Final

Facility-wide Groundwater Monitoring Program Plan
RVAAP-66 Facility-wide Groundwater
Addendum for 2019

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract No. W912QR-16-D-0003
Delivery Order No. W912QR-18-F-0337

Prepared for:

United States Army Corps of Engineers
Louisville District

Prepared by:

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May 3, 2019

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14. ABSTRACT

This Addendum provides the sampling and analytical approach to continue the Facility-wide Groundwater Monitoring Program (FWGWMP) Plan in support of the Ravenna Army Ammunition Plant Restoration Program into 2019. This report provides a summary of data collected to date, a matrix to decide if and where additional samples should be collected, and summarizes wells and parameters to be collected for the 2019 FWGWMP activities.

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Ohio Environmental Protection Agency

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Jon Husted, Lt. Governor
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May 24, 2019

RE: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859036

Mr. David Connolly
Army National Guard Directorate
ARNGD-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Subject: Approval of the "Final Facility-Wide Groundwater Monitoring Plan, RVAAP-66 Facility-Groundwater, Addendum for 2019," Dated May 3, 2019

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA) has received the "Final Facility-Wide Groundwater Monitoring Plan, RVAAP-66 Facility-Groundwater, Addendum for 2019" at the Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, Dated May 3, 2019. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) on May 6, 2019. The document was prepared for the Army National Guard Directorate by Leidos.

The final document was reviewed by personnel from Ohio EPA's DERR and Division of Drinking and Ground Waters (DDAGW). 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

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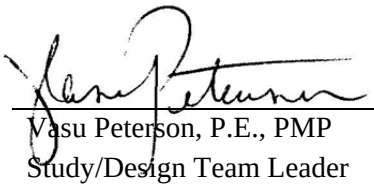
CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Leidos has completed the Facility-wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-wide Groundwater Addendum for 2019 for the Ravenna Army Ammunition Plant Restoration Program. 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 assumptions; 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 United States Army Corps of Engineers (USACE) policy. In addition, an independent verification was performed to ensure all applicable changes were made per regulatory and Army comments.



Vasu Peterson, P.E., PMP
Study/Design Team Leader

May 3, 2019
Date

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Independent Technical Review Team Leader

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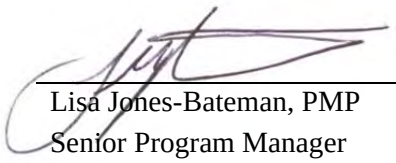
Significant concerns and the explanation of the resolution are documented within the project file. As noted above, all concerns resulting from independent technical review of the project have been considered.



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Senior Program Manager

May 3, 2019
Date

Final

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600 Martin Luther King, Jr. Place
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May 3, 2019

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ARNG = Army National Guard.
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Ohio EPA = Ohio Environmental Protection Agency.
REIMS = Ravenna Environmental Information Management System.
SWDO = Southwest District Office.
USACE = U.S. Army Corps of Engineers.

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ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
Army	U.S. Department of the Army
ARNG	Army National Guard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CJAG	Camp James A. Garfield
COC	Chemical of Concern
COPC	Chemical of Potential Concern
DFFO	Director's Final Findings and Orders
DoD	U.S. Department of Defense
FS	Feasibility Study
FWGW	Facility-wide Groundwater
FWGWMP	Facility-wide Groundwater Monitoring Program
IRP	Installation Restoration Program
MCL	Maximum Contaminant Level
Ohio EPA	Ohio Environmental Protection Agency
P.E.	Professional Engineer
PCB	Polychlorinated Biphenyl
PMP	Project Management Professional
PP	Proposed Plan
PWS	Performance Work Statement
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
ROD	Record of Decision
RSL	Regional Screening Level
RVAAP	Ravenna Army Ammunition Plant
S.U.	Standard Unit
SAP	Sampling and Analysis Plan
SRC	Site-Related Compound
SVOC	Semi-volatile Organic Compound
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

Leidos has been contracted by the U.S. Army Corps of Engineers (USACE), Louisville District to execute the performance work statement (PWS) titled "Groundwater Investigation and Reporting Services, Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Camp James A. Garfield (CJAG) Joint Military Training Center, Portage and Trumbull Counties, Ohio." This work is being performed under a firm-fixed price basis in accordance with USACE, Louisville District Contract No. W912QR-16-D-0003, Delivery Order No. W912QR-18-F-0337. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation and cleanup are occurring under the U.S. Department of Defense (DoD) Installation Restoration Program (IRP). Activities include monitoring an extensive network of groundwater monitoring wells to determine nature and extent of groundwater impacts, provide additional information in support of hydrogeologic and fate-and-transport models, evaluate potential exit pathways, and evaluate vertical contaminant distribution and/or particle inflow/outflow through the facility.

1.1 PURPOSE

The Director's Final Findings and Orders (DFFO) was issued to the U.S. Department of the Army (Army) on June 10, 2004. The purpose of the DFFO is for the Army to develop and implement:

- A Remedial Investigation/Feasibility Study (RI/FS), Proposed Plan (PP), Record of Decision (ROD), or other appropriate document and remedy for each area of concern (AOC) or appropriate group of AOCs at the former RVAAP, and
- A Facility-wide Groundwater (FWGW) investigation, monitoring, and remediation program at the former RVAAP.

Section 15 of the DFFO outlines the requirements of the Facility-wide Groundwater Monitoring Program (FWGWMP). The purpose of this 2019 Addendum is to satisfy the requirements of Section 15d that specifies the FWGWMP Plan will "utilize an iterative process, with an annual review and revision cycle to accommodate the addition or deletion of wells from the groundwater monitoring network."

This Addendum provides an update to the FWGWMP Plan for 2019, including the identification of wells to be sampled as part of the semi-annual FWGWMP.

1.2 OBJECTIVES

The primary objectives of the facility-wide monitoring well network in this 2019 Addendum are to assess potential exit pathways, assess nature and extent data gaps, and monitor contaminant levels related to historical RVAAP activities (e.g., explosives/propellants, volatile organic compounds [VOCs], semi-volatile organic compounds [SVOCs], pesticides, polychlorinated biphenyls [PCBs]) at selected source area wells for trend analysis. This 2019 Addendum is a supplement to the FWGWMPP Plan and discusses the subset of currently existing monitoring wells at the former RVAAP that will be monitored on a semi-annual basis (spring and fall 2019) and the chemicals of

potential concern (COPCs) that will be evaluated at each selected well. Metals concentrations also will be determined in groundwater, but the evaluation of the nature and extent of metals constituents representing a release requiring a corrective action response is dependent upon finalization of the background concentrations for metals.

Results of the 2018 FWGWMP sampling were reviewed to determine the presence of site-related compounds (SRCs) and to evaluate contaminant concentration trends within individual wells. Wells were selected for inclusion in the 2019 semi-annual FWGWMP based on the following criteria:

- FWGWMP Criterion 1: Wells representing critical exit pathway monitoring points (generally a carryover from the 2018 program).
- FWGWMP Criterion 2: Wells representing primary AOC-specific contaminant source area conditions indicated to be potentially increasing or otherwise potentially unstable plume conditions.
- FWGWMP Criterion 3: Wells with 2018 sampling results representing a historical maximum concentration above regulatory screening levels for one or more SRCs in groundwater (based on AOC-specific sampling histories).
- FWGWMP Criterion 4: Co-located wells used to establish the vertical distribution of contaminants within the stratigraphic sequence.

Contaminant trend analysis of the 2018 sampling results was conducted by reviewing the well specific sampling histories and time series graphs provided in the *Facility-wide Groundwater Monitoring Program RVAAP-66 Facility-wide Groundwater Annual Report for 2018* (2018 Annual Report) (Leidos 2019). With the exception of Resource Conservation and Recovery Act (RCRA) wells, which will be analyzed for the same parameters as 2018, groundwater monitoring wells sampled in 2018 that do not meet the FWGWMP sampling criteria listed above will not be recommended for sampling in 2019. The 2019 FWGWMP will generally include sampling of wells identified with one or more screening level exceedances in 2018. In addition, the 2019 FWGWMP will include necessary critical migration exit pathway well points and vertical delineation well pairs. A detailed summary of the proposed analytical testing suite from 2018 proposed for 2019 is discussed in Section 3.0.

1.3 REPORT ORGANIZATION

The remaining sections of this Annual Report are organized as follows:

- Section 2.0. Background
- Section 3.0. Scope of Work Under the Addendum
- Section 4.0. Schedule
- Section 5.0. References.

