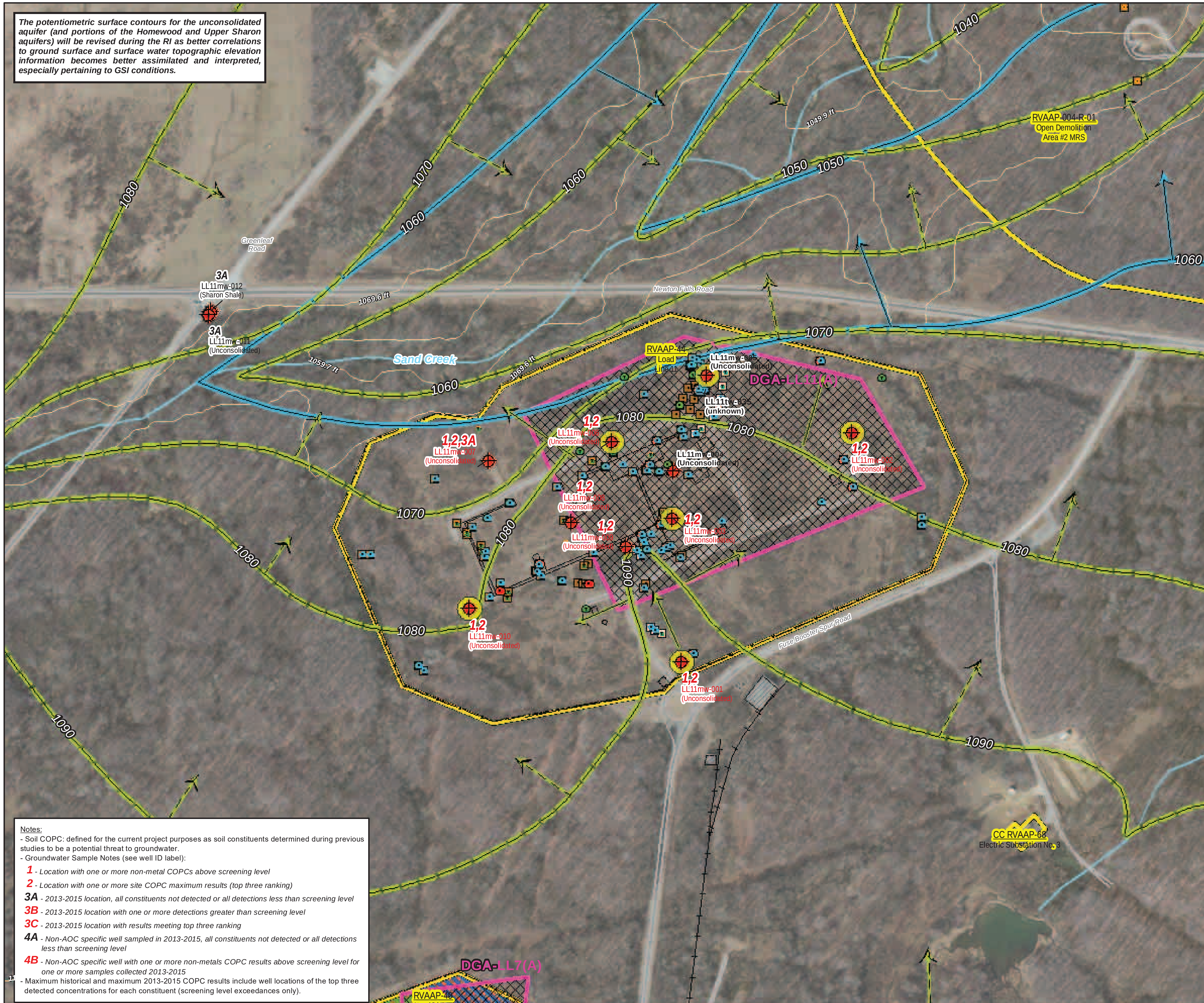
TEC-Weston Joint Venture

RVAAP-33 WITH RVAAP-14, RVAAP-15, AND RVAAP-033-R-01 - (LOAD LINE 6 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

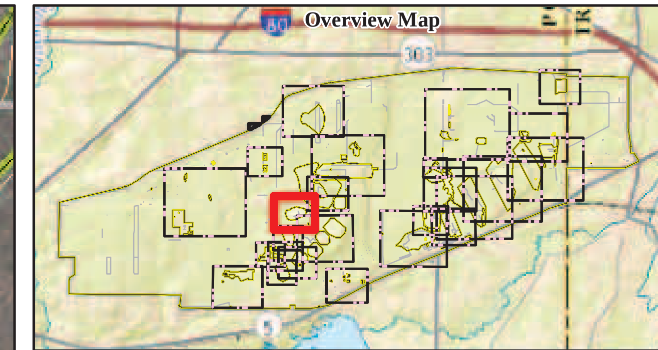
Figure: C-17
PRELIMINARY DRAFT FOR DISCUSSION ONLY

Path: I:\GIS Project Files\15363_Cardno Weston Services\Ravenna\GIS\MXDs\Work_Plans\RI_WP_FINAL\Appendix_C_AOC_Eval_v20160603.mxd, 6/13/2016 1:01:34 PM, wilderj

The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Temporary Well Location
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 175 350 525 700 Feet

1 " = 350 ft

NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-44
(LOAD LINE 11 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-18

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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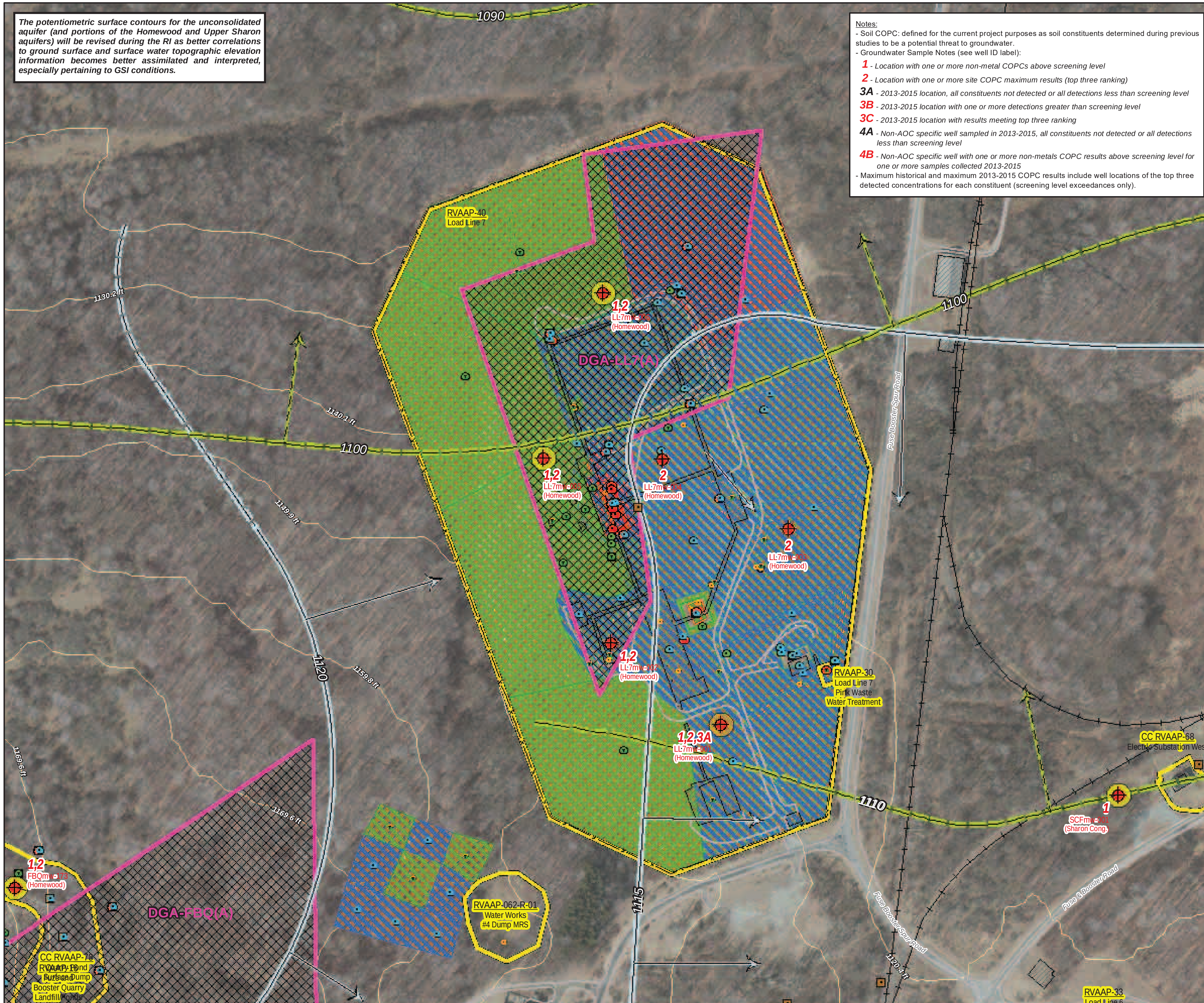
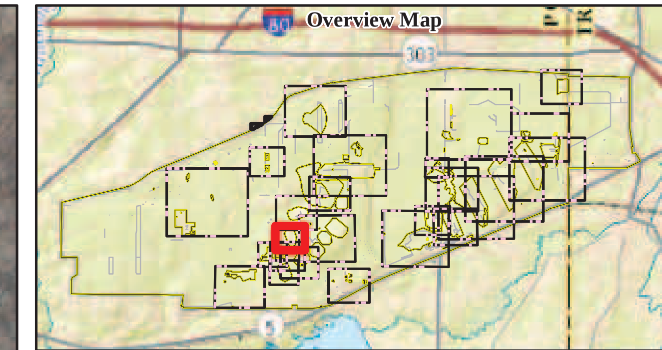
The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Elevation Contour Line (0.5m from USDA)

N

0 125 250 375 500 Feet

1 " = 250 ft
NAD83 UTM Zone 17N

Cardno TEC | WESTON SOLUTIONS
TEC-Weston Joint Venture

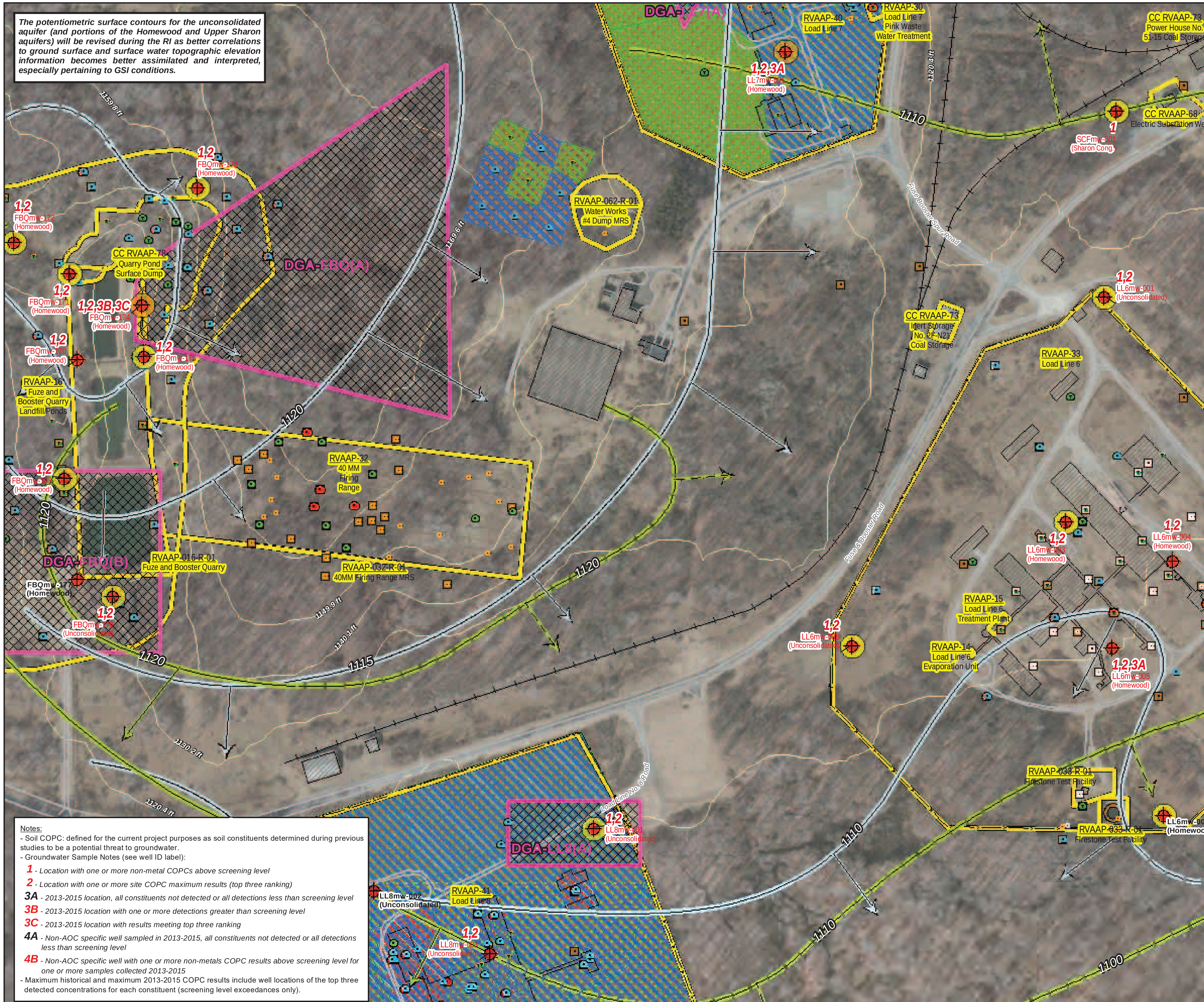
RVAAP-40 WITH RVAAP-30 & RVAAP-062-R-01 (LOAD LINE 7 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

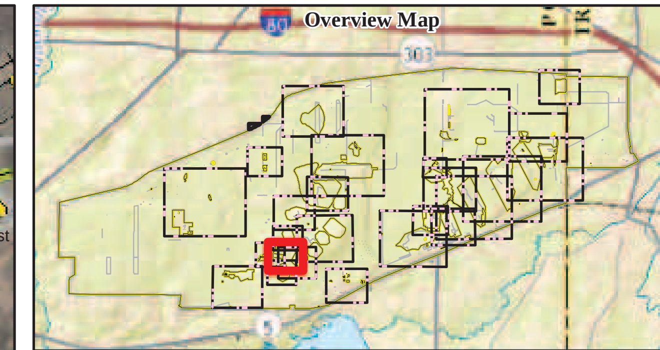
Figure: C-19

PRELIMINARY DRAFT FOR DISCUSSION ONLY

Path: I:\GIS Project Files\15363_Cardno Weston Services\Ravenna\GIS\MXDs\Work_Plans\RI_WP_FINAL\Appendix_C_AOC_Eval_v20160603.mxd, 6/13/2016 1:06:04 PM, wilderj