2.0 BACKGROUND

In 2004, the Army and Ohio Environmental Protection Agency (Ohio EPA) finalized the *Facility-wide Groundwater Monitoring Program Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (Portage Environmental 2004) for the former RVAAP, now known as CJAG Joint Military Training Center. The FWGWMP was initiated in April 2005 with quarterly sampling of 36 FWGWMP monitoring wells. Fourteen of these wells were identified as "background wells," and the remaining wells were located at various AOCs at CJAG. Five RCRA wells (RQLmw-007, RQLmw-008, RQLmw-009, DETmw-003, DETmw-004) were incorporated into the FWGWMP after May 2005 and are sampled semi-annually. Beginning in fiscal year 2008, the FWGWMP was expanded to include the characterization of groundwater from 243 existing monitoring wells at the facility.

The Facility-wide Groundwater Monitoring Program Plan RVAAP-66 Facility-wide Groundwater Addendum (EQM 2012a) prescribed the installation of 38 additional monitoring wells to complete the RI hydrogeologic system and contaminant fate and transport modeling. New wells were sampled quarterly until at least four quarters of data were obtained from each location. The five RCRA wells remained on a semi-annual sampling schedule.

As a supplement to the FWGWMP Groundwater Addendum, the Army submitted the *Facility-wide Groundwater Monitoring Program Plan RVAAP-66 Facility-wide Groundwater Semiannual Monitoring Addendum* (EQM 2012b), which proposed that the FWGW monitoring schedule be modified from quarterly to semi-annually (January and July events only). New RI wells remained on a quarterly sampling schedule, beginning in April 2012. The semi-annual well network eliminated wells that provided redundancy or minimal information on groundwater quality or fate and transport migration. A subset of the well network was selected in association with or paired with several of the RI wells to assess horizontal and/or vertical contaminant distribution, provide upgradient data for the various site-wide models, identify potential exit pathway wells, and provide continued monitoring of the five RCRA wells at the site. Forty-two wells were selected as part of the semi-annual well network. The *Facility-wide Groundwater Monitoring Program Plan RVAAP-66 Additional Well Installation Addendum* (EQM 2013) proposed that the FWGW monitoring well network schedule be modified. Wells were selected that exhibited COPCs, and wells were eliminated that were redundant or provided minimal information on groundwater quality or fate and transport migration.

The *Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater* (herein referred to as the RIWP; TEC-Weston 2016) serves as a supplement to the FWGWMP Plan. The RIWP discussed the subset of existing monitoring wells that were to be monitored in 2016 and the COPCs that were to be evaluated at each selected well. Forty-six existing wells were identified for semi-annual sampling in May and November 2016 to evaluate potential off-site migration along with potential source area attenuation and temporal fluctuations. Results of these sampling activities are summarized in the *Facility-wide Groundwater Monitoring Program, RVAAP-66 Facility-wide Groundwater, Annual Report for 2016* (TEC-Weston 2017).

FWGW RI activities in 2016 included sampling of 124 previously existing wells and the installation of 11 new monitoring wells for evaluation of nature and extent of groundwater contamination. The RI field activities included installation of four wells for the purposes of completing a background study for metals. Sampling results for these wells and evaluation of background conditions for inorganic constituents will be provided in the pending Background Study for Metals.

As summarized in the *Facility-wide Groundwater Monitoring Program, RVAAP-66 Facility-wide Groundwater, Annual Report for 2017* (TEC-Weston 2018a), 96 existing wells and 15 new wells that were installed in 2016 were included in the FWGWMP semi-annual sampling in 2017. The *Facility-wide Groundwater Monitoring Addendum for 2018* (TEC-Weston 2018b) discusses the subset of monitoring wells that were included in the semi-annual sampling events in 2018 and the COPCs that were evaluated at each selected well.

In June 2018, during the first semi-annual event of 2018, 79 monitoring wells were sampled, including 4 of the 5 RCRA wells. Leidos conducted the second semi-annual monitoring well sampling event of 2018 under the FWGWMP in October-November 2018. A total of 81 monitoring wells were sampled, including all 5 of the RCRA wells. This sampling event also included seven groundwater monitoring wells installed as part of the second semi-annual event of 2018. Three permanent wells (SCLmw-001, SCLmw-002, SCLmw-003) were installed at Sand Creek Disposal Road Landfill; three temporary wells (ES3tw-001, ES3tw-002, ES3tw-003) were installed at Electric Substation No. 3; and one temporary well (DA1tw-001) was installed at Open Demolition Area # 1. The former RVAAP presently has 301 restoration program monitoring wells. A summary of results of groundwater monitoring activities conducted in 2018, including a screening to current regulatory standards, is provided in the *Facility-wide Groundwater Monitoring Program, RVAAP-66 Facility-wide Groundwater, Annual Report for 2018* (Leidos 2019).

3.0 SCOPE OF WORK UNDER THE ADDENDUM

The 2019 Addendum is intended to further address AOC-specific nature and extent data gaps in the historical sampling dataset, as indicated by an analysis of results through 2018. To this end, 72 wells (including 5 RCRA wells) have been selected for sampling during the semi-annual events in 2019. Monitoring well sampling and analytical testing will be conducted in accordance with the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) updates provided with the RIWP (TEC-Weston 2016).

3.1 pH MONITORING WELLS

Selection of existing wells for semi-annual pH monitoring was made based on anomalous pH values outside the typical range of natural groundwater (i.e., 5 to 9 standard units [S.U.s]). Ten wells will be tested in 2019 for alkalinity, sulfate/sulfide, and nitrate/nitrite. These 10 wells were included in this assessment in 2018; however, RQLmw-014 will no longer be monitored for pH conditions based on consistent normal range readings in its sampling history (mean pH of 5.75):

- Homewood Aquifer: FBQmw-171; FBQmw-174; FBQmw-175.
- Unconsolidated Aquifer: LL1mw-086 (alkalinity only); LL1mw-088 (alkalinity only).
- Upper Sharon Aquifer: LL1mw-083; LL1wmw-084; RQLmw-011; RQLmw-012; RQLmw-013.

The annual FWGWMP reporting for these wells will include discussion of trends for pH values. An evaluation of secondary geochemical parameters potentially associated with the anomalous pH conditions will be provided in the Annual Report.

3.2 NEW WELLS INSTALLED IN 2018

To support the FWGW RI, four temporary and three permanent groundwater monitoring wells were installed in 2018. These well installations are described in the 2018 Annual Report (Leidos 2019). The following subsections summarize the analytical results and sampling to be performed in 2019.

3.2.1 Open Demolition Area #1

On October 24, 2018, one temporary well (DA1tw-001) was installed south of the AOC boundary of Open Demolition Area #1. A temporary bladder pump was installed immediately following development. On November 1, 2018, a groundwater sample was collected from DA1tw-001 for explosives analysis.

The analytical results from the groundwater sample did not have detections of explosives. Accordingly, this temporary well will not be sampled again in 2019, and the temporary well will be abandoned.

3.2.2 Sand Creek Disposal Road Landfill

From October 25-29, 2018, three permanent monitoring wells were installed at the Sand Creek Disposal Road Landfill. Monitoring wells SCLmw-001 and SCLmw-002 were installed within the floodplain of Sand Creek, downgradient from the hillside used to dispose of waste. Monitoring well SCLmw-003 was installed upgradient of the hillside. On November 1, 2018, a groundwater sample was collected from SCLmw-002, and on November 2, 2018, groundwater samples were collected from SCLmw-001 and SCLmw-003.

The groundwater samples from these three wells were sent for full suite analysis. The results are summarized below:

- VOCs – The only VOC detected was methylene chloride in each well, with a maximum estimated concentration of 0.00085J mg/L at SCLmw-003.
- SVOCs
  - SVOCs were not detected in SCLmw-001 or SCLmw-002.
  - SCLmw-003 had estimated concentrations of six SVOCs, all at concentrations less than the tap water Regional Screening Level (RSL).
- Explosives
  - No explosives were detected at SCLmw-001 or SCLmw-003.
  - The only explosive detected at SCLmw-002 was hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) at an estimated concentration of 0.00017 mg/L.
- PCBs – None detected.
- Pesticides – None detected.
- Metals
  - Hexavalent chromium was not detected in SCLmw-001 or SCLmw-003. SCLmw-002 had an estimated concentration of 0.0044J mg/L.
  - The only metals to exceed the screening criteria were antimony, manganese, iron, and arsenic.

These newly installed wells will be sampled for the RVAAP full suite constituents for three additional quarters in 2019.

3.2.3 Electric Substation No. 3

On October 23, 2018, three temporary wells (ES3tw-001, ES3tw-002, ES3tw-003) were installed within the footprint of the since demolished Electric Substation No. 3. Groundwater samples were collected for naphthalene analysis. Naphthalene was not detected based on the analytical results from these groundwater samples. Accordingly, these temporary wells will not be sampled again in 2019 and will be abandoned.

3.3 RCRA WELLS

RCRA wells will be sampled semi-annually as FWGWMP wells. The RCRA wells include the Ramsdell Quarry Landfill wells (RQLmw-007, RQLmw-008, RQLmw-009) and the Open Demolition Area #2 wells (DETmw-003, DETmw-004). The sampling suite for these wells is consistent with analyses conducted in 2018. Although these wells were designated as RCRA wells, they are being monitored as part of the CERCLA program at CJAG in accordance with the DFFOs and will be included in evaluations conducted as part of the pending FWGW RI.

3.4 CERCLA WELLS

Selection of wells for the semi-annual FWGWMP was made based on consideration of the following criteria. Wells in the below bulleted list denoted with an asterisk (*) indicate wells that meet more than one of the criteria for additional sampling. A summary of 2018 FWGWMP results and a description of the selection rationale for wells listed below and included in the 2019 FWGWMP is provided in Table 3-1.

- **FWGWMP Criterion 1**: Wells representing critical exit pathway monitoring points (i.e., located along the CJAG boundary):
  - ***Unconsolidated Aquifer***: LL1mw-064, LL1mw-065, LL1mw-086, LL1mw-087, LL1mw-088, LL4mw-200*, LL12mw-247, FWGmw-004, FWGmw-007, FWGmw-011*, FWGmw-015*
  - ***Upper Sharon Aquifer***: LL2mw-059*, LL3mw-237, LL3mw-244, LL3mw-246, FWGmw-012*, FWGmw-020*, FWGmw-021, FWGmw-024*
  - ***Basal Sharon Conglomerate Aquifer***: SCFmw-004, FWGmw-018.
- **FWGWMP Criterion 2**: Wells representing primary AOC-specific contaminant source area conditions routinely monitored (e.g., RCRA monitoring well locations) or indicated to be potentially increasing or otherwise potentially unstable plume conditions:
  - ***Unconsolidated Aquifer***: CBPmw-008, DETmw-003*, DETmw-004, EBGmw-125*, LL12mw-185, LL12mw-242, LL12mw-245, FBQmw-176, NTAmw-119*, WBGmw-006*, WBGmw-009*
  - ***Homewood Aquifer***: FBQmw-174, FBQmw-175, LL7mw-006*, LL10mw-003*
  - ***Upper Sharon Aquifer***: EBGmw-131*, FWGmw-023, LL1mw-080, LL1mw-081*, LL1mw-083, LL1mw-084*, LL2mw-059*, LL2mw¬264*, LL2mw-267, RQLmw-007*, RQLmw-008*, RQLmw-011*, RQLmw-012, RQLmw-013
  - ***Basal Sharon Conglomerate Aquifer***: None currently proposed.
- **FWGWMP Criterion 3**: Wells with non-metals (including cyanide) historical maximum concentrations from the 2016 or 2017 sampling events (Note: There were no historical maximum non-metals concentrations from the 2018 sampling events):
  - ***Unconsolidated Aquifer***: DETmw-003*, EBGmw-125*, FWGmw-011*, LL4mw-200*, LL11mw-005*, LL12mw-187, NTAmw-119*
  - ***Homewood Aquifer***: FBQmw-171, FBQmw-172, LL7mw-001, LL7mw-006*, LL10mw-003*

- ***Upper Sharon Aquifer***: CBPmw-009, DA2mw-115*, EBGmw-131*, LL1mw-081*, LL1mw-084*, LL2mw-059*, LL2mw-264*, LL3mw-234, LL12mw-183, RQLmw-007*, RQLmw-008*, RQLmw-009, RQLmw-016
- ***Basal Sharon Conglomerate Aquifer***: None.

- **FWGWMP Criterion 4**: Co-located wells used to evaluate the vertical distribution of contaminants within the stratigraphic sequence (includes all wells installed to date).
  - *East of Ramsdell Quarry Landfill*: FWGmw-011 (Unconsolidated Aquifer), FWGmw-012 (Upper Sharon Aquifer)
  - *Erie Burning Grounds*: EBGmw-125* (Unconsolidated Aquifer), EBGmw-131 (Upper Sharon Aquifer)
  - *Load Line 10:* LL10mw-005* (Homewood Aquifer), FWGmw-022 (Upper Sharon Aquifer), FWGmw-019 (Basal Sharon Conglomerate Aquifer)
  - *Post Boundary at Load Line 12*: FWGmw-020* (Upper Sharon Aquifer), FWGmw-018* (Basal Sharon Conglomerate Aquifer)
  - *Open Detonation Area 2*: DETmw-003* (Unconsolidated Aquifer), DA2mw-115* (Upper Sharon Aquifer)
  - *Winklepeck Burning Grounds*: WBGmw-009* (Unconsolidated Aquifer), WBGmw-020 (Upper Sharon Aquifer)
  - *Winklepeck Burning Grounds*: WBGmw-006* (Unconsolidated Aquifer), WBGmw-021 (Upper Sharon Aquifer)
  - *Post Boundary South of the CJAG Main Cantonment Area*: FWGmw-015* (Unconsolidated Aquifer), FWGmw-016 (Upper Sharon Aquifer).

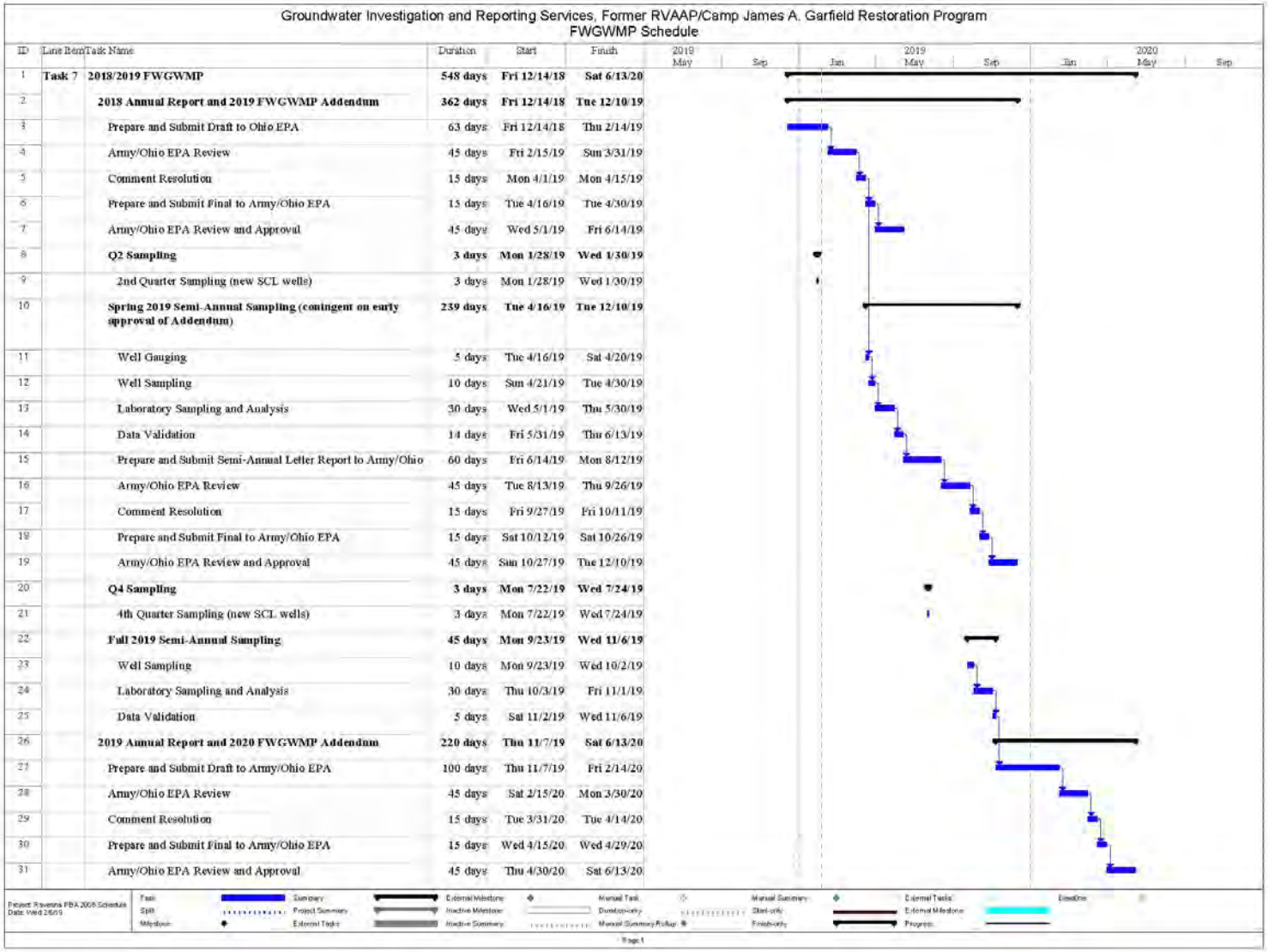
Results for 2018 metals constituent testing indicated screening level exceedances for aluminum, antimony, arsenic, iron, manganese, and nickel. Since the background study for metals is in progress, all 2018 sample locations with metals exceeding current screening criteria will be sampled and analyzed again in 2019. Metals sampling in 2019 will include new wells installed in 2018 at the Sand Creek Disposal Road Landfill.