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - Location with one or more non-metal COPCs above screening level
  - **2** - Location with one or more site COPC maximum results (top three ranking)
  - **3A** - 2013-2015 location, all constituents not detected or all detections less than screening level
  - **3B** - 2013-2015 location with one or more detections greater than screening level
  - **3C** - 2013-2015 location with results meeting top three ranking
  - **4A** - Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level
  - **4B** - Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Elevation Contour Line (0.5m from USDA)

N
0 150 300 450 600 Feet
1 " = 300 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-32 AND RVAAP-062-R-01 (40MM FIRING RANGE AND WATER WORKS)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-20
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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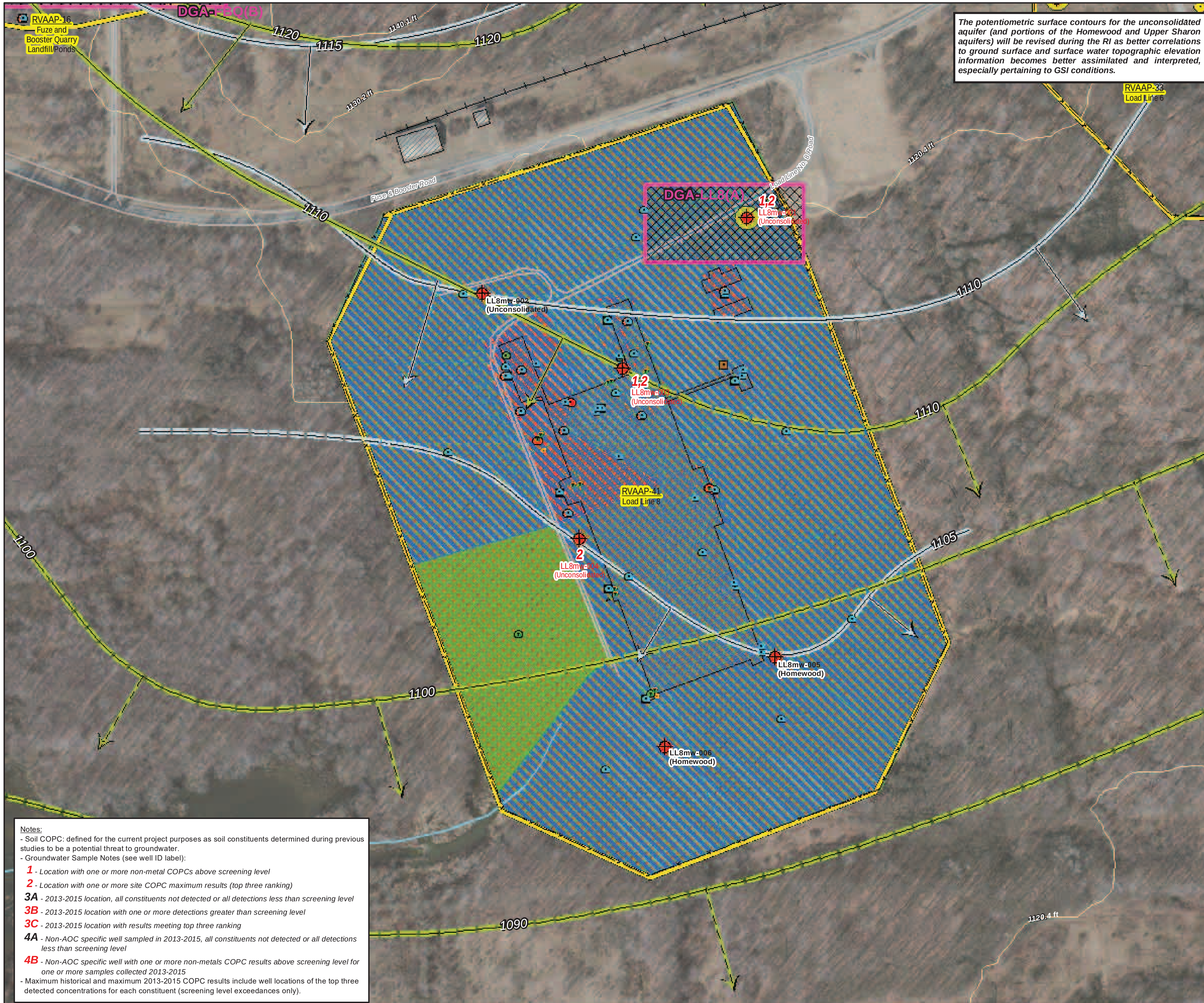
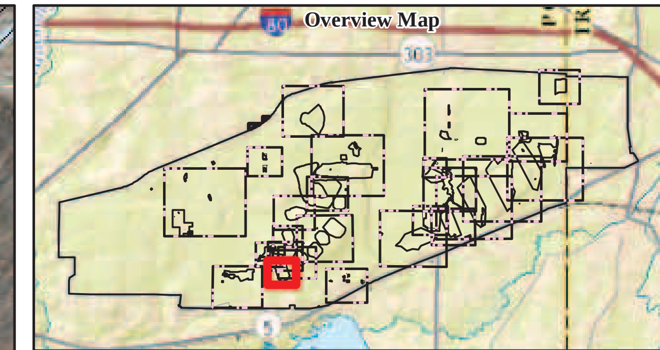


The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

<u>Notes:</u>

- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 125 250 375 500 Feet

1 " = 250 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-41
(LOAD LINE 8 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-21

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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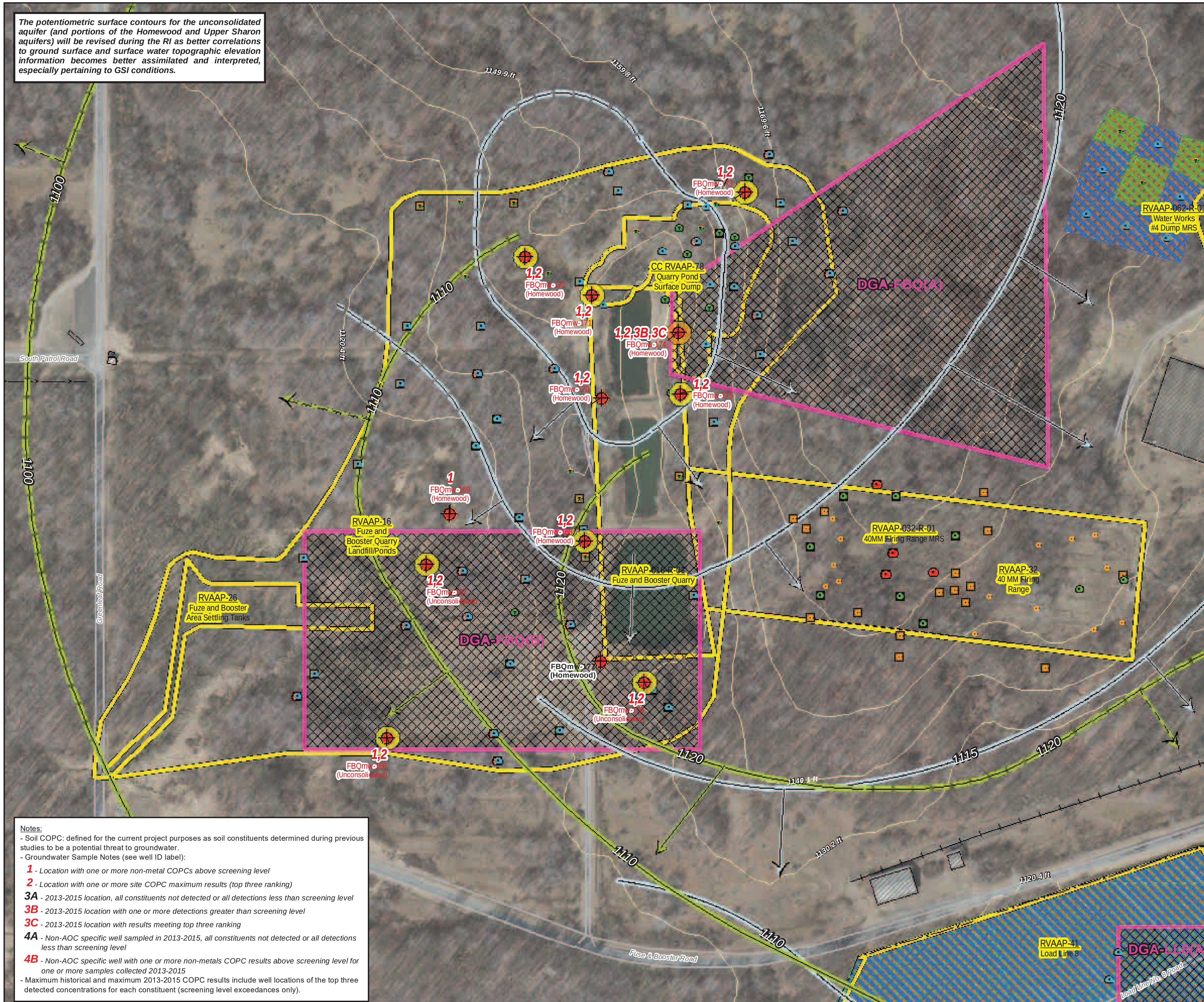

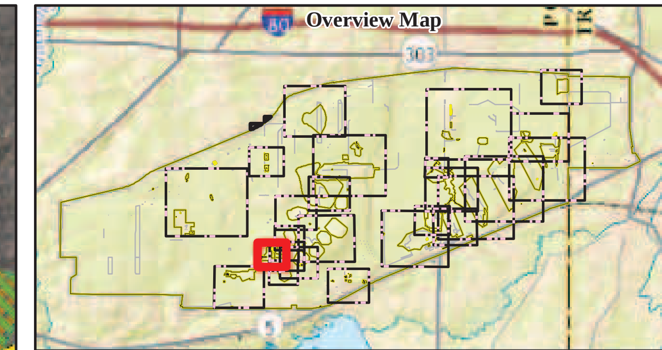

- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Elevation Contour Line (0.5m from USDA)

N

0 125 250 375 500 Feet

1 " = 250 ft

NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-16 WITH RVAAP-26, RVAAP-32, AND CC-RVAAP-78 (FUZE & BOOSTER QUARRY)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater

Former Ravenna Army Ammunition Plant

Ravenna, Ohio

Figure: C-22

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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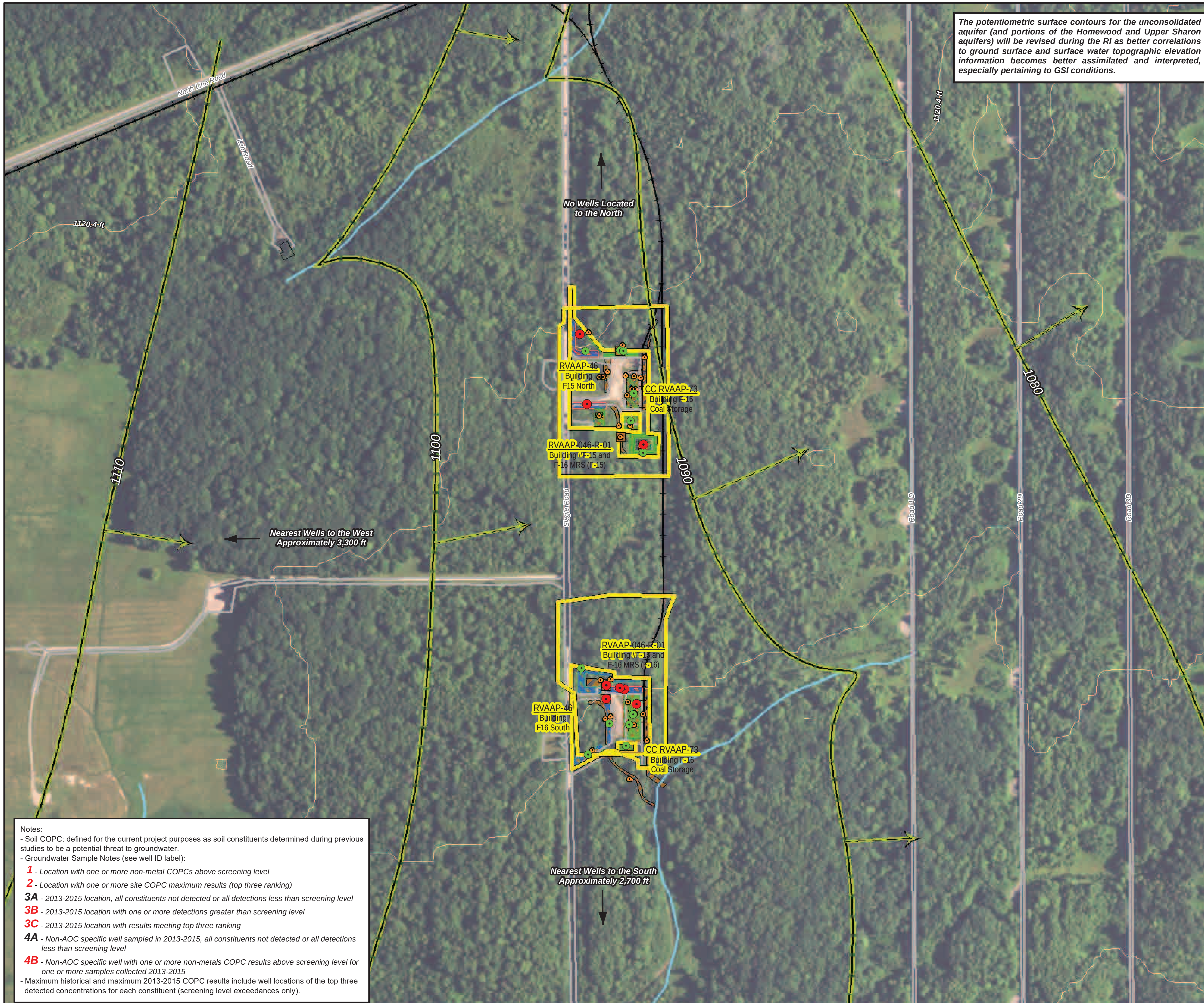