The 2018 sampling results for cyanide testing indicate a range of concentrations generally consistent with the 2017 testing. The detected concentrations in 2018 are largely less than 10 µg/L (ranging from 2.1 to 25 µg/L) and are below the maximum contaminant level (MCL) of 200 µg/L.

Table 3-1 provides a comprehensive summary of the proposed wells, 2018 results summary, and rationale for their inclusion in the FWGW monitoring program. Figure 3-1 show the wells to be sampled during the semi-annual monitoring events.

The list of analytes for 2019 reflects the potential chemicals of concern (COCs) within certain areas of the site or immediately downgradient from potential source areas, as appropriate. The refined analyte list for the semi-annual wells is presented in Table 3-2. The analytical methods for these analytes are provided in Table 3-3. Evaluation of data collected during 2019 will be conducted in accordance with the Final FWGW RI Work Plan, including the supporting SAP and QAPP updates (TEC-Weston 2016).

4.0 SCHEDULE



ID	Line Item	Task Name	Duration	Start	Finish
1	Task 7	**2018/2019 FWGWMP**	**548 days**	**Fri 12/14/18**	**Sat 6/13/20**
2		**2018 Annual Report and 2019 FWGWMP Addendum**	**362 days**	**Fri 12/14/18**	**Tue 12/10/19**
3		Prepare and Submit Draft to Ohio EPA	63 days	Fri 12/14/18	Thu 2/14/19
4		Army/Ohio EPA Review	45 days	Fri 2/15/19	Sun 3/31/19
5		Comment Resolution	15 days	Mon 4/1/19	Mon 4/15/19
6		Prepare and Submit Final to Army/Ohio EPA	15 days	Tue 4/16/19	Tue 4/30/19
7		Army/Ohio EPA Review and Approval	45 days	Wed 5/1/19	Fri 6/14/19
8		**Q2 Sampling**	**3 days**	**Mon 1/28/19**	**Wed 1/30/19**
9		2nd Quarter Sampling (new SCL wells)	3 days	Mon 1/28/19	Wed 1/30/19
10		**Spring 2019 Semi-Annual Sampling (contingent on early approval of Addendum)**	**239 days**	**Tue 4/16/19**	**Tue 12/10/19**
11		Well Gauging	5 days	Tue 4/16/19	Sat 4/20/19
12		Well Sampling	10 days	Sun 4/21/19	Tue 4/30/19
13		Laboratory Sampling and Analysis	30 days	Wed 5/1/19	Thu 5/30/19
14		Data Validation	14 days	Fri 5/31/19	Thu 6/13/19
15		Prepare and Submit Semi-Annual Letter Report to Army/Ohio	60 days	Fri 6/14/19	Mon 8/12/19
16		Army/Ohio EPA Review	45 days	Tue 8/13/19	Thu 9/26/19
17		Comment Resolution	15 days	Fri 9/27/19	Fri 10/11/19
18		Prepare and Submit Final to Army/Ohio EPA	15 days	Sat 10/12/19	Sat 10/26/19
19		Army/Ohio EPA Review and Approval	45 days	Sun 10/27/19	Tue 12/10/19
20		**Q4 Sampling**	**3 days**	**Mon 7/22/19**	**Wed 7/24/19**
21		4th Quarter Sampling (new SCL wells)	3 days	Mon 7/22/19	Wed 7/24/19
22		**Fall 2019 Semi-Annual Sampling**	**45 days**	**Mon 9/23/19**	**Wed 11/6/19**
23		Well Sampling	10 days	Mon 9/23/19	Wed 10/2/19
24		Laboratory Sampling and Analysis	30 days	Thu 10/3/19	Fri 11/1/19
25		Data Validation	5 days	Sat 11/2/19	Wed 11/6/19
26		**2019 Annual Report and 2020 FWGWMP Addendum**	**220 days**	**Thu 11/7/19**	**Sat 6/13/20**
27		Prepare and Submit Draft to Army/Ohio EPA	100 days	Thu 11/7/19	Fri 2/14/20
28		Army/Ohio EPA Review	45 days	Sat 2/15/20	Mon 3/30/20
29		Comment Resolution	15 days	Tue 3/31/20	Tue 4/14/20
30		Prepare and Submit Final to Army/Ohio EPA	15 days	Wed 4/15/20	Wed 4/29/20
31		Army/Ohio EPA Review and Approval	45 days	Thu 4/30/20	Sat 6/13/20

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5.0 REFERENCES

EQM (Environmental Quality Management, Inc.) 2012a. *Facility-wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-wide Groundwater Addendum*. January 2012.

EQM 2012b. *Facility-wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-wide Groundwater, Semi-Annual Monitoring Addendum*. January 2012.

EQM 2013. *Facility-wide Groundwater Monitoring Program Plan, RVAAP-66 Additional Well Installation Addendum.* September 2013.

Leidos 2019. *Facility-wide Groundwater Monitoring Program Annual Report for 2018.* January 2019.

Portage Environmental 2004. *Facility-wide Groundwater Monitoring Program Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio.* September 2004.

TEC-Weston 2016. *Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater*. December 2016.

TEC-Weston 2017. *Facility-wide Groundwater Monitoring Program, RVAAP-66 Facility-wide Groundwater, Annual Report for 2016.* May 2017.

TEC-Weston 2018a. *Facility-wide Groundwater Monitoring Program, RVAAP-66 Facility-wide Groundwater, Annual Report for 2017.* July 2018.

TEC-Weston 2018b. *Facility-wide Groundwater Monitoring Addendum for 2018.* June 2018.

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FIGURES

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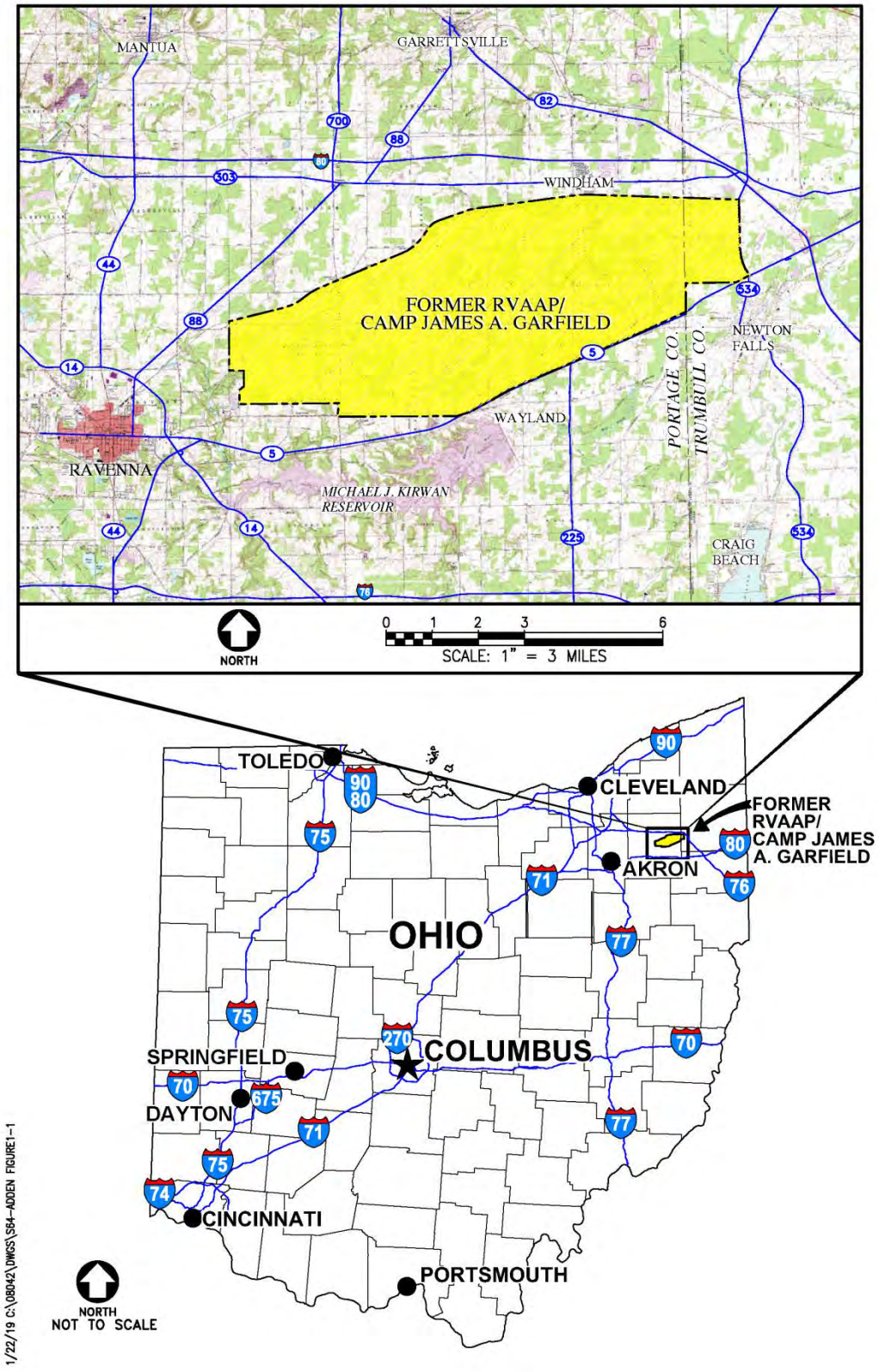