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

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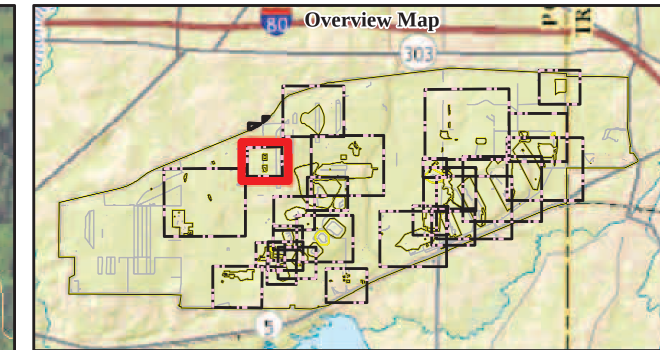


- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 200 400 600 800 Feet

1 " = 400 ft
NAD83 UTM Zone 17N

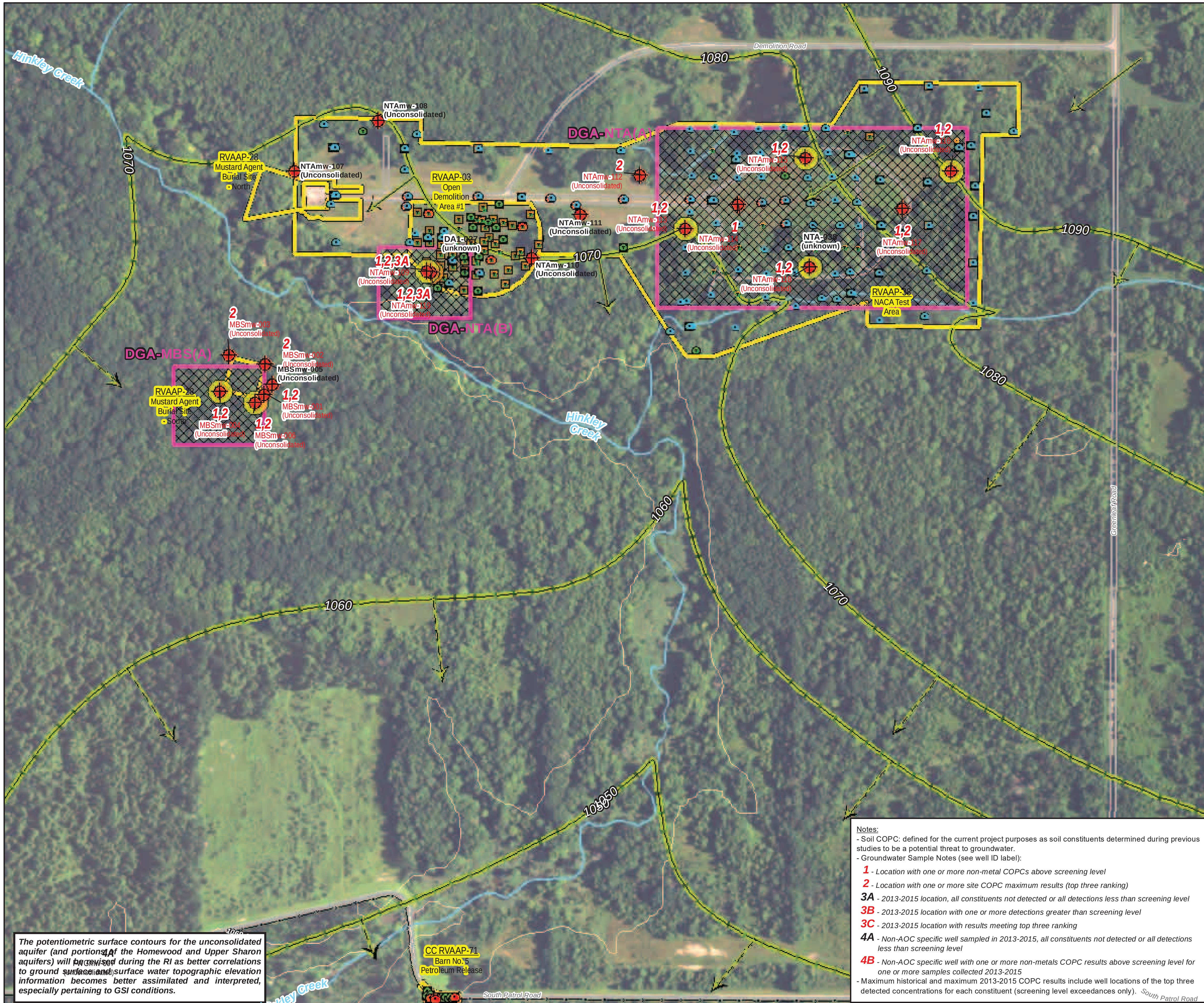
Cardno TEC WESTON SOLUTIONS
TEC-Weston Joint Venture

RVAAP-46 WITH RVAAP-046-R-01 (BUILDINGS F15 AND F16 AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

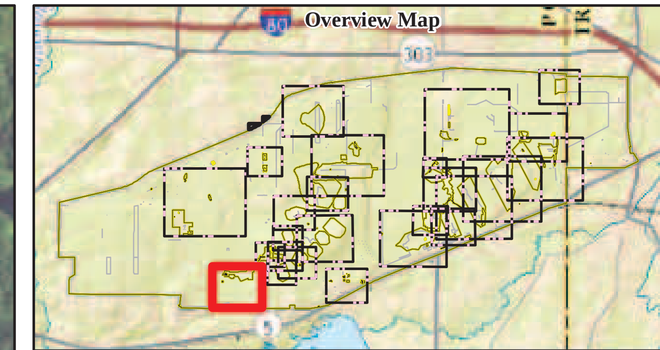
Figure: C-23

PRELIMINARY DRAFT FOR DISCUSSION ONLY



The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Temporary Well Location
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 210 420 630 840 Feet

1 " = 425 ft

NAD83 UTM Zone 17N

Cardno TEC | WESTON SOLUTIONS

TEC-Weston Joint Venture

RVAAP-28, RVAAP-38, RVAAP-03 AND CC RVAAP-71

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-24

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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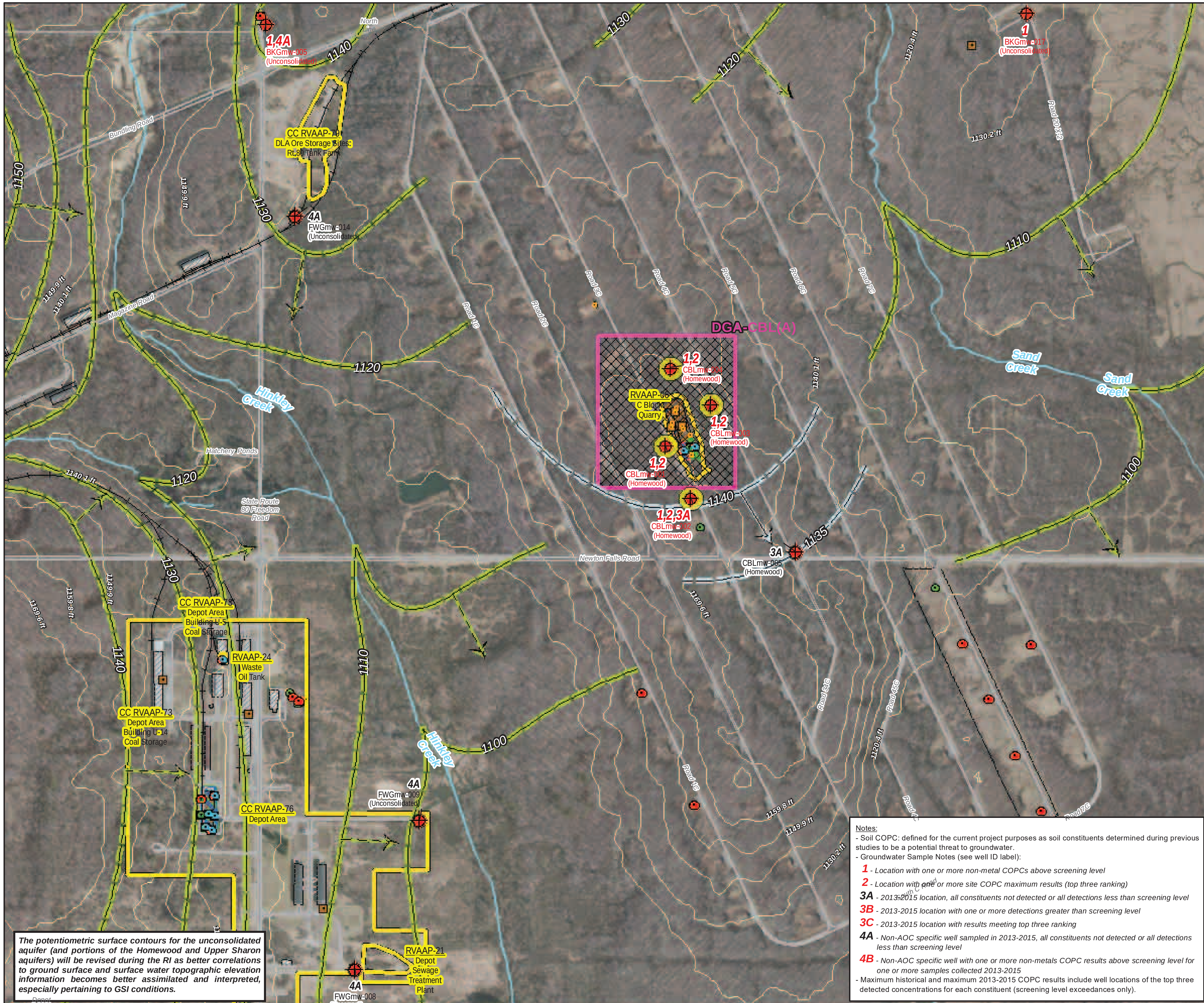

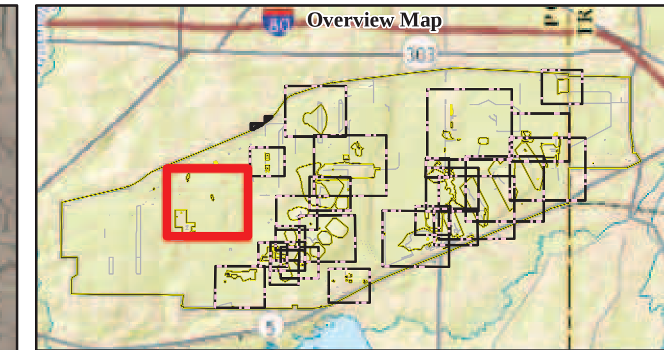

- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Location with Groundwater COPCs Detected Greater than the Mean
- ISM Location with detected Groundwater COPC
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed FWGWMP Well Location
- Proposed RI Well Location
- Proposed RI and FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed) * Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Homewood and Mercer (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

N

0 350 700 1,050 1,400 Feet

1 " = 700 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

RVAAP-06 WITH RVAAP-24, CC RVAAP-76 & CC RVAAP-79 - (C BLOCK QUARRY AREA)

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-25

PRELIMINARY DRAFT FOR DISCUSSION ONLY

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NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

16 September 2016

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Kevin Palombo
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Response to Comments - Draft Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater, and Semiannual Facility-Wide Groundwater Monitoring Addendum for 2016
Camp Ravenna, Portage and Trumbull Counties, Ohio
Ohio EPA ID # 267-000859-036
Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Dear Mr. Kevin Palombo:

The Army National Guard is pleased to submit the enclosed the Response to Comments on the Draft Remedial Investigation Work Plan (RIWP) for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater for your review. This deliverable is in response to Ohio EPA comments dated 31 August, 2016. This deliverable consists of one hardcopy and one electronic copy containing a single pdf of the submission.

Please contact the undersigned at 703-607-7955 or mark.s.leeper.civ@mail.mil if you would like to discuss this submission.

Sincerely,

Mark Leeper, P.G., MBA
RVAAP Restoration Program Manager
Army National Guard Directorate

CC:
Rod Beals, Ohio EPA, DERR-NEDO
Al Muller, Ohio EPA, DERR-NEDO
Bob Princic, Ohio EPA, DERR-NEDO
Kevin Sedlak, ARNG, Camp Ravenna
Katie Tait, OHARNG, Camp Ravenna
Gail Harris, Vista Sciences Corporation
Brent Ferry, JV Project Manager

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Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
N/A	N/A	N/A	Based on discussion with Ohio EPA representatives during an on-site meeting/teleconference at Camp Ravenna on September 14, 2016, the locations of all Ohio EPA approved new groundwater monitoring wells will be provided on the AOC-specific maps in Appendix C of the Final Facility-Wide Groundwater Remedial Investigation (RI) Work Plan (in addition to their inclusion on Figures 3-1 through 3-3). Maps provided for interim Ohio EPA review of well locations with this RTC are not intended for submittal with the Final RI Work Plan.
1	General	The NGB has not adequately addressed Ohio EPA's General Comment 1. Ohio EPA understood from numerous meetings with the NGB and the U.S. Army Corps of Engineers (USACE) that evaluation of ground water would be conducted at all applicable areas of concern (AOCs). Ohio EPA's General Comment 1 asked for assurance from the NGB that those areas identified (e.g., leaching potential screening) in historical studies of specific AOCs as needing evaluation of ground water are included in the Facility-Wide Draft RI Work Plan. A review of Appendix C, entitled "AOC-Specific Evaluation" provides a Status Summary Table. It was noted that the Status Summary Table identifies several sites (AOCs/MRS/CRS) where ground water needs or may need additional evaluation, while other AOCs (i.e., the Fire Station, Motor Pool Area, and Classification Yard) are not addressed by the Facility-Wide Draft RI Work Plan. Also, the submitted draft RI Work Plan identifies 24 Data Gap Areas. However, for some of these sites and/or data gap areas, additional monitoring wells are proposed, while in others, no additional data collection (new wells or borings) or insufficient sampling of existing wells are proposed (see Ground Water Specific Comment 6). While the NGB response provides a better explanation of their rationale for when new wells are to be installed and/or when	Additional proposed assessment activities and clarification text regarding the investigation of AOC-specific groundwater have been provided in responses to Ground Water Specific Comments No. 6 and 12. See response to General Comment No. 7 regarding planned groundwater investigation activities at the Fire Station, Motor Pool Area and Classification Yard. Regarding ODA1, ARNG will install a single temporary groundwater monitoring well to characterize potential impact to groundwater from 2,4,6-dinitrotoluene (2,4,6-DNT) identified at soil sample DA1SB-070. Due to the active firing range status of ODA1, the temporary well will be installed outside of the southern AOC boundary edge, in the downgradient direction towards Hinkley Creek (the well location is provided on AOC specific map C-24, attached). See response to Specific Ground Water Comment No. 10 below for details on temporary well installation methods. Table 1-3 of the Final RI Work plan will be updated to indicate the identified leaching potential to groundwater from 2,4,6-DNT. Table 2-1 will be revised to include the temporary well point installation and concurrent gauging of monitoring wells NTAmw-109, -110 and -119 to determine the localized direction of groundwater flow in the Unconsolidated Aquifer. Table 3-1 will also be updated to capture the temporary well installation and sampling for

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
		additional data is to be collected from existing wells by the text added to Section 1.8.6, in the additional information provided in Tables 1-3 and 2-1, many data gaps still appear to not be appropriately addressed in the Draft RI Work Plan (Refer to Ground Water Specific Comments 6 and 12). Also; NGB has not explained how it will assure that ground water Data Gaps identified by other contractors and under other contracts will get incorporated into the RI Work Plan. It is Ohio EPA's understanding that the NGB is planning separate Draft RI Work Plans for the Fire Station (Building 1048), Classification Yard, and Motor Pool Area under separate contracts and contractors from the Facility-Wide Draft RI Work Plan. It is not clear why investigations of ground water beneath the three aforementioned AOCs are being conducted outside the Facility-Wide Draft RI Work Plan, and this needs to be explained. The NGB needs to explain how ground water data gaps identified in separate RIs by other contractors under other contracts are to be incorporated into the Facility-Wide Draft RI Work Plan. The RI Investigation for RVAAP-003-Open Demolition Area 1 (ODA 1) identified potential for leaching of explosives (2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene) and eight metals (antimony, barium, cadmium, chromium, cobalt, copper, selenium, and thallium). Ground water beneath ODA 1 represents a Data Gap. The submitted Draft RI Work Plan does not address ground water beneath ODA 1, and Ohio EPA believes that this needs to be addressed.	explosives. ARNG does not consider the other isolated and low-level detections of site-related compounds (SRCs) in soil at ODA1 to present a leaching hazard to groundwater.
2	General	The NGB has not adequately addressed Ohio EPA's General Comment 2 asking for assurance that areas such as RVAAP-38 NACA Test Area, RVMP-03 ODA 1, RVAAP-05 Winklepeck Burning Grounds, RVAAP-002 Erie Burning Grounds, RVAAP-01 Ramsdell Quarry and others will be evaluated to determine if perfluorochemical (PFC)	Perfluorinated compounds (PFCs) are synthetic materials used by the DoD and others to extinguish petroleum fires since the 1970s. These types of foams were not abundant until the 1970's when they were readily available on a commercial and industrial basis (source: Interim United Stater Air Force Guidance on Sampling and Response

		containing firefighting foams have impacted ground water or evidence will be provided that will eliminate the need for such evaluation. The NGB's response incorrectly states that PFCs were not used in fire-fighting products prior to 1970 (no citation given). According to the U.S. EPA (2013), PFCs have been manufactured since the 1960's. According to McGuinness (2016), citing the Department of Defense, the military began widespread use of PFCs in the 1960's. The NGB indicates that the use of RVAAAP-38 NACA Test Area pre-dated the use of PFCs in fire-fighting foams. Ohio EPA agrees that the use of the NACA Test area from 194 7 through 1953, predates the use of PFCs in fire-fighting foams in the 1960's. The NGB's response also indicates that the potential for PFCs in the vicinity of RVAAP-69 Building 1048 Fire Station will be investigated under separate contract/contractor from the Facility-Wide Draft RI Work Plan (See General Comment 1). The NGB's response states: *No other Camp Ravenna sites are suspected to have potentially been subject to the* use *of PFC containing fire-fighting products.* It is unclear why the NGB believes that PFC containing fire-fighting products were not used in areas such as: ODA 1, Winklepeck Burning Grounds, Erie Burning Grounds, and Ramsdell Quarry, and other areas at Camp Ravenna where fire-fighting may have occurred. Ohio EPA requests additional information to support the contention that PFC containing fire-fighting products were not used in the	Actions for Perflourinated Compounds at Active and BRAC Installations, August 2012). Information regarding the type of foam and fire extinguishing materials that were used at the NACA Test Area can be found in the Phase I RI for NACA Test Area at the Ravenna Army Ammunition Plant, Ravenna Ohio. SAIC, 2001. The NACA Test Area was used from 1947 to 1953 and 17 planes were tested. Because of the nature of available materials at the time and the high temperatures that result from the combustion of the plane engines, bromochloromethane was the fire-extinguishing agent that was used at the NACA Test Area (NACA, 1953). Fluorinated foams were not readily available in the late 1940's and 1950's for commercial use. Previously completed studies at the NACA site and throughout the facility have included the analysis of bromochloromethane as one of the volatiles routinely assessed in environmental media. Bromochloromethane was identified as a Potential Chemical of Concern (COPC) in the Phase I RI for the NACA site but was not identified as a Chemical of Concern (COC) for the Area of Concern (AOC). Since PFC-based foams were not used at the NACA as part of the former operations conducted there, these materials do not need to be assessed at NACA or adjacent ODA1 as part of future investigations. Multiple burning grounds were utilized on the facility to demilitarize munitions (Winklepeck Burning Grounds (WBG), Erie Burnings Grounds (EBG), Ramsdell Quarry Landfill (RQL)). There is no evidence of the use of fire suppressants in these areas. The historical operations of

		aforementioned areas. Also, in the NGB response, the RI report for NACA by SAIC, dated December 2001, was referenced. Ohio EPA noted that the RI stated that water and bromochloromethane were used on the 17 airplanes crashed. Include bromochloromethane in the analytes list if it is not already included.	these areas will be further described through the incorporation of the following text into the Table 1-3 CSM descriptions for the referenced AOCs: **Winkelpeck Burning Grounds** *Historical operations at WBG included destruction of explosives from various types of munitions by open burning. Historical activities at WBG also included destruction of bulk explosives, propellants, and explosive-contaminated combustible material using open burning. In some instances, black powder and explosives were laid out along roads and burned.* *Prior to 1980, materials destroyed by burning included bulk explosives and explosives-contaminated burnable wastes, propellants, black powder, sludge and sawdust from load lines, and domestic wastes. After 1980, burns were conducted in two metal refractory lined trays set on top of a bed of slag.* *These trays were located at Pad 37. Ash residues were drummed and stored in Building 1601 until being tested for proper disposal. Burning at this location ceased in the early 1990's and this area was closed under RCRA in 1999. It was common practice for munitions and wastes to be set on fire and allowed to burn overnight. No history of the use of fire suppressants has been identified.* **Erie Burning Grounds** *EBG was in operation from 1941 to 1951. The site was used to conduct open burning of explosives and related materials. Bulk, obsolete, non-specification explosives, as well as propellants, rags, and Army railcars used for transporting explosives, were treated at EBG. Aerial photos*

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
			of the site from the 1940s and 1950s depict open boxcars staged at the end of the rail spur, known as Track 49. Presumably, materials were either tipped out of the cars on either side of the embankment to be burned, were set on fire and then allowed to burn. No history of the use of fire suppressants has been identified. **Ramsdell Quarry Landfill** *RQL was initially a stone quarry that operated until 1941. During operations, the quarry was excavated 30 to 40 ft below existing grade. The excavated sandstone and quartzite pebble conglomerate was used for road and construction ballast. From 1946 to the 1950s, the bottom of the quarry was used to burn waste explosives from Load Line 1. Munitions were set on fire and allowed to burn. No history of the use of fire suppressants has been identified.* *Although bromocloromethane has not been identified as a site COC, Table 3-1 has been revised so that sampling for VOCs (including bromochloromethane) will be conducted for all NACA Test Area wells planned for characterization during the RI.*
3	General	The NGB has adequately responded to Ohio EPA's General Comment 3.	Comment noted.
4	General	The NGB has adequately responded to Ohio EPA's General Comment 4.	Comment noted.
5	General	The NGB has adequately responded to Ohio EPA's General Comment 5.	Comment noted.
6	General	The NGB has adequately responded to Ohio EPA's General Comment 6.	Comment noted.
7	General	The NGB's response to Ohio EPA's General Comment 7 requires additional clarification. In Ohio EPA's General Comment 7, the NGB was asked to clarify why it was	Federal funds for executing environmental assessment activities must be appropriated under a demonstrated need for a specific site. The investigation status for the Motor Pool Area at the time

		planning a ground water investigation (including the installation of new monitoring wells in the Unconsolidated Aquifer) during 2016 of the Motor Pool Area outside of the *Facility-Wide Draft RI Work Plan.* The NGB's response indicates that impacted wells installed in the Motor Pool Area (Figure C-13) will be incorporated into the FWGWMP/RI monitoring system after four quarters of initial characterization sampling has been completed. First, the NGB's response does not explain why the ground water investigation of the Motor Pool Area is being conducted outside the *Facility-Wide Draft RI Work Plan* (See General Comment 1). Second, it is not clear if, how many, and where the new unconsolidated wells were installed in the Motor Pool Area. Please provide Ohio EPA with a map showing the proposed locations of wells to be located in the Motor Pool Area. Third, it is not clear which constituent of potential concern (COPC) may be impacting ground water beneath the Motor Pool Area. Ohio EPA recommends that sampling analyses of the proposed wells in the Motor Pool Area include VOCs, PAHs, and PCBs. Ohio EPA requests additional information regarding NGB's responses to these issues.	of contracting the current Facility-Wide Groundwater RI project did not yet indicate a demonstrated need for the assessment of groundwater. Thus, a separate contracting action is necessary to implement the initial characterization of groundwater underlying the AOC. The pending RIs for Building 1048 Fire Station and Building 1034 Motor Pool Hydraulic Lift will include review of existing soil sampling data and determine whether data gaps exist and conduct additional sampling as necessary to define the nature and extent of contamination. If additional data is collected, the Risk Assessment will be updated as part of the RI. Groundwater characteristics to be covered by the RI include flow direction and the nature and extent (horizontal and vertical) of groundwater contamination, if any. A minimum of three groundwater monitoring wells will be installed at each AOC in accordance with guidance and requirements set forth as part of the facility-wide groundwater monitoring program. One of the Building 1048 Fire Station groundwater monitoring wells will be installed at or near the location with the highest carbon tetrachloride detection with the well screen placed so that first water can be monitored year-round. One of the Building 1034 Motor Pool groundwater monitoring wells will be installed at or near the soil sampling location exhibiting the highest amount of contamination. All groundwater wells will be installed and sampled in accordance with guidance and requirements set forth as part of the facility-wide groundwater monitoring program (full suite testing for four quarters). Soil and groundwater analysis at the Building 1048 Fire Station swill include perfluorinated compounds. Upon the conclusion of the four quarterly groundwater sampling events, the groundwater monitoring wells will be incorporated into the facility-wide groundwater monitoring program. Proposed

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
			monitoring well installation details, including location maps, will be submitted for Ohio EPA review with the planning documents associated with the pending project. In the event that the CC RVAAP-70, East Classification Yard is not considered NFA after the SI is finalized, soil and groundwater sampling will be conducted as necessary to determine the nature and extent of contamination at the AOC. As part of the RI, the contractor will determine groundwater characteristics to include flow direction and the nature and extent (horizontal and vertical) of groundwater contamination, if any. All other minimum well installation and sampling requirements described for the Motor Pool and Fire Station AOCs will also apply.
SPECIFIC COMMENTS			
Specific Groundwater Comments			
1	Specific Groundwater	The NGB's response acknowledges Ohio EPA's March 2, 2016 approval of four proposed background well locations (FWBKG-HSS1, FWBKG-HSS2, FWBKGSCON1, and FWBKG-SCON2).	Comment noted.
2	Specific Groundwater	The NGB's response acknowledges Ohio EPA's March 2, 2016 approval of five proposed extent monitoring wells (FWG-SS/C3, FWG-SS/C4, FWG-SS/C8, FWG-SCON3, and FWG-SCON4) be located down-gradient of AOC's near Camp Ravenna boundaries.	Comment noted.
3	Specific Groundwater	The NGB's response acknowledges Ohio EPA's March 2, 2016 approval of the schedule of wells to be sampled and associated analytical parameters for the Spring 2016 semi-annual ground water sampling event at Camp Ravenna. The Spring 2016 ground water sampling event occurred in May 2016.	Comment noted.
4	Specific Groundwater	The NGB's response to Ohio EPA's Ground Water Comment 4 requires additional clarification. To summarize Ohio EPA's Ground Water Comment 4, it appears that the hydrogeologic characteristics of the Homewood, Mercer, and Massillon Members are not adequately described or discussed in Section	As noted in our previous response, a number of existing Camp Ravenna monitoring wells previously thought to have been installed within the Homewood Sandstone Aquifer may in fact have been installed within the Mercer or Massillon members of the Pottsville Group. However, historical monitoring well logs

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		1.4.3 of the plan. Ohio EPA requests a more thorough description in order to ensure that the information supporting the hydrogeologic site conceptual model is accurate, and that ground water at the facility is appropriately monitored. We have noted in our review that there appear to be no currently installed or proposed monitoring wells in the Massillon Sandstone. Please provide information detailing clearly how the NGB is going to evaluate the water quality and hydrogeology of the Massillon Sandstone in the absence of data points. The NGB's response indicates that it intends on utilizing vertical gradients between hydrostratigraphic units in interpreting the hydrogeology of the facility. Based on its review of NGB's May 6, 2016 *FWGMP Annual Report for 2015,* Ohio EPA has concerns about the method by which the NGB intends on determining vertical gradients. In the *FWGMP Annual Report for 2015*, the NGB used data from monitoring well pairs that are horizontally separated by distances of over 100 feet to as much as 610 feet to determine vertical gradients. According to U.S. EPA (2016), vertical gradients are calculated using data from closely spaced wells. According to Ohio EPA's Chapter 3 (Revised 2015) *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring*, vertical gradient is determined by comparing heads in well/piezometers clusters (i.e., closely spaced wells). It is DDAGW's opinion that closely spaced means within no more than about 10 to 15 feet of each other. Ohio EPA requests that NGB use data from closely spaced wells in order to calculate meaningful vertical gradients. Also, gradient itself does not prove that an aquitard is effective at protecting underlying ground water. U.S. EPA *On-line Tools for Site Assessment* website and *Vertical Gradient Calculator* is a helpful means to calculate vertical gradients and is located at the link below:	or these wells generally provide insufficient lithologic description details to make definitive delineations of the various bedrock upper contact areal extents (and, therefore, limit confidence in the identification of individual formations monitored). The planned RI installation of two Upper Sharon Sandstone Aquifer wells (FWG-SS/C5, SS/C6) and a single Basal Sharon Conglomerate Aquifer well (FWG-SCON5) will provide critical stratigraphic data for the area of interest (i.e., Fuze and Booster Quarry, Load Lines 5 through 11), supporting an updated evaluation of the site-specific geology. FWG-SS/C5 and FWG-SCON5 will be installed as a nested well pair to support the evaluation of vertical gradients. As the installation of each of these three wells is anticipated to require penetration of one or more upper formation units, a full sequence stratigraphic profile will be prepared for the RI document. The work plan text in Section 1.4.3 will be revised to describe that vertical gradients and the presence of potential aquitards will be evaluated in accordance with the Ohio EPA recommended guidance documents. Additionally, Section 1.4.3 will be revised to indicate that (inserted text in italics) current data gaps in the characterization of the upper contact geology in the Fuze and Booster Quarry area will be re-evaluated through results of the pending RI well installations. The RI Report will provide an analysis of groundwater within the Mercer and Massillon formations as separate aquifers requiring additional investigation during the RI, or as a contiguous water bearing unit hydraulically connected to other formations also present in this portion of the post and adequately covered by the existing FWGWMP well network.