Figure 1-1. General Location and Orientation of the Former RVAAP/CJAG

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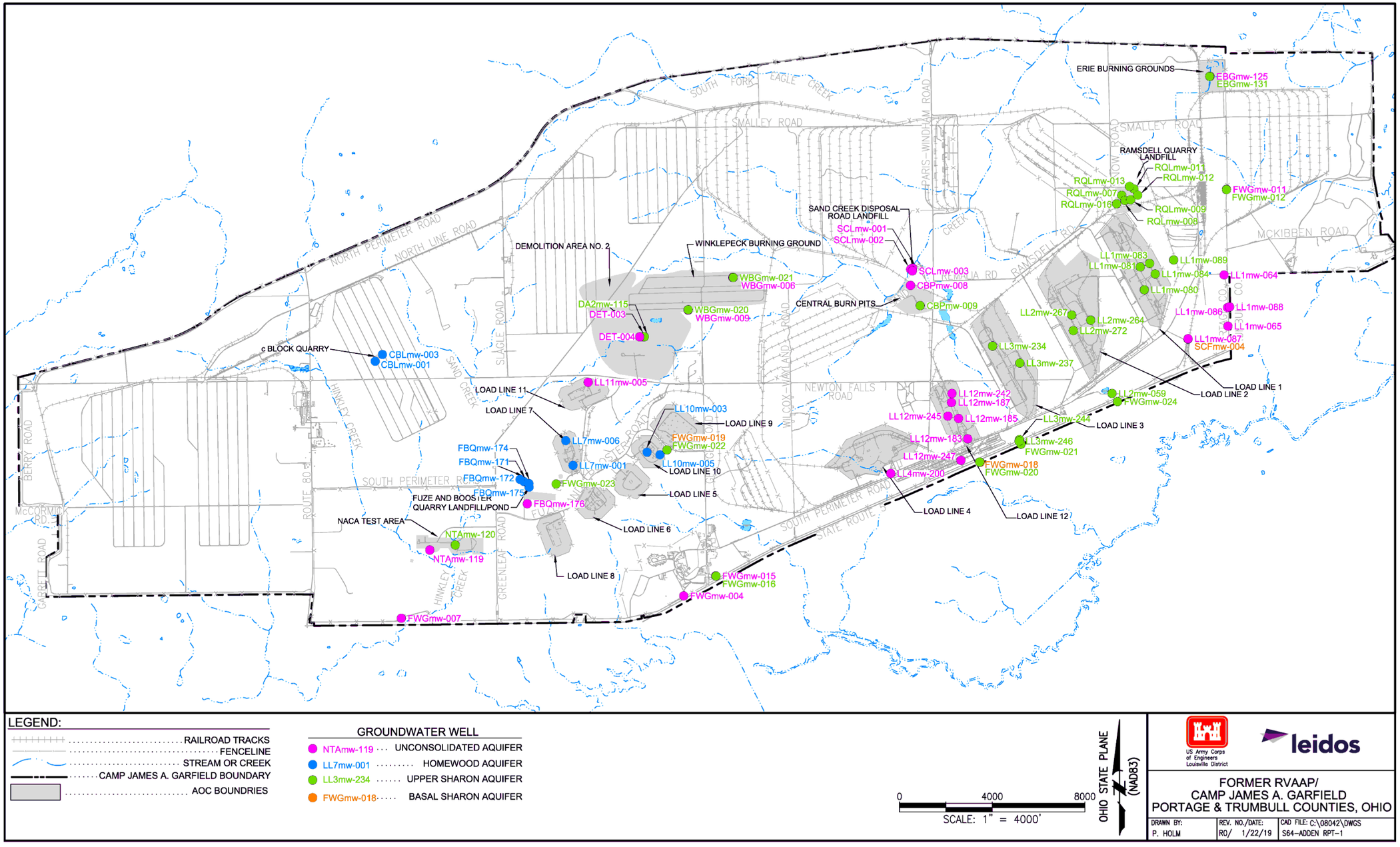

Figure 3-1. 2019 FWGWMP Wells

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TABLES

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Table 3-1. Recommended FWGWMP Wells for 2019