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		https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/vgradient02.html In the NGB's response, the Mercer Member and the upper shale beds of the Sharon Member are identified as potential aquitards. It is not clear from the NGB's response what criteria the NGB will use to determine if these units are acting as aquitards. Ohio EPA recommends that the NGB refer to guidance in Ohio EPA's *Technical Guidance Manual* (TGM) entitled; *Assessment of an Aquitard during a Ground Water Contamination Investigation* (2009).	
5	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 5.	Comment noted.
6	Specific Groundwater	The NGB has not adequately addressed all of the issues raised in Ohio EPA's Ground Water Comment 6. In summary, in Ground Water Comment 6, Ohio EPA recommended that the NGB install additional wells and/or include existing wells in the Facility-Wide Draft RI Work Plan in order to address the 24 Data Gap Areas. Ohio EPA has agreed to allow the NGB to defer sampling for metals until it has completed its Background Study; however, sampling metals now would likely greatly expedite the determination of rate, extent, and concentration of COPCs, because the need to re-mobilize and re-sample for metals would not be needed. Symbols on revised Figures C-1 through C-25 submitted with the NGB's response differentiate between FWGWMP, RI, and FWGWMP/RI well locations. All wells sampled under the Facility-Wide Draft RI Work Plan should support the RI. It is not clear why the NGB has differentiated between FWGWMP, RI, and FWGWMP/RI between wells on Figures C-1 through C-25. This needs to be explained.	The intended purpose of the map symbols in the Draft RI maps was to convey wells that would be only sampled as part of the FWGWMP spring event. Based on discussion with Ohio EPA during the September 14, 2016, comment resolution meeting, map symbols have been revised to generically indicate currently existing monitoring wells to be sampled for either the RI or as part of the FWGWMP. Additional characterization of select wells for potential metals contamination prior to approval of the background study will be reviewed and addressed in the 2017 Semi-Annual Facility-Wide Groundwater Monitoring Program (FWGWMP) Addendum.

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		The NGB's responses to Ohio EPA's specific concerns/recommendations regarding the 24 Data Gap areas are discussed below.	
		• **Erie Burning Grounds (Two Data GAP Areas - Figure C-1)**. In Ground Water Comment 6, Ohio EPA recommended that EBGmw-127 be included as part of FWGWMP/RI sampling, because the well is identified on Figure C-1 as having one or more metal COPCs above screening levels and one or more site COPC maximum results. According to the NGB's response, the designation of EBGmw-127 on Figure C-1 as having elevated concentrations of COPCs above screening levels appears to be due to the presence of a pesticide beta BHC. Beta BHC is not present at a concentration consistent with a regulated release. Table 1-3 (page 1) also states: "The need for additional sampling of EBGmw-127 will be based on the results of centerline well planned for updating during the RI." While Ohio EPA concurs with the facility that it does not appear that EBGmw-127 needs to be included in the FWGWMP/RI sampling plan, it is not clear as to what the "centerline wells" are. The NGB needs to explain what the planned "centerline wells" are.	**Erie Burning Ground.** The word "centerline" has been deleted from the work plan text.
		• **Load Line 1/Ore Storage Area/ Ramsdell Quarry (Two Data Gap Areas -Figures C-2 and C-3).** The NGB's response adequately responded to Ohio EPA concerns regarding Data Gaps in Load Line 1/Ore Storage Area/ Ramsdell Quarry.	**Load Line 1/Ore Storage Area/ Ramsdell Quarry).** Comment noted.
		• **Load Line 2/Electrical Substation-East (Figure C-4).** In Ground Water Comment 6, Ohio EPA	**Load Line 2/Electrical Substation-East.** Response covered by revisions to Table 3-3 provided to Ohio EPA on 29 August 2016.

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		recommended that wells LL2mw-269, LL2mw-263, LL2mw-264, and LL2mw-268 be included as part of RI/FWGMP sampling to evaluate the potential migration of COPCs. Ohio EPA also recommended that the NGB could include LL2mw-271 instead of installing FWGSS/C8, as there appears to be an adequate amount of Sharon Aquifer wells in the Load Line 2 area. Considering that LL 1-4 FFS (May 2005) SESOIL modeling indicates that antimony, arsenic, cadmium, chromium, mercury, and ROX were predicted to exceed screening criteria in ground water beneath the source area, Ohio EPA recommended that metals should be included as COPCs analytes (Table 3-3). The NGB's response indicates that they concur with most of Ohio EPA's recommendations or responded adequately. The NGB agreed to add LL2mw-268 and LL2mw-269 to the RI/FWGMP sampling plan. Ohio EPA concurs with the NGB's decision to install FWGSS/C8 instead of including LL2mw-271 in the RI sampling plan. Ohio EPA is willing to allow the NGB to complete a metals background study prior to further assessment of metals in ground water in the vicinity of LL2. Table 3-3 does not indicate that well LL2mw-268 will be sampled for explosives. Ohio EPA requests that LL2mw-268 be sampled for explosives, as LL 1-4 FFS SESOIL modeling predicts leaching of RDX, and Table 2-1 lists explosives as COPCs for Load Line 2. Also, please add Well LL2mw-269 to	

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		Table 3-3. Additionally, the NGB has not adequately explained why wells LL2mw-263 and LL2mw-264 have not been added to the RI/FWGMP sampling plan as requested. Either LL2mw-263 or LL2mw-264 need to be added to the RI/FWGMP sampling plan because of radial flow in the Upper Sharon Aquifer in Load Line 2 area. • **Sand Creek Landfill/Dump (Figure C-9).** In Ground Water Comment 6, Ohio EPA commented that it is not clear how the submitted Draft *RI Work Plan* addresses this Data Gap. • Ohio EPA recommends the installation of monitoring wells in the Unconsolidated Aquifer within the northern portion of Sand Creek Landfill/Dump to address this Data Gap. According to Section 5-11 of the May 19, 2016 Draft *RI Report for RVAAP-034* (page 5-22), two explosives: 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, three SVOCs: 1,4-dichlorobenzene, carbazole, and pentachlorophenol, and one VOC: benzene, have the potential for leaching to ground water. The highest soil concentrations of COPCs appear to be located in the north portion of the Sand Creek Disposal Area. Because there are no existing or planned monitoring wells located within the northern portion of Sand Creek Landfill, a Data Gap exists in that AOC that needs to be addressed by the *Facility-Wide Draft RI Work Plan.*	 **Sand Creek Landfill/Dump.** A map is attached providing proposed locations of three new permanent wells (FWG-UNCONS4, -UNCONS5, -UNCONS6) to be installed in the Unconsolidated Aquifer at the Sand Creek Landfill/Dump to address this data gap. The map provides labels for each sample location representing a site related compound maximum concentration utilized for the site SESOIL analysis. The new wells will be sampled for the comprehensive Camp Ravenna potential SRC suite for four quarters. Potential addition of the new Sand Creek Landfill/Dump wells to the FWGWMP will be evaluated after the initial four quarters of sampling results.

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		• **Atlas Scrap Yard Storage Area and Load-Line 4 (Two Data Gap Areas-Figures C-10 and C-11)**. In Ground Water Comment 6, Ohio EPA recommended that the NGB include hexavalent chromium as part of analytical testing for this area. Ohio EPA recommended that the NGB include all wells still having one or more non-metal COPCs above screening levels or provide justification explaining why they can be excluded from the sampling effort. Ohio EPA recommended that metals be included as COPCs Analytes (Table 3-3), based on the results of LL 1-4 FFS (May 2005) SESOIL modeling. Ohio EPA recommended that LL4mw-197 and LL4mw-198 be included in the FWGWMP/RI sampling because these wells are identified as having more than one non-metal COPCs above screening levels and more than one COPC maximum results. Ohio EPA also recommended the installation of wells downgradient of LL4mw-197 to evaluate the migration of COPCs. Ohio EPA also recommended that the NGB add the vapor intrusion pathway as a key CSM pathway. The NGB's response indicates concurrence with many of EPA's recommendations. The NGB response indicates that hexavalent chromium will be added to the analytical testing suite and test for metals; however, assessment of metals in this area is deferred pending concurrence of Ohio EPA on the pending metals background study. The NGB has agreed to include LL4mw-197 to the RI Sampling Plan. The NGB proposes to utilize data from LL4-	**Atlas Scrap Yard Storage Area and Load-Line 4**. Response covered by revisions to Table 3-3 provided to Ohio EPA on 29 August 2016.

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		mw-199 and LL4mw-200 in lieu of installing new extent well(s) downgradient of LL4mw-197. Ohio EPA concurs with the NGB's aforementioned proposal. Based on a review of historical data, Ohio EPA concurs with the NGB that LL4mw-198 does not need to be included as part of FWGWMP/RI sampling. The NGB has included the vapor intrusion pathway for all sites with currently existing surface structures that could be potentially impacted by VOCs in ground water and for locations with surface structures that could be potentially impacted in the future from plume migration or through new construction. Hexavalent chromium needs to be added to Table 3-3 (even if sampling for metals is deferred) for wells sampled in Atlas Scrap Yard Storage Area and Load Line 4. Table 3-3 does not indicate that LL4mw-197 will be sampled for explosives, and that well needs to be sampled for explosives. Explosives are COPCs for Load Line 4, and the LL 1-4 FFS indicates the potential for leaching of ROX to ground water in this area. Table 3-3 does not list well LL4-199 as part of FWGWMP/RI sampling, and that well needs to be included on that table. • **Winklepeck Burning Grounds (Two Data Gap Areas-Figure C-12).** In Ground Water Comment 6, Ohio EPA recommended that monitoring wells located within that AOC, that were identified on Figure C-12 as having one or more results for non-metal COPCs above screening levels, need to be included in FWGWMP/RI sampling.	**Winklepeck Burning Grounds (Two Data Gap Areas-Figure C-12).** Response covered by revisions to Table 3-3 provided to Ohio EPA on 29 August 2016.

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		Based on further review of historical data, Ohio EPA agrees with the NGB that monitoring wells identified on Figure C-12 as having one or more results for COPCs above screening levels and/or one or more COPC maximum results (i.e., WBGmw-005, WBGmw-008, WBGmw-010, WBGmw-011, WBGmw-015, and WBGmw-016) do not need to be included as part of FWGWMP/RI sampling. It appears that these exceedances in the aforementioned wells can be attributed to common laboratory contaminants and/or pesticides and/or concentrations of COPCs, and/or results from more recent sampling events have been below screening levels. Figure C-12 indicates unconsolidated well OBG-4 is not part of the FWGWMP/RI monitoring system, but Table 3-3 indicates that this well is being sampled as part of FWGWMP/RI sampling. Figure C-12 indicates that OBG-4 has one or more site COPCs maximum results. Ohio EPA believes that OBG-4 needs to be included as part of FWGWMP/RI sampling. The sampling status of well OBG-4 needs to be clarified.	
		• **Motor Pool Area (Figure C-13).** The NGB has not adequately responded to Ohio EPA's concerns regarding Data Gaps in the Motor Pool Area. Refer to Ohio EPA's General Comment 7.	**Motor Pool Area.** See response to General Comment No. 7 above.
		• **Load-Line 8 (Figure C-21**). The NGB has adequately responded to Ohio EPA's concerns regarding Data Gaps in Load Line 8.	**Load-Line 8**. Comment noted.

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		• **Load-Line 11 (Figure C-18).** The NGB has adequately addressed Ohio EPA's concerns regarding Data Gaps in the Load-Line 11 AOC.	**Load-Line 11.** Comment noted.
		• **Load-Line 7 (Figure C-19).** In Ground Water Comment 6, Ohio EPA recommended that a well be installed down-gradient of Homewood Aquifer well LL7mw-001, to delineate the nature and extent of 1, 1-dichloroethane and 1, 1-dichloroethene. The *RI/FS Report for Load-Line* 7 indicates that silver, TNT, 3-nitrotoluene, 2,6-DNT, nitroglycerin, and naphthalene are predicted to exceed screening criteria in ground water beneath the load-Line 7 source area and/or in the down-gradient receptor location. Ohio EPA recommended that Load-Line 7 wells in the sampling plan include testing for SVOCs in addition to explosives. Ohio EPA also asked the NGB to review Load-Line 7 well placement to ensure that the wells in the sampling plan are appropriately placed in relationship to the source area(s) identified in the RI/FS Report.	**Load-Line 7.**
		• The NGB response indicates that 1, 1-dichloroethane and 1, 1-dichloroethene have not historically been detected in down-gradient Homewood Aquifer well in Load-Lines 5 and 6. In lieu of adding a new Homewood Aquifer well downgradient of LL7mw-001, the NGB has proposed to add VOCs to the testing suite for Homewood Aquifer Wells: LL5mw-002, LL5mw-006, and LL6mw-003 to evaluate the potential migration of these constituents down-gradient of LL7mw-001. The need for the	