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
1	Central Burn Pits	CBPmw-008	Cyanide only	**Unconsolidated** monitoring well sampled in 2018 for cyanide.	• Cyanide had an estimated concentration of 0.0045J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
2	Central Burn Pits	CBPmw-009	Cyanide only	**Upper Sharon** monitoring well sampled in 2018 for cyanide. The historical well result high for total cyanide was reported in 2017.	• Cyanide had an estimated concentration of 0.0046J mg/L in June 2018 and 0.0022J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
3	C Block Quarry	CBLmw-001	SVOCs, PCBs, explosives, cyanide, anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for in the first semi-annual field event only for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization of metals at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected. Nitrate was below screening criteria, and sulfate does not have a screening criteria. • Of the metals, only iron exceeded the screening criteria. • pH was 5.6 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, cyanide, anions, and hexavalent chromium, additional sampling of these parameters is not warranted. • Although iron was detected, sampling at CBL wells was limited to provide updated metals characterization. • Additional sampling is not recommended.
4	C Block Quarry	CBLmw-002	SVOCs, PCBs, explosives, cyanide, anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected. Nitrate was below screening criteria, and sulfate does not have a screening criteria. • No metals exceeded the screening criteria. • pH was 5.5 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite, additional sampling of these constituents is not warranted. • Although detected, nitrate and metals did not exceed the screening criteria. • Additional sampling is not recommended.
5	C Block Quarry	CBLmw-003	SVOCs, PCBs, explosives, cyanide, anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected. Nitrate was below screening criteria, and sulfate does not have a screening criterion. • No metals exceeded the screening criteria. • Cyanide was detected at an estimated concentration of 0.0037J mg/L, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • pH was 6.1 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, hexavalent chromium, sulfide, and nitrite, additional sampling of these constituents is not warranted. • Although detected, sulfate, nitrate, and metals did not exceed screening criteria and cyanide was below the MCL. • Additional sampling is not recommended.
6	C Block Quarry	CBLmw-004	SVOCs, PCBs, explosives, cyanide; anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected; nitrate was below screening criteria. • No metals exceeded the screening criteria. • pH was 6 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite, additional sampling of these constituents is not warranted. • Although detected, sulfate, nitrate, and metals did not exceed screening criteria. • Additional sampling is not recommended.
7	Erie Burning Grounds	EBGmw-125	Cyanide only	**Unconsolidated** monitoring well sampled in 2018 for cyanide. The historical well result high for total cyanide was reported in 2017.	• Cyanide had concentration of 0.02 mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
8	Erie Burning Grounds	EBGmw-131	Cyanide only	**Upper Sharon** monitoring well sampled for cyanide with historical maximum cyanide concentrations reported in 2016.	• Cyanide had an estimated concentration of 0.004J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
9	SE/Load Line 1	LL1mw-064	Explosives, metals	**Unconsolidated** monitoring well located downgradient from Load Line 1; sampled to monitor potential groundwater exit pathway.	• Explosives were not detected in June or October 2018. • No metals exceeded the screening criteria except iron and manganese.	• In the absence of explosives detections, additional sampling of explosives is not warranted. • Continue to monitor metals in this sentinel well.
10	SE/Load Line 1	LL1mw-065	Phthalates, explosives, metals	**Unconsolidated** monitoring well located downgradient from Load Line 1; sampled to monitor potential groundwater exit pathway.	• No SVOCs (phthalates) or explosives were detected in June or October 2018. • No metals exceeded the screening criteria except manganese, which exceeded the screening criteria in both June and October 2018.	• In the absence of detections of SVOCs, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
11	Load Line 1	LL1mw-080	Explosives	**Upper Sharon** well characterized for explosives.	• In June and October 2018, 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX exceeded the screening criteria. • In June 2018, only 1,3-DNB and 2,4-DNT exceeded the screening criteria with estimated concentrations. Neither chemical had a detected concentration in October 2018.	• Continue to monitor explosives.
12	Load Line 1	LL1mw-081	Explosives, cyanide	**Upper Sharon** well with historical maximum cyanide concentration reported in 2016. Semi-annual sampling in 2018 included for characterization of explosives. Initial nitrobenzene detection of 0.58 µg/L in 2017 exceeded the screening level.	• In June 2018, only 2-amino-4,6-DNT exceeded screening criteria. This explosive did not have a detected concentration in October 2018. No other explosives exceeded the screening criteria in June or October 2018. • Nitrobenzene did not have detections in June or October 2018. • Cyanide was not detected in June 2018. Cyanide had an estimated concentration of 0.0027J mg/L, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor explosives and cyanide.
13	Load Line 1	LL1mw-083	SVOCs (phthalates), explosives, pesticides, Cr[VI]6	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT; 2,4-DNT; 4-amino-2,6-DNT). Semi-annual sampling included characterization of groundwater pH conditions outside the range of naturally occurring conditions.	• No SVOCs were detected in June or October 2018. • No pesticides were detected in June or October 2018 except delta-BHC in October 2018 with an estimated concentration of 0.0002J mg/L. • The explosives 2,4,6-TNT; 2,4-DNT; 2,4-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX had exceedances of the screening criteria. All other explosives were below the screening criteria. • Hexavalent chromium was not detected in either sampling event. • Chloride, nitrate, nitrite, and sulfide were all either not detected or at concentrations below screening criteria. Sulfate does not have a screening criterion and had a concentration of 150 mg/L in June 2018 and an estimated concentration of 160J mg/L in October 2018.	• In the absence of detections or exceedances of SVOCs and hexavalent chromium, additional sampling for these constituents is not warranted • Continue to monitor explosives, anions, and alkalinity.
14	Load Line 1	LL1mw-084	SVOCs (phthalates), explosives, pesticides, cyanide, metals, Cr[VI]	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT; 2,4-DNT; 4-amino-2,6-DNT; RDX). Well result high for free cyanide reported in 2017. Semi-annual sampling included characterization of groundwater pH conditions outside the range of naturally occurring conditions	• No SVOCs were detected in June or October 2018. • No pesticides were detected in June or October 2018 except beta-BHC in June 2018. This estimated concentration was below the screening criteria. • The explosives 1,3-DNB; 2,4,6-TNT; 2,4-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX had exceedances of the screening criteria. All other explosives were below the screening criteria. • No metals except manganese and nickel exceeded screening criteria. Both manganese and nickel exceeded screening criteria in both sampling events. • Hexavalent chromium and cyanide were not detected in either sampling event. • Chloride, nitrate, nitrite, and sulfide were all either not detected or at concentrations below screening criteria. Sulfate does not have a screening criterion and had an estimated concentration of 160J mg/L.	• In the absence of detections or exceedances, SVOCs, pesticides, cyanide, anions, and hexavalent chromium do not warrant further sampling. • Continue to monitor explosives, anions, alkalinity, and metals.
15	SE/Load Line 1	LL1mw-086	SVOCs (phthalates), explosives, alkalinity, metals	Second water-bearing zone well (**deep unconsolidated**) downgradient from Load Line 1 for monitoring potential groundwater exit pathway. Semi-annual sampling included characterization of groundwater pH conditions outside the range of naturally occurring conditions.	• No SVOCs or explosives were detected in June or October 2018. • No metals except aluminum, iron, and manganese exceeded the screening criteria. Aluminum and iron exceeded the screening criteria in October 2018 and not June 2018. Manganese exceeded the screening criteria in both sampling events. • Cyanide was detected at an estimated concentration of 0.0043 mg/L, above the tap water RSL of 0.00015 mg/L in June 2018. Cyanide was not analyzed in October 2018.	• In the absence of detections of SVOCs and explosives, additional sampling of these constituents is not warranted. • Continue to monitor metals, cyanide, and alkalinity in this sentinel well.
16	SE	LL1mw-087	SVOCs (phthalates), explosives, metals	**Unconsolidated** well located approximately downgradient from Load Line 1. Monitors potential groundwater exit pathway.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Iron exceeded the screening criteria in June 2018 only, and manganese exceeded the screening criteria in both sampling events.	• In the absence of detections of SVOCs, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
17	Load Line 1	LL1mw-088	SVOCs (phthalates), explosives, pesticides, alkalinity, metals	**Unconsolidated** well located downgradient from Load Line 1 and LL1mw-086, which has historically had pesticides detection above screening levels. Sentinel well for monitoring groundwater exit pathway outside perimeter fence.	• No SVOCs or pesticides were detected in June or October 2018. • No explosives were detected in June or October 2018, except 4-nitrotoluene in June 2018. This concentration was below the screening criteria. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three chemicals exceeded the screening criteria in both sampling events.	• In the absence of detections in SVOCs and pesticides, sampling of these constituents is not warranted. • Continue to monitor explosives, alkalinity, and metals in this sentinel well.
18	Load Line 1	LL1mw-089	SVOCs[1], explosives[1], cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Unconsolidated** well located downgradient from Load Line 1 and LL1mw-086, which has historically had pesticides detection above screening levels. Sentinel well for monitoring groundwater exit pathway outside perimeter fence.	• No SVOCs were detected in June 2018. SVOCs were not analyzed in October 2018. • No explosives were detected in June 2018 except 2,4-DNT and 2,6-DNT, both of which exceeded the screening criteria. Explosives were not analyzed in October 2018. • Hexavalent chromium was not detected in June 2018. It was not analyzed in October 2018. • Cyanide was not detected in either sampling event. • Perchlorate was detected in June 2018, but the estimated concentration was below the screening criteria.	• In the absence of detections in SVOCs, cyanide, and hexavalent chromium, additional sampling of these constituents is not warranted. • Continue to monitor explosives and recollect rejected propellant results from 2018.