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		installation of a new well down-gradient of LL7mw-001 will be evaluated based on the VOC results for the Load-line 5 and 6 wells. Ohio EPA concurs with the proposal. The NGB's response indicates historical naphthalene concentrations in ground water beneath Load Line 7 have not been detected above screening levels; therefore, the NGB does not plan to sample Load Line 7 wells for SVOCs. However, Table 3-3 indicates that Homewood Aquifer well LL7mw-006 is to be sampled for SVOCs which contradicts the NGB's response indicating that SVOCs will not be sampled in wells located within Load-Line 7. The sampling of SVOCs in Load-Line 7 wells needs to be clarified. Also, considering the leaching potential for explosives, it is not clear why LL7mw-005 will not be tested for explosives. Please explain this omission. The NGB response indicates that they have reviewed the placement of existing wells with respect to adequately characterizing ground water underlying the presumed source of naphthalene at Load-Line 7, and have determined that the wells are adequately placed for that purpose. However, there do not appear to be any Unconsolidated Aquifer wells in the vicinity of Load Line 7; therefore, it is unclear how the potential for leaching of various COPCs predicted in the *RI/FS Report for Load-Line* 7 was evaluated without sampling ground water in the uppermost Unconsolidated Aquifer beneath Load	The inclusion of SVOCs for testing at LL7mw-006 was an error that was corrected in the revised Table 3-3 submitted for Ohio EPA review on 29 October 2016. Explosives have been added to the testing suite for LL7mw-005. The text of the Draft RI/FS Report for Soil, Sediment, and Surface Water at RVAAP-40 Load-Line 7, dated 27 January 2016, states that "*potentiometric data indicate the groundwater table occurs within bedrock throughout the AOC.*" This statement is supported by geologic cross sections A-A', B-B' and C-C' provided in the Final Characterization of 14 AOCs at Ravenna Army Ammunition Plant, Characterization of Load Line 7, dated March 2007. The Final Characterization of 14 AOCs document provides a discussion of trenching activities conducted in the area of planned monitoring well installations prior to drilling indicated one of five trenches encountered saturated conditions, but the saturated medium composition is not described and the trench

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		Line 7. Ohio EPA requests that NGB explain how the predicted leaching of COCs beneath the Load-Line 7 source area(s) was investigated using only Homewood Aquifer wells. Additionally, in order to evaluate the NGBs response it would be helpful for the NGB to provide Ohio EPA with a map showing the source area(s) in Load-Line 7.	locations are not mapped in the document. Review of LL7mw-001 through LL7mw-006 well installation logs indicates depths to encountered groundwater during drilling were all below the upper contact of bedrock. Maps providing presumed SRC source areas and strategy for well locations are provided in the Final Characterization of 14 AOCs at Ravenna Army Ammunition Plant, Characterization of Load Line 7, dated March 2007.
		Fuse and Booster Quarry/40 MM Firing Range/Water Works (Two Data Gap Areas -Figure C-20). The NGB has adequately responded to Ohio concerns regarding Data Gaps in the Fuse and Booster Quarry/40 MM Firing Range/Water Works AOCs.	**Fuse and Booster Quarry/40 MM Firing Range/Water Works.** Comment noted.
		• **NACA TEST Area and Mustard Gas Burial Site-South (Figure C-24).** In Ground Water Comment 6, Ohio EPA Recommended that the NGB include NTAmw-114, NTAmw-115, NTAmw-117, and NTAmw-118 as part RI/FACILITY-WIDE DRAFT RI WORK PLAN sampling; because these wells are identified as *having one or more non-metal* COPCs *results above screening levels and one or more* COPC *maximum results.;* Ohio EPA also requested the NGB to evaluate placement of wells to ensure down-gradient migration from the area is being sampled, and install new wells as necessary. The NGB's response indicates that wells NTAmw-115, NTAmw-117, and NTAmw-118 have been added and a vertical extent well will be installed in the Upper Sharon formation to the east of NTAmw-117. Table 3-3 (FWGW and RI Monitoring Wells) does not include NTAmw-117, and it needs to include this well. Also, it	**NACA TEST Area and Mustard Gas Burial Site-South.** NTAmw-117 and NTAmw-114 were added to the revised Table 3-3 submitted for Ohio EPA review on 29 August 2016. Based on further review of subsurface conditions at the NACA Test Area, FWG-SS/C7 will be moved to be installed in the immediate area of NTAmw-113, identified as one of the primary groundwater COPC wells for the NACA Test Area. The new well will be installed as closely as possible to NTAmw-113 to allow for use as a vertical gradient evaluation well pair.

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		is not clear why NTAmw-114 was not included in the FWGWMP/RI sampling plan as requested, and we request an explanation regarding this omission. There are no Upper Sharon wells in the NACA Test Area. The purpose of proposed Upper Sharon well FWGSS/C7 is to evaluate the vertical extent of COPCs into the Upper Sharon Aquifer in the NACA Test Area. However, the proposed location of well FWG-SS/C7 is approximately 650 feet east of the NACA Test Area. Normally, vertical extent wells would be expected to be located immediately below the source area. It is not clear why the proposed vertical extent well FWG-SS/C7 is not located within the NACA test area. Please explain this discrepancy. • **C-Block Quarry (Figure C-25).** The NGB has adequately responded to Ohio EPA's concerns regarding Data Gaps in the C-Block Quarry AOC.	**C-Block Quarry (Figure C-25).** Comment noted.
7	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 7.	
8	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 8.	Comment noted.
9	Specific Groundwater	The NGB's response does not adequately respond to all of Ohio EPA's concerns in Ground Water Comment 9. To summarize Ground Water Comment 9, Ohio EPA recommended that the NGB install an additional Upper Sharon Sandstone Aquifer well down-gradient of, but closer to well LL2mw-267 than the proposed location of FWG-SS/C2, in order to adequately determine the rate, extent, and concentration of explosive COPCs in ground water in the triangular Load-Line 2 Data Gap Area. Ohio EPA also recommended that the NGB also install an additional Upper Sharon Aquifer well down-gradient of, but closer to LLmw-241 than the proposed location of FWG-SS/C4, in order to adequately determine the rate, extent, and	ProUCL outputs completed for Camp Ravenna AOCs to date are attached.

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		concentration of COPCs in ground water in the triangular Load-Line 3/Load-Line 12 Data Gap Area. The NGB's response and Figure 3-1 indicate that the proposed location of well FW-SS/C2 has been relocated to a position about 650 feet down-gradient of Llmw-267, and that the need for an additional delineation well down-gradient of FWG-SS/C2 will be evaluated pending sampling results of FWG-SS/C2. The aforementioned proposal is acceptable to Ohio EPA. The NGB's response indicates that an addition of Sharon Sandstone delineation well located closer to LL#mw-241 is not needed; because, statistical trend analyses of COPCs concentrations in LL3mw-238 and LL3mw-241 are stable to declining. No supporting statistical analyses and/or time-series graphs were provided with the response. In order for Ohio EPA to be able to properly evaluate the NGB's response, the NGB need to provide Ohio EPA the referenced supporting statistical analyses and/or time-series graphs.	Comment noted
10	Specific Groundwater	The NGBs has not adequately responded to Ohio EPA's Ground Water Comment 10. To summarize Ground Water Comment 10, Ohio EPA requests the NGB to clarify how the potential for naphthalene leaching to ground water beneath Electrical Substation No. 3 (RVAAP-68) is going to be addressed by the *Facility-Wide Draft RI Work Plan.* In a letter dated July 6, 2015, the NGB indicated that the potential of naphthalene impact in the vicinity of Electrical Substation No.3 would be investigated as part of RVAAP-66 Facility Wide Ground Water. The draft *Facility-Wide Draft RI Work Plan* does not include any Unconsolidated Aquifer wells in the vicinity of Electrical Substation No. 3. The NGB response indicates that three temporary monitoring wells will be installed in the Unconsolidated	The proposed temporary monitoring wells will be installed in general accordance with methods described in the ITRC guidance document The Use of Direct-push Well technology for Long-Term Environmental Monitoring in Groundwater Investigations, dated March 2006. Specifically, the wells will be installed as pre-packed screen sampling points. The pre-packed wells will consist of Schedule 40 PVC casing with 0.010 screen. The well installation will include a bentonite seal. Well development and purging for sampling will be conducted in accordance with the FWSAP methodologies, including the use of small diameter bladder pumps.

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		Aquifer beneath the location of maximum naphthalene concentrations in soils in the vicinity of Electrical Substation No. 3. The temporary wells will be plugged and abandoned immediately after gauging and sampling. In order for the NGB to adequately respond to Ohio EPA's comment, we request information regarding how these three temporary wells are going to be constructed, installed, and purged to ensure that the samples obtained from them are representative. Ohio EPA recommends that the wells include a sand pack, and are adequately developed and purged prior to sampling.	
11	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 11.	Comment noted.
12	Specific Groundwater	The NGB has not adequately responded to Ohio EPAs Ground Water Comment 12. It is not clear that Section 1.6.3 of the Draft *RI Work Plan* addresses potential data gaps in the facility's ground water monitoring network that may exist in the Massillon and Mercer Members beneath Camp Ravenna. The NGB's response to this comment refers to their response to Ohio EPA's Ground Water Comment 4. Refer to Ohio EPA's Ground Water Comment 4 and Ohio EPA's Response to the NGB's Response to that comment.	See response to General Comment No. 4.
13	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 13.	Comment noted.
14	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 14.	Comment noted.
15	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 15.	Comment noted.
16	Specific Groundwater	The NGB's response to Ground Water Comment 16 requires additional clarification. In Ground Water Comment 16, Ohio EPA requested the NGB to clarify the purpose listed in Table 3-1 of seven extent wells: FWG-SCON4,	A copy of the revised Table 3-1 has been attached.

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
		FWGSCON5, FWG-SS/C1, FWG-SS/C3, FWG-SS/C5, FWG-SS/C6, and FWGSS/C7. The purposes listed in that table do not provide sufficient information. The purpose needs to identify specific non-metal COPCs. The NGB's response indicates that table 3-1 has been revised as requested to identify specific non-metal COPCs to be characterized by each new monitoring well installation. However, a revised version of Table 3-1 was not submitted with the NGB's response. In order for Ohio EPA to evaluate the NGB's response, please provide the Agency with a revised copy of Table 3-1.	
17	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 17.	Comment noted.
18	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 18.	Comment noted.
19	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 19.	Comment noted.
20	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 20.	Comment noted.
21	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 21.	Comment noted.
22	Specific Groundwater	The NGB's response does not adequately address Ohio EPA's Ground Water Comment 22. To summarize Ground Water Comment 22, eight monitoring wells: LL 1 mw-083, LL 1 mw-084, LL 1 mw-086, RQLmw-011, RQLmw-012, RQLmw-013, FWGmw-002, and FBQmw-17 4 have had pH measurements outside the typical range for natural ground water (i.e., <5 and >9). It is not clear that the RI Work Plan addresses determining the extent of pH impacted ground water, particularly in the vicinity of Ramsdell Quarry and Load-Line 1. The NGB's response indicates that Tables 2-1 and 3-3 will	The requested wells and sampling parameters requested were provided in the revised Table 3-3 provided for Ohio EPA on 29 August 2016.

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
		be modified to indicate that the above referenced eight wells, plus six additional wells will be monitored for pH outside the natural range. The six additional wells are: LL 1 mw-088, FWGmw-SS/C1, RQLmw-014, FBQmw-171, FBQmw-175, and BGKmw-021. The submitted revised Table 3-3 does not indicate that the 14 above referenced wells will be monitored for pH outside the natural range as part of FWGWMP/RI sampling. Well FWGmw-002 is not listed in Table 3-3. According to the 2005 draft *Phase I Remedial Investigation Report for Ramsdell Quarry Landfill* (page 1-11): *Based upon available information and past uses of the abandoned quarry, wastes may include domestic, commercial, and industrial solid and liquid* wastes, *including explosives [e.g. 2,4,6-TNT, hexahydro-1,3,5-trinitro-1,3,5-triazine (ROX); and Composition BJ, napalm, gasoline, acid dip liquor, annealing residue (e.g., sulfuric acid, shell casings, sodium orthosilicate, chromic acid, and alkali), aluminum chloride, and inert material. Interviews with former RVAAP personnel have indicated that much of the landfill wastes and debris at the abandoned quarry were removed in the 1980's.* The NGB needs to determine the cause of low pH in the areas of Ramsdell, Quarry, Load-Line 1, and the Fuse and Booster Quarry. In order to help determine the cause of low pH, Ohio EPA recommends that wells with low pH (e.g., RQLmw-011, RQLmw-012, RQLmw-013, LL 1mw-083, LL 1mw-084, and FBQmw-174) be analyzed for: hexavalent chromium, nitrate, nitrite, nitrate, sulfite, and sulfate.	

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Response to Ohio EPA Comments on the Draft RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Reviewer(s): Kevin M. Palombo, Ohio EPA, (330) 963-1292
Date: 31 August 2016

Cmt No.	Page or Sheet	Comment	Response
23	Specific Groundwater	The NGB has adequately responded to Ohio EPA's Ground Water Comment 23.	Comment noted.
GENERAL RISK ASSESSMENT COMMENTS			
1	General Risk	The NGB has adequately responded to Ohio EPA's General Risk Comments 1 through 10.	Comment noted.
RISK ASSESSMENT COMMENTS: AOC SPECIFIC EVALUATIONS (APPENDIX C)			
11	Risk Assessment	Load Line 5 (Figure C-14) a. Well LL5mw-001 needs to be included in the 2016 FWGW Monitoring Program sampling. The well had a maximum detection of PCB-1248 at a concentration of 0.00041 mg/L in 2008 (screening level is 0.0000078 mg/L). The most recent sample from 2009 had an elevated detection limit of 0.0005 mg/L.	Response covered by revisions to Table 3-3 provided to Ohio EPA on 29 August 2016.
12	Risk Assessment	The NGB has adequately responded to Risk Assessment Comments: AOC Specific Evaluations (Appendix C) **12 through 18.**	Comment noted.
19	Risk Assessment	Central Burn Pits (Figure C-9) a. Well CBPmw-004 needs to be included in the 2016 FWGW Monitoring Program sampling. The well had a maximum detection of PCB-1248 at a concentration of 0.0001 mg/Lin 2008 (screening level is 0.0000078 mg/L). The most recent sample from 2011 had an elevated detection limit of 0.0005 mg/L.	Response covered by revisions to Table 3-3 provided to Ohio EPA on 29 August 2016.
20	Risk Assessment	ODA#2 (Figure C-15) a. Well DA2mw-107 needs to be included in the 2016 FWGW Monitoring Program sampling. The well had a maximum detection of PCB-1254 at a concentration of 0.00016 mg/L in 2006 (screening level is 0.0000078 mg/L). The most recent sample from 2011 had an elevated detection limit of 0.00048 mg/L.	Response covered by revisions to Table 3-3 provided to Ohio EPA on 29 August 2016.