19	S/Load Line 2	LL2mw-059	Phthalates, explosives, metals	**Upper Sharon** well located downgradient from Load Lines 2 and 3 and serves as potential groundwater exit pathway off of former RVAAP; consistently found to contain explosives. 1,3,5-Trinitrobenzene; tetryl; and perchlorate were detected below screening levels in 2017. Historical well result high over screening levels for 1,3-DNB in 2017.	• No SVOCs were detected in June 2018. SVOCs were not analyzed in October 2018. • The explosives that exceeded screening criteria are 1,3-DNB; 2,4-DNT; 2-amino-4,6-DNT; and 4-amino-2,6-DNT. All four explosives exceeded screening criteria in June and October 2018, except for 1,3-DNB that did not have a detected concentration in June 2018. • No metals except manganese exceeded the screening criteria. Manganese only exceeded screening criteria in October 2018.	• In the absence of SVOC detections, additional sampling of phthalates is not warranted. • Continue to monitor explosives and metals.
20	Load Line 2	LL2mw-264	Cyanide	**Upper Sharon** monitoring well sampled for cyanide due to a well-specific historical maximum result in 2016.	• Cyanide had an estimated concentration of 0.0033J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
21	Load Line 2	LL2mw-267	Phthalates, explosives, metals	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4-DNT; RDX).	• No SVOCs were detected in June or October 2018. • The explosives that exceeded screening criteria are 2,4-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX. All four explosives exceeded screening criteria in October 2018 and did not have detected concentrations in June 2018. • No metals except iron and manganese exceeded the screening criteria. Both metals exceeded screening criteria in June and October 2018.	• In the absence of detected SVOCs, additional sampling of phthalates is not warranted. • Continue to monitor explosives and metals.
22	Load Line 2	LL2mw-272	SVOCs[1], explosives[1], cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Upper Sharon** well installed in 2016 on the southwest interior of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide reported in 2017 over the screening level.	• No SVOCs or explosives were detected in June 2018. SVOCs and explosives were not analyzed in October 2018. • Hexavalent chromium was not detected. • Cyanide had an estimated concentration of 0.0033J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Perchlorate was detected at an estimated concentration below the screening criteria. • Nitroguanidine and nitrocellulose were not detected at concentrations exceeding the screening criteria	• In the absence of detections or exceedances in SVOCs, explosives, propellants, and hexavalent chromium, additional sampling of these constituents is not warranted. • Continue to monitor cyanide.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
23	Load Line 2/Facility-wide	FWGmw-017	VOCs, SVOCs, explosives, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Basal Sharon Conglomerate** exit pathway well installed at the post boundary southeast of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents reported with detected concentrations include acetone and naphthalene under their respective screening levels.	• No explosives were detected in June or October 2018. • Hexavalent chromium was not detected. • No VOCs were detected except acetone and methylene chloride in both samples. All concentrations were below screening criteria. • No SVOCs were detected in June 2018. SVOCs were detected in the field duplicate collected in October 2018. The primary sample associated with the field duplicate did not have detected concentrations of those SVOCs. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• Monitoring well abandoned in 2018. • Chemicals were either not detected or below screening criteria except iron and manganese. • Additional sampling in this location/aquifer is not recommended.
24	Facility-wide	FWGmw-024	VOCs, SVOCs, explosives, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI]	**Upper Sharon** exit pathway well installed at the post boundary southeast of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents (other than hexavalent chromium) reported with detected concentrations include naphthalene and nitrobenzene. Nitrobenzene was reported below its FWCUG but over the tap water RSL in April 2017. Hexavalent chromium was also reported over the tap water RSL in April 2017.	• The only explosive detected was 4-nitrotoluene in June 2018 at a concentration less than the screening criteria. No other explosives, including nitrobenzene, were detected in June or October 2018. • No SVOCs were detected with the exception of methylnaphthalene and naphthalene, each in one of the sampling events. The concentrations were less than the screening criteria, and SVOCs were not detected during the other sampling event. • No VOCs were detected in either sampling event with the exception of acetone in June 2018, which was at a concentration less than the screening criteria. Acetone was not detected in October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018. • Perchlorate and hexavalent chromium were not detected.	• In the absence of detections or exceedances of VOCs, SVOCs propellants, and hexavalent chromium, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
25	Load Line 3	LL3mw-234	Cyanide	**Upper Sharon** well with historical well-specific maximum cyanide concentration observed in 2016.	• Cyanide and was not detected in June 2018. • Cyanide had an estimated concentration of 0.0023J mg/L in October 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
26	Load Line 3	LL3mw-237	Explosives	**Upper Sharon** well sampled for potentially increasing explosives concentrations. Primary source area well for explosives constituents. Exit pathway well.	• Four explosives exceeded screening criteria: 2,4,6-TNT; 2,4-DNT; 2-amino-4,6-DNT; and 4-amino-2,6-DNT. 2,4,6-TNT and 2,4-DNT were only detected in June 2018. 2-Amino-4,6-DNT and 4-amino-2,6-DNT were detected and exceeded the screening criteria in June and October 2018.	• Continue to monitor explosives.
27	Load Line 3	LL3mw-244	Phthalates, explosives, pesticides, metals, Cr[VI]	**Upper Sharon** well located downgradient from Load Lines 3 and 12; consistently found to contain low level explosive constituents (2-amino-4,6-DNT; 4-amino-2,6-DNT; RDX) and hexavalent chromium. Exit pathway well with detected explosive constituents nitrobenzene and RDX below screening levels in 2017.	• SVOCs and pesticides were not detected in June or October 2018. • No explosives exceeded screening criteria except 2-amino-4,6-DNT and 4-amino-2,6-DNT. Both exceeded the screening criteria in June and October 2018. • No metals exceeded the screening criteria with the exception of antimony. The concentration of antimony was below the screening criteria. • Hexavalent chromium was not detected.	• In the absence of phthalates, pesticides, and hexavalent chromium, further sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
28	Load Line 3	LL3mw-246	Phthalates, explosives, perchlorate, metals	**Upper Sharon** well located downgradient from Load Lines 3 and 12 and affected well LL3mw-244; serves as potential groundwater exit pathway; low levels of explosives consistently identified in well. RDX; 4-amino-2,6-DNT; and perchlorate were detected below screening levels in 2017.	• SVOCs were not detected in June or October 2018. • No explosives exceeded screening criteria except 2-amino-4,6-DNT and 4-amino-2,6-DNT. Both exceeded the screening criteria in June and October 2018. • No metals exceeded the screening criteria except mercury. Mercury had an estimated concentration in June 2018 that exceeded the screening criteria; however, the duplicate sample did not have a detection of mercury. Mercury was not detected in October 2018. • Perchlorate was detected in June and October 2018 but the concentrations were below screening criteria.	• In the absence of SVOCs, further sampling for phthalates is not warranted. • Continue to monitor explosives, perchlorate, and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
29	Load Line 3/Facility-wide	FWGmw-021	VOCs, SVOCs, PCBs, explosives, pesticides, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Upper Sharon** exit pathway well installed at the post boundary southwest of Load Line 3 in 2016 to further characterize the nature and extent of facility-wide groundwater impacts. Nitrobenzene, RDX, acetone, naphthalene, and perchlorate were detected below screening levels in 2017. 2-amino-4,6-DNT; 4-amino-2,6-DNT; total cyanide; and Aroclor-1254 were reported over screening levels in 2017.	• No SVOCs or PCBs (including Aroclor-1254) were detected in June or October 2018. • No VOCs were detected except acetone and methylene chloride. Each was detected in one sampling event at concentrations below the screening criteria. • No explosives were detected except 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX. 2-amino-4,6-DNT and 4-amino-2,6-DNT exceeded their screening criteria with estimated concentrations in June 2018 but did not have detected concentrations in October 2018. • No metals except iron and manganese exceeded the screening criteria. Both metals exceeded the screening criteria in both samples. • Hexavalent chromium was not detected. • Cyanide had an estimated concentration of 0.0033J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Perchlorate was detected in June 2018 at a concentration below the screening criteria.	• In the absence of detections of SVOCs, PCBs, cyanide, and hexavalent chromium, additional sampling of these constituents is not warranted. • VOC detections limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling is warranted for VOCs. • Continue to monitor explosives and metals.
30	Load Line 4	LL4mw-193	Cyanide	**Unconsolidated** well sampled for cyanide due to well-specific historical high concentrations in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended.
31	Load Line 4	LL4mw-200	Cyanide	**Unconsolidated** well with historical well-specific maximum cyanide concentration observed in 2016. Exit pathway well for Load Line 4.	• Cyanide had an estimated concentration of 0.0063 mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
32	Load Line 7	LL7mw-001	VOCs, phthalates, explosives, cyanide	**Homewood** source area well that has historically been found to contain chlorinated solvents (specifically 1,1-dichloroethane; 1,1-dichloroethene; and 1,1,1-trichloroethane). Historical well result high for total cyanide in 2017.	• SVOCs were not detected in June or October 2018. • No explosives were detected with the exception of RDX. RDX was detected at a concentration below the screening criteria in October 2018. RDX was not detected in June 2018. • No metals except iron and manganese exceeded the screening criteria. Both metals exceeded the screening criteria in both samples. • Four VOCs were detected: 1,1,1-trichloroethane; 1,1-dichloroethane; 1,1-dichloroethene; and acetone. These VOCs were detected in June and October 2018, all at concentrations below the screening criteria. • Cyanide had an estimated concentration of 0.0038J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of detections or exceedances of SVOCs and explosives, additional sampling of those constituents is not warranted. • Although VOCs were detected, concentrations do not exceed screening criteria and 1,1,1-trichloroethane; 1,1-dichloroethane; and 1,1-dichloroethene remain consistent since 2010, demonstrating stability. • Continue to sample for metals and cyanide.