Table 3-1
Summary of New Well Locations by Aquifer

Monitored Aquifer/Preliminary Well ID	Purpose/Location
Homewood	
FWBKG-HSS1	Background Study, Northwest of CBL
FWBKG-HSS2	Background Study, Northwest of CBL
Basal SCF	
FWBKG-SCON1	Background Study, collocated with BKGmw-018
FWBKG-SCON2	Background Study, Northwest of CBL
FWG-SCON3	Vertical delineation of non-metals COPCs: • 2-amino-4,6-Dintrotoluene, 4-amino-2,6-Dintrotoluene, perchlorate; Determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs at LL2mw-060 and LL2mw-271. The new well will be installed on federal government property across Route 5, south of LL2mw-271.
FWG-SCON4	Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated Aquifer at LL12: • 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; RDX; Cyanide; Benz(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,2-Dichloroethene; 2,6-Dinitrotoluene; 3-Nitrotoluene; Nitroglycerin; Hydrazine; Benzene and in the Upper Sharon formation at LL3: • 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Nitrobenzene; RDX; Cyanide; Pentachlorophenol, DEHP. Determine the potential for off-post migration of SRCs. The new well will be installed on federal government property across Route 5 to the southeast of LL12.

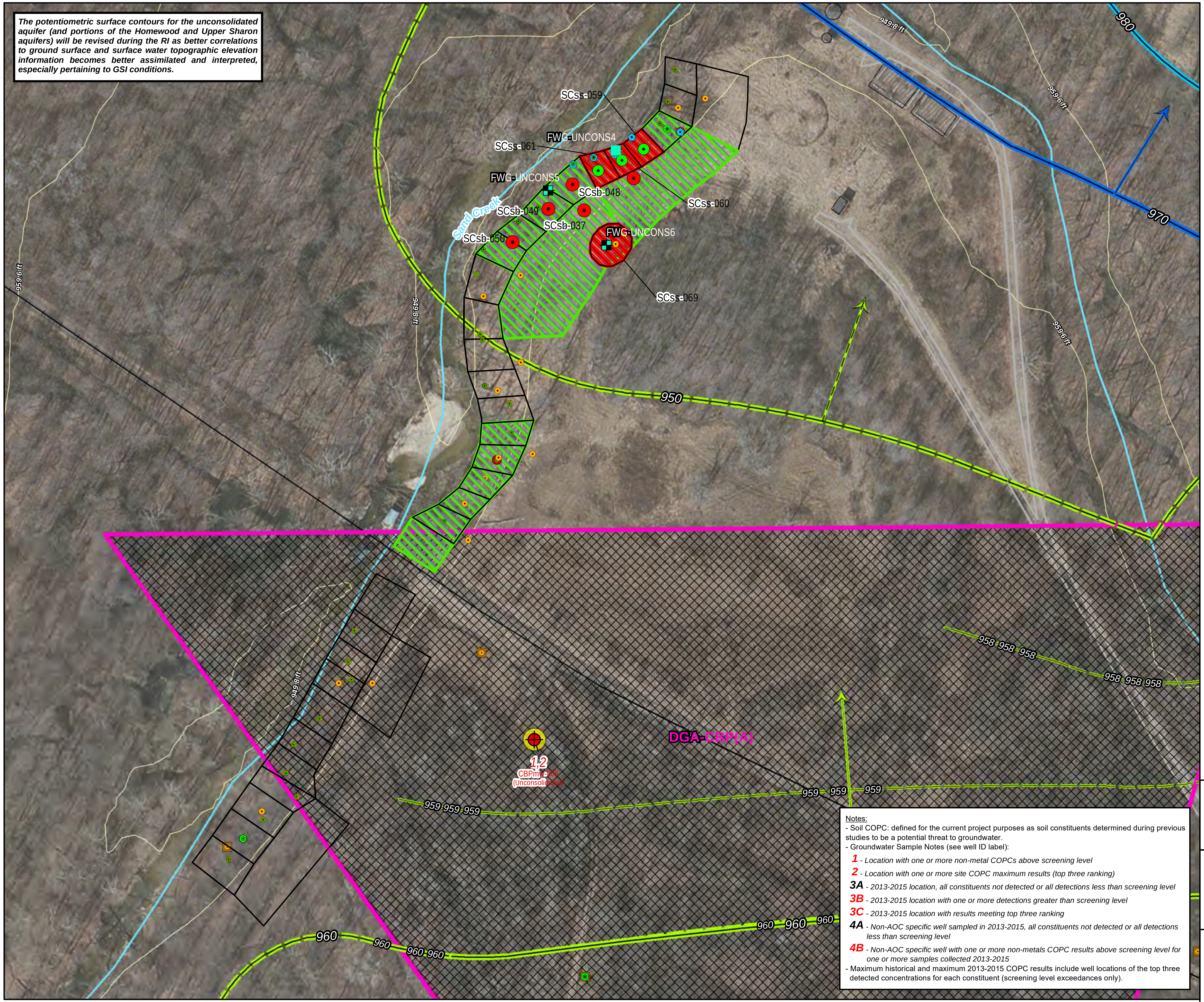
Monitored Aquifer/Preliminary Well ID	Purpose/Location
FWG-SCON5	Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated and Homewood Aquifers at LL5, LL9, and LL10: • 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, cyanide, carbon tetrachloride; PCB-1248 The new well will be installed adjacent to the paved access road between LL9 and LL10, outside of the LL10 perimeter fence and approximately 400 feet northeast of LL10mw-005 (same general location as for FWG-SS/C5 below).
Sharon SS/Cong	
FWG-SS/C1	Horizontal delineation of various non-metals COPCs in the Upper Sharon formation reported in sampling results for LL1mw-083 and LL1mw-084: • 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; RDX; Cyanide; 2,6-Dinitrotoluene; DEHP The new well will be installed approximately 1,100 feet east of LL1mw-083.
FWG-SS/C2	Horizontal delineation of LL2 non-metals COPCs: • 2,4-Dinitrotluene; 2,6-Dinitrotoluene; RDX; Cyanide; Pentachlorophenol; Benzene. The new well will be installed at a position about 650 feet down-gradient of LL2mw-267.

Monitored Aquifer/Preliminary Well ID	Purpose/Location
FWG-SS/C3	Horizontal and vertical delineation for various non-metals COPCs present in the Unconsolidated Aquifer at LL12 • 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2-Nitrotoluene; Nitrobenzene; RDX; Cyanide; Benz(a)anthracene; Benzo(a)pyrene; Benzo(b)fluoranthene; Dibenz(a,h)anthracene; Indeno(1,2,3-cd)pyrene; Naphthalene; 1,2-Dichloroethene; 2,6-Dinitrotoluene; 3-Nitrotoluene; Nitroglycerin; Hydrazine; Benzene and in the Upper Sharon formation at LL3: • 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; Nitrobenzene; RDX; Cyanide; Pentachlorophenol, DEHP; Determine the potential for off-post migration of SRCs. The new well will be installed on federal government property across Route 5 to the southeast of LL12.
FWG-SS/C4	Horizontal delineation of perchlorate to determine the potential for off-post migration of groundwater concentrations below screening levels but above laboratory MDLs at LL3mw-246. The new well will be installed on federal government property across Route 5 to the south of LL3mw-246.
FWG-SS/C5	Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at LL9 and LL10: • 2,6-dinitrotoluene, 2,4,6-trinitrotoluene, cyanide, carbon tetrachloride The new well will be installed adjacent to the paved access road between LL9 and LL10, outside of the LL10 perimeter fence and approximately 400 feet northeast of LL10mw-005.
FWG-SS/C6	Vertical delineation for various non-metals COPCs present in the Homewood Aquifer at the FBQ: • 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene,; Nitrobenzene; Cyanide; Trichloroethene, DEHP The new well will be installed approximately 1,100 feet east of FBQmw-174.

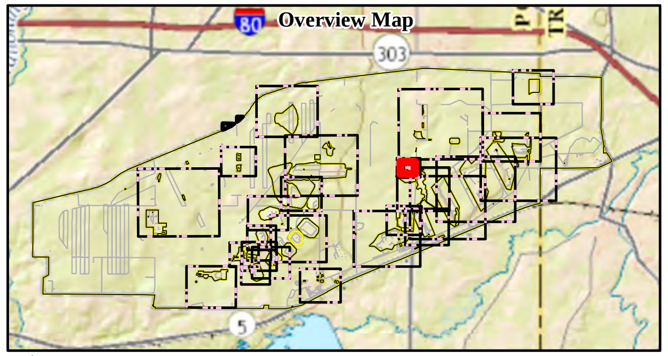
Monitored Aquifer/Preliminary Well ID	Purpose/Location
FWG-SS/C7	Vertical delineation for various non-metals COPCs present in the Unconsolidated Aquifer of the NTA area: • 2,6-dinitrotoluene, cyanide, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, bromochloromethane The new well will be installed immediately adjacent to currently existing well NTAmw-113.
FWG-SS/C8	Horizontal delineation of non-metals COPCs: • 2-amino-4,6-Dintrotoluene, 4-amino-2,6-Dintrotoluene, perchlorate Determine the potential for off-post migration of SRCs below screening levels but above laboratory MDLs at LL2mw-060 and LL2mw-271. The new well will be installed on federal government property across Route 5, south of LL2mw-271.
Unconsolidated Aquifer	
FWG-UNCONS1	Assess the potential presence of naphthalene leaching from soil to groundwater above regulatory screening levels at Electrical Substation No. 3. Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS2	Assess the potential presence of naphthalene leaching from soil to groundwater above regulatory screening levels at Electrical Substation No. 3. Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS3	Assess the potential presence of naphthalene leaching from soil to groundwater above regulatory screening levels at Electrical Substation No. 3. Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS4	Assess the potential presence of leaching from soil to groundwater above regulatory screening levels at the Sand Creek Landfill/Dump for the following constituents: • 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene; Determine a localized direction of flow in the Unconsolidated Aquifer.

Monitored Aquifer/Preliminary Well ID	Purpose/Location
FWG-UNCONS5	Assess the potential presence of leaching from soil to groundwater above regulatory screening levels at the Sand Creek Landfill/Dump for the following constituents: • 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene; Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS6	Assess the potential presence of leaching from soil to groundwater above regulatory screening levels at the Sand Creek Landfill/Dump for the following constituents: • 2,4,6-trinitrotoluene and 2-amino-4,6-dinitrotoluene, 1,4-dichlorobenzene, carbazole, pentachlorophenol, and benzene; Determine a localized direction of flow in the Unconsolidated Aquifer.
FWG-UNCONS7	Assess the potential presence of 2,4,6-trinitrotoluene leaching from soil to groundwater above regulatory screening levels at ODA1. Determine a localized direction of flow in the Unconsolidated Aquifer.

The potentiometric surface contours for the unconsolidated aquifer (and portions of the Homewood and Upper Sharon aquifers) will be revised during the RI as better correlations to ground surface and surface water topographic elevation information becomes better assimilated and interpreted, especially pertaining to GSI conditions.



Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).



- Proposed Unconsolidated Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected
- ISM Sample Grid
- ISM Location with Soil COPC Detected Greater than the Mean
- ISM Location with detected Soil COPC

Data Gap Areas
- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern
- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections
- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed) Note: Locations without results are not shown
- Groundwater Station
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Potentiometric Surface Contour: Upper Sharon (July 2015)
- Potentiometric Surface Contour: Sharon Conglomerate (July 2015)
- Excavation Areas
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 60 120 180 240 Feet

1 " = 125 ft
NAD83 UTM Zone 17N

TEC-Weston Joint Venture

Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure:
PRELIMINARY DRAFT FOR DISCUSSION ONLY

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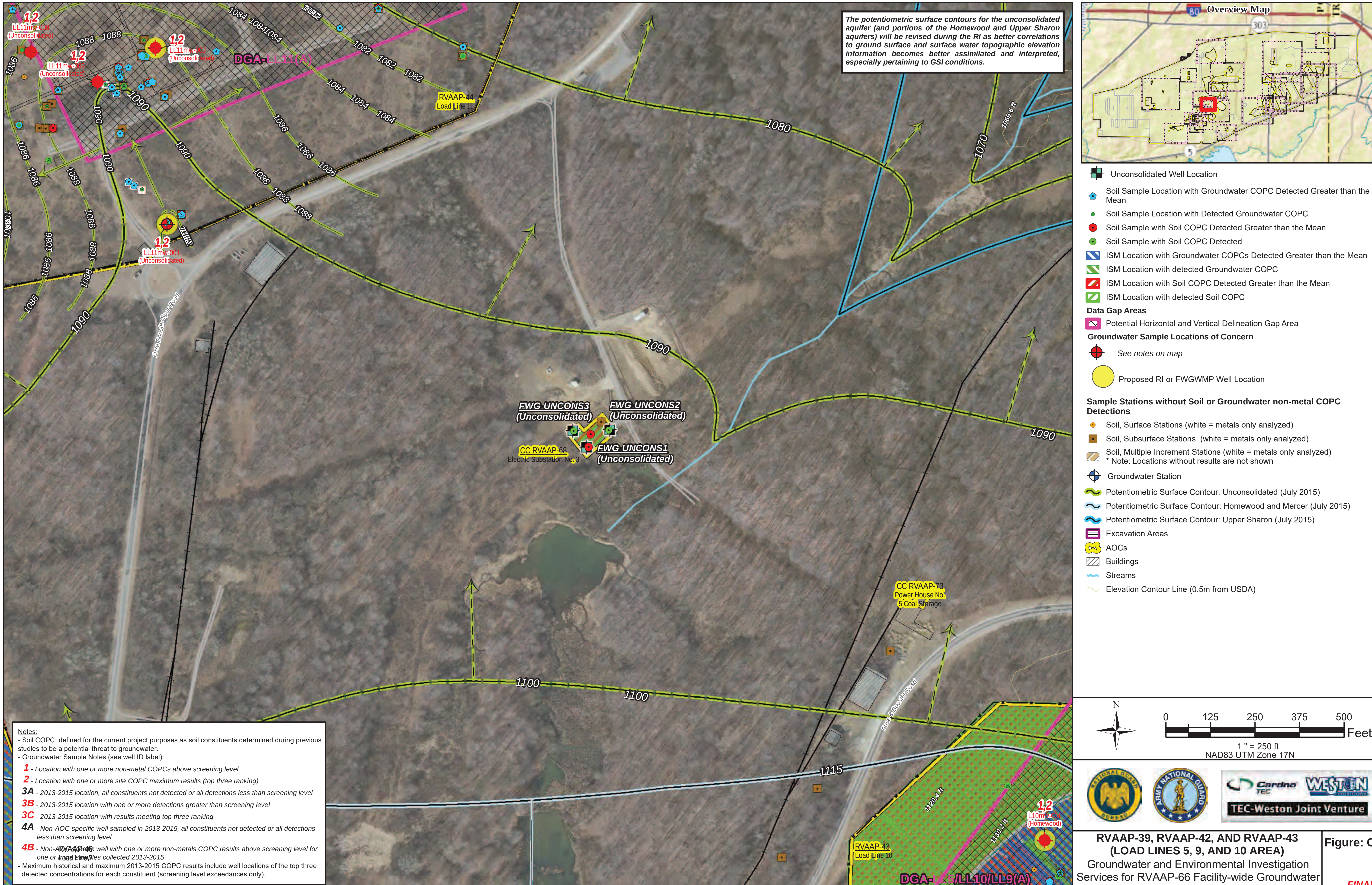

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  - **1** - *Location with one or more non-metal COPCs above screening level*
  - **2** - *Location with one or more site COPC maximum results (top three ranking)*
  - **3A** - *2013-2015 location, all constituents not detected or all detections less than screening level*
  - **3B** - *2013-2015 location with one or more detections greater than screening level*
  - **3C** - *2013-2015 location with results meeting top three ranking*
  - **4A** - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  - **4B** - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Unconsolidated Well Location
Soil Sample Location with Groundwater COPC Detected Greater than the Mean
Soil Sample Location with Detected Groundwater COPC
Soil Sample with Soil COPC Detected Greater than the Mean
Soil Sample with Soil COPC Detected
ISM Location with Groundwater COPCs Detected Greater than the Mean
ISM Location with detected Groundwater COPC
ISM Location with Soil COPC Detected Greater than the Mean
ISM Location with detected Soil COPC

Data Gap Areas

Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

See notes on map
Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

Soil, Surface Stations (white = metals only analyzed)
Soil, Subsurface Stations (white = metals only analyzed)
Soil, Multiple Increment Stations (white = metals only analyzed)
* Note: Locations without results are not shown
Groundwater Station
Potentiometric Surface Contour: Unconsolidated (July 2015)
Potentiometric Surface Contour: Homewood and Mercer (July 2015)
Potentiometric Surface Contour: Upper Sharon (July 2015)
Excavation Areas
AOCs
Buildings
Streams
Elevation Contour Line (0.5m from USDA)

N
0 125 250 375 500 Feet
1 " = 250 ft
NAD83 UTM Zone 17N

Cardno TEC WESTON
TEC-Weston Joint Venture

RVAAP-39, RVAAP-42, AND RVAAP-43 (LOAD LINES 5, 9, AND 10 AREA)
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-14A

FINAL

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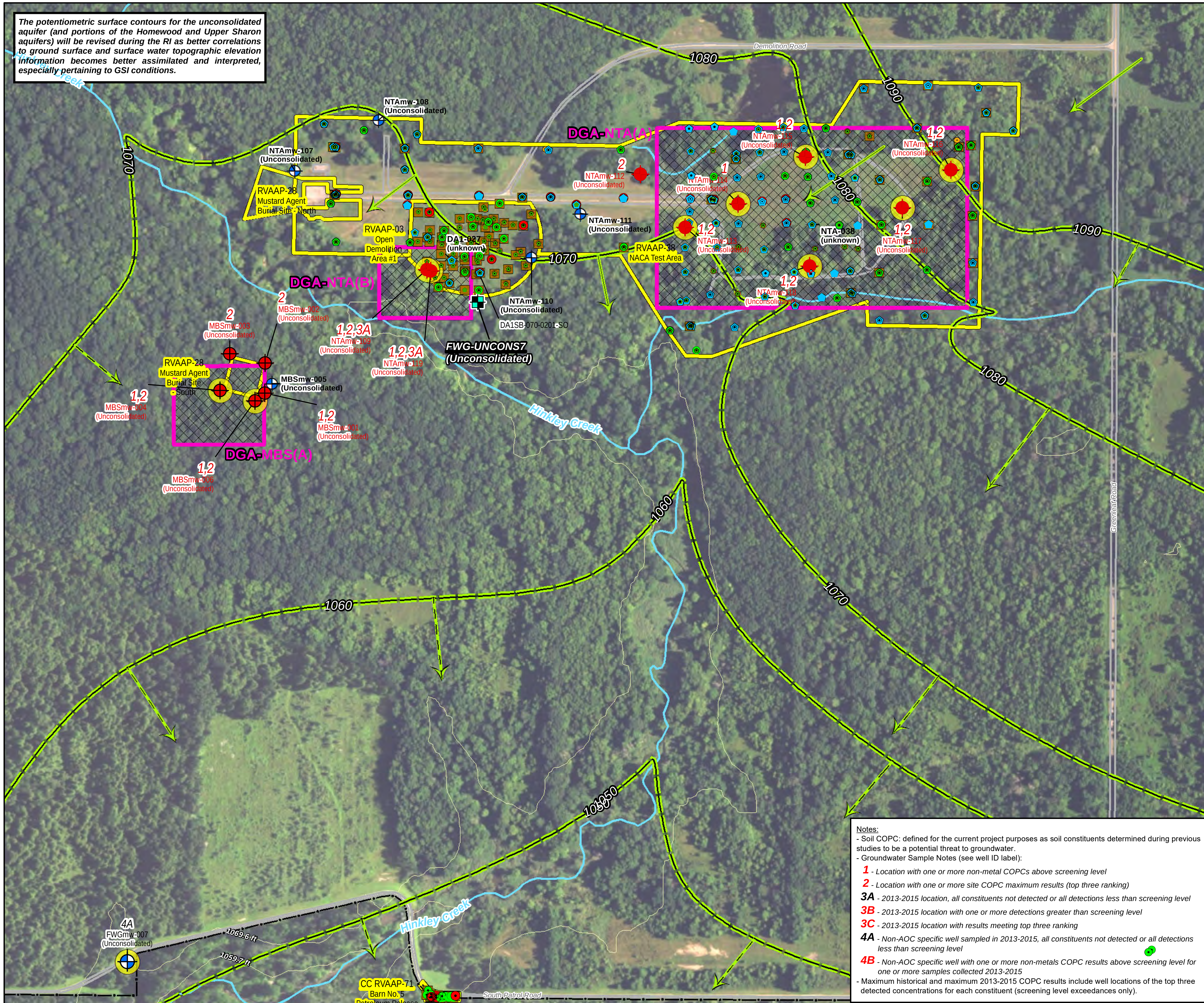

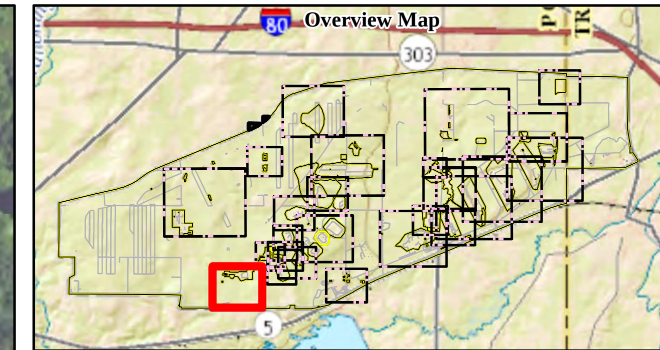

- Proposed Unconsolidated Well Location
- Soil Sample Location with Groundwater COPC Detected Greater than the Mean
- Soil Sample Location with Detected Groundwater COPC
- Soil Sample with Soil COPC Detected Greater than the Mean
- Soil Sample with Soil COPC Detected

Data Gap Areas

- Potential Horizontal and Vertical Delineation Gap Area

Groundwater Sample Locations of Concern

- *See notes on map*
- Proposed RI or FWGWMP Well Location

Sample Stations without Soil or Groundwater non-metal COPC Detections

- Soil, Surface Stations (white = metals only analyzed)
- Soil, Subsurface Stations (white = metals only analyzed)
- Soil, Multiple Increment Stations (white = metals only analyzed)
  * Note: Locations without results are not shown
- Groundwater Station
- Temporary Well Location
- Potentiometric Surface Contour: Unconsolidated (July 2015)
- Excavation Areas
- AOCs
- Buildings
- Streams
- Elevation Contour Line (0.5m from USDA)

N

0 210 420 630 840 Feet

1 " = 425 ft
NAD83 UTM Zone 17N

Notes:
- Soil COPC: defined for the current project purposes as soil constituents determined during previous studies to be a potential threat to groundwater.
- Groundwater Sample Notes (see well ID label):
  1 - *Location with one or more non-metal COPCs above screening level*
  2 - *Location with one or more site COPC maximum results (top three ranking)*
  3A - *2013-2015 location, all constituents not detected or all detections less than screening level*
  3B - *2013-2015 location with one or more detections greater than screening level*
  3C - *2013-2015 location with results meeting top three ranking*
  4A - *Non-AOC specific well sampled in 2013-2015, all constituents not detected or all detections less than screening level*
  4B - *Non-AOC specific well with one or more non-metals COPC results above screening level for one or more samples collected 2013-2015*
- Maximum historical and maximum 2013-2015 COPC results include well locations of the top three detected concentrations for each constituent (screening level exceedances only).

Cardno TEC WESTON
TEC-Weston Joint Venture

RVAAP-28, RVAAP-38, RVAAP-03 AND CC RVAAP-71
Groundwater and Environmental Investigation Services for RVAAP-66 Facility-wide Groundwater
Former Ravenna Army Ammunition Plant
Ravenna, Ohio

Figure: C-24

DRAFT

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Unsolicited Revisions to Appendix A.2 QAPP Draft

Installation: Camp Ravenna/Former RVAAP
Document: RI Work Plan for RVAAP-66 Facility-Wide Groundwater
Date: 13 December 2016

In addition to the Work Plan revisions initiated by the RTCs, the following changes were made to Appendix A.2 QAPP Worksheet #15 Reference Limits and Evaluation:

1. Updated introduction text as follows:

    a. Added the following text after the first sentence of the 1st paragraph: *LOQs/LODs/DLs are evaluated, reviewed, and verified quarterly by the laboratory according to DoD QSM v5.0 requirements; therefore, these values are subject to change. The laboratory will adhere to the most current and verified values. Any deviations from LODs and LOQs presented in this QAPP will be captured during validation and presented in the data usability analysis included in the project reports.*

    b. Added the following text to the end of the 1st paragraph: *If a chemical concentration is equal to or greater than its RSL or MCL, then the chemical is considered to be an exceedance of screening criteria. If a detected chemical does not have either a RSL or MCL, a cleanup goal may need to be developed in coordination with Ohio EPA.*

    c. Clarified the definitions of LOD, LOQ, and PAL (end of 3rd paragraph): *Note that the LOD is considered to be a qualitative result with 99% confidence it is a detection and will be reported as an estimated concentration (assigned a "J" flag). The LOQ is the smallest concentration that produces a quantitative result with known precision and bias and will be reported within the calibration range of the analytical instrument. Per the UFP-QAPP Manual (2005), the PAL is ideally 3 to 10 times lower than the LOQ to allow for variances in uncertainty factors such as calibration and spike recoveries.*

2. Updated all Worksheet #15 tables to show May 2016 EPA RSLs associated with a THQ of 0.1. Previous versions were from June 2015 and were associated with a THQ of 1.0. A review of the updated RSLs resulted in the following changes from the Draft version:

    a. Bromomethane (RSL is 0.75 µg/L; LOD is 0.8 µg/L)

b. Trichloroethene (RSL is 0.28 µg/L; LOD is 0.4 µg/L)

c. 1,2,4-Trichlorobenzene (RSL is 0.4 µg/L; LOD is 1 µg/L)

d. 2,4-Dinitrophenol (RSL is 3.9 µg/L; LOD is 30 µg/L)

e. Dibenzofuran (RSL is 0.79 µg/L; LOD is 1 µg/L)

f. 3-Nitrotolune (RSL is 0.17 µg/L; LOD is 0.2 µg/L)

g. Antimony (RSL is 0.78 µg/L; LOD is 1 µg/L)

h. Cadmium (RSL is 0.92 µg/L; LOD is 1 µg/L)

i. Mercury (RSL is 0.063 µg/L; LOD is 0.2 µg/L)

j. Hexavalent Chromium (RSL is 0.035 µg/L; LOD is 4 µg/L)

k. Free Cyanide (RSL is 0.15 µg/L; LOQ is 10 µg/L)

All of the above analytes meet the Project Reporting Level from the 2011 FWSAP, with the exception of 2,4-dinitrophenol. This indicates that historical Ravenna data would be in line with the current LODs. In addition, the entire project LODs were reviewed and are comparable to the reporting ability of other commercial environmental laboratories.

All other analytes either meet the EPA RSL or were shown in the original Draft document as not meeting the EPA RSL. As in the Draft document, Worksheet #15 analytes are bolded when the laboratory LOD is higher than the screening criteria and shaded when the laboratory LOD is higher than the Project Reporting Level (2011 FWSAP).

3. Table 15-2: Removed PAHs and explosives from the SVOC analyte list. These analytes will be reported as PAHs by Method 8270D SIM and Explosives by Method 8330B, respectively.

4. Corrected LODs and LOQs for nitrate+nitrite, barium, manganese, hexavalent chromium, total cyanide, and free cyanide. The LODs/LOQs for nitrate+nitrite, hexavalent chromium, total and free cyanide were erroneously reported as exceptionally low values due to an error

converting mg/L to µg/L units. The barium and manganese values appear to be typos in the Draft document. Please note that, with the exception of hexavalent chromium and free cyanide, these changes to LODs and LOQs did not impact data usability (i.e., the LODs meet the screening criteria). Hexavalent chromium and free cyanide are shown in the Item 2 list.

5. Corrected CAS # for perchlorate from "sodium perchlorate" to "perchlorates and perchlorate salts". Added the USEPA MCL.

6. Corrected CAS # for potassium.

7. Added the MCL for nitrate+nitrite.

8. Clarified/identified analytes that are common laboratory contaminants (indicated by footnote 4).

9. Mercury by Method 7470A was added (Table 15-13).

10. Hydrazine by Method 8315A Modified was added (Table 15-17).

11. Alkalinity by Method 2320B was added (Table 15-18).

12. pH was added to the Natural Attenuation Parameters (Table 15-19).

Other unsolicited QAPP Worksheet changes:

1. WS#36. Validation will be performed by qualified chemist on the TEC-Weston JV team. The external validation company has been removed from the QAPP.

2. WS#11. References to the use of Automated Data Review (ADR) software for use during data validation was removed. No changes to the type, level, or quality of validation occurred.

3. Minor clarifications and revisions to the bottle types and preservatives shown in QAPP Worksheet #19. In addition, the containers for IDW soil and IDW water were separated from the investigative soil and groundwater bottles for clarification.

4. A clarification was made to Worksheet #24 that for when CCV recoveries are high and samples are reported as not detected, no further corrective action is warranted.

5. A clarification was made to Worksheet #28 for the corrective actions for LCS recovery outliers.

6. Worksheet #25 was updated to include maintenance for GC, GC/MS, HPLC, ICP-MS, and LC/MS instruments.

7. WS#16. Updated schedule.