33	Load Line 7	LL7mw-006	Explosives	**Homewood** source area well representing primary contaminant (RDX) source area conditions at Load Line 7. Historical well result high for RDX in 2017.	• No explosives were detected with the exception of RDX and HMX. All detected concentrations were below the screening criteria.	• Continue to monitor explosives.
34	Load Line 10	LL10mw-003	VOCs, phthalates, nitroaromatics, metals	**Homewood** well that has had historically consistent occurrence of VOCs (specifically carbon tetrachloride). Historical well results high or first detection for nitrobenzene, carbon, tetrachloride, and chloroform in 2017.	• No SVOCs were detected in June or October 2018. • No metals exceeded the screening criteria in June or October 2018. • No VOCs exceeded screening criteria with the exception of carbon tetrachloride. Carbon tetrachloride exceeded the screening criteria in June and October 2018.	• In the absence of SVOCs and metals detected or exceeding criteria, further sampling of these constituents is not warranted. • Continue to monitor VOCs.
35	Load Line 10	LL10mw-005	VOCs, phthalates, nitroaromatics, metals	**Homewood** well paired with FWGmw-022; serves to assess potential vertical contaminant migration in this area of the site.	• No SVOCs exceeded the screening criteria in June or October 2018. • No VOCs were detected in either sampling event with the exception of acetone and methylene chloride in October 2018, which was at a concentration less than the screening criteria. Acetone and methylene chloride were not detected in October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both samples.	• In the absence of SVOC exceedances, continued sampling of these constituents is not warranted. • VOC detections limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling warranted at this well. • Continue to monitor metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
36	Facility-wide	FWGmw-019	VOCs, SVOCs[1], PCBs, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Basal Sharon Conglomerate** vertical delineation well installed between Load Line 9 and Load Line 10 to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide, Aroclor-1254, and chloroform were detected above screening levels in 2017.	• No SVOCs or explosives were detected in June 2018. These were not analyzed in October 2018. • No PCBs (including Aroclor-1254) were detected in June or October 2018. • No VOCs were detected except acetone and methylene chloride. Each was detected in one sampling event at a concentration below the screening criteria. • Hexavalent chromium, cyanide, and perchlorate were not detected.	• In the absence of SVOC, explosive, PCB, cyanide, perchlorate, and hexavalent chromium detections, further sampling of these constituents is not warranted. • VOC detections were limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling is warranted at this well with the exception of rejected propellants results from 2018, which require additional monitoring.
37	Facility-wide	FWGmw-022	VOCs, SVOCs[1], PCBs, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Upper Sharon** vertical delineation well installed between Load Line 9 and Load Line 10 to further characterize the nature and extent of facility-wide groundwater impacts. Aroclor-1254, total cyanide, and chloroform were detected above screening levels in 2017.	• No SVOCs or explosives were detected in June 2018. These were not analyzed in October 2018. • No PCBs (including Aroclor-1254) were detected in June or October 2018. • No VOCs were detected except acetone and methylene chloride. Each was detected in one sampling event at a concentration below the screening criteria. • Hexavalent chromium, cyanide, and perchlorate were not detected.	• 2018 results indicate detections limited to acetone and methylene chloride, which were more than an order of magnitude lower than any screening criteria; therefore, no additional sampling of 2018 constituents warranted at this well. • Rejected propellant results from 2018 require additional monitoring.
38	Load Line 11	LL11mw-005	Cyanide	**Unconsolidated** well with AOC historical maximum concentration for cyanide in 2016 results.	• Cyanide had an estimated concentration of 0.0021J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide
39	Load Line 12	LL12mw-183	PAHs, cyanide	**Upper Sharon** monitoring well with well-specific historical maximum cyanide reported in 2016. Cyanide and benz(a)anthracene concentrations reported over screening levels in 2017.	• No SVOCs were detected in June or October 2018 samples with the exception of naphthalene. Naphthalene was detected at an estimated concentration in October 2018 that was below the screening criteria. Naphthalene was not detected in June 2018. Benz(a)anthracene was not detected in June or October 2018. • Cyanide had an estimated concentration of 0.0048 mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of PAH detections exceeding screening criteria, further sampling of these constituents is not warranted. • Continue to monitor cyanide
40	Load Line 12	LL12mw-185	Cyanide, nitrate, arsenic	**Unconsolidated** well that has been found to contain elevated levels of nitrate and is downgradient from potential arsenic source. Initial nitrate and total cyanide detections in 2016 over screening levels.	• Arsenic was the only metal analyzed in June and October 2018. Both samples had arsenic concentrations below the screening criteria. • Nitrate was detected above the screening criteria in both the June and October 2018 sample. • Cyanide was not detected in the June or October 2018 samples.	• Arsenic and cyanide were either not detected or did not exceed screening criteria and do not warrant further sampling. • Continue to monitor nitrate.
41	Load Line 12	LL12mw-187	Phthalates, nitrate, metals	**Unconsolidated** well that has been found to contain elevated levels of nitrate. Historical constituent high for nitrate in 2017.	• SVOCs were not detected in June and October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both samples. • Nitrate was detected above the screening criteria in both the June and October 2018 sample.	• In the absence of SVOC detections, further sampling is not warranted. • Continue to monitor nitrate and metals.
42	Load Line 12	LL12mw-242	Phthalates, explosives, nitrate, metals	**Unconsolidated** well located downgradient from a potential arsenic source area near LL12mw-113.	• SVOCs and explosives were not detected in June and October 2018. • Of the total metals, only arsenic, iron, and manganese exceeded screening criteria. All three exceeded the screening criteria in both sampling events. • Nitrate was detected in June 2018 but below the screening criteria. Nitrate was not detected in October 2018.	• In the absence of SVOC and explosive detections, further sampling of these constituents is not warranted. • Continue to monitor nitrate and metals.
43	Load Line 12	LL12mw-245	Phthalates, explosives, nitrate, metals	**Unconsolidated** well located downgradient from potential nitrate source in the area of LL12mw-185.	• No SVOCs were detected in June or October 2018. • No explosives were detected in June or October 2018 with the exception of 2,4-DNT. 2,4-DNT had an estimated concentration in June 2018 below the screening criteria and was not detected in October 2018. • Of the metals, arsenic, iron, manganese, and mercury exceeded the screening criteria. Arsenic and mercury exceeded the screening criteria only in October 2018. • Nitrate was not detected in June or October 2018.	• In the absence of SVOCs, additional sampling for phthalates is not warranted. • Although nitrates not detected, a history of nitrate detections in recent years and nearby wells warrant further monitoring. • Continue to monitor explosives, nitrate, and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
44	SE	LL12mw-247	Phthalates, explosives, cyanide, nitrate, metals, Cr[VI]	**Unconsolidated** well located downgradient from Load Line 12. Total and free cyanide were reported over screening levels in 2017. Nitrobenzene and nitrate detected below screening levels in 2017. Monitors potential groundwater exit pathway.	• No SVOCs or explosives were detected in June or October 2018. • No metals except aluminum, iron, and manganese exceeded the screening criteria. Iron and manganese exceeded the screening criteria in both samples. • Hexavalent chromium and cyanide were not detected. • Nitrate was not detected in June or October 2018.	• In the absence of detections of SVOCs, explosives, cyanide, and hexavalent chromium, additional sampling of these constituents is not warranted. • Although nitrate not detected, a history of nitrate detections in recent years and nearby wells warrants further monitoring at this exit pathway well. • Continue to monitor metals and nitrate.
45	Load Line 12/Facility-wide	FWGmw-018	VOCs, SVOCs, PCBs, explosives, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Basal Sharon Conglomerate** exit pathway well installed at the post boundary south of Load Line 12 to further characterize the nature and extent of facility-wide groundwater impacts. Ethylbenzene, total xylene, benzyl alcohol, and naphthalene were detected below screening levels in 2017. Aroclor-1254 was reported over its screening level.	• No SVOCs, explosives, or PCBs were detected in June or October 2018. • No VOCs were detected except acetone, methylene chloride, and toluene. Each was detected in one sampling event at concentrations below the screening criteria. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three metals exceeded the screening criteria in both samples. • Perchlorate and hexavalent chromium were not detected. • Cyanide had an estimated concentration of 0.0097J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of detections or exceedances in SVOCs, explosives, perchlorate, PCBs, and hexavalent chromium, additional monitoring of these constituents is not warranted. • Although VOCs were not detected, a history of low VOC concentrations warrants monitoring in this exit pathway well. • Continue to monitor VOCs, metals and cyanide.
46	Load Line 12/Facility-wide	FWGmw-020	VOCs, SVOCs[1], PCBs, explosives,, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI]	**Upper Sharon** exit pathway well installed at the post boundary southeast of Load Line 12 to further characterize the nature and extent of facility-wide groundwater impacts. Acetone and naphthalene were detected below screening levels in 2017. Cyanide was detected over its screening level.	• No SVOCs, explosives, or PCBs were detected in June or October 2018. • No VOCs were detected except acetone and toluene. Each was detected in one sampling event at concentrations below the screening criteria. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three metals exceeded the screening criteria in both samples. • Perchlorate and hexavalent chromium were not detected. • Cyanide had an estimated concentration of 0.0035J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Nitrate was detected at a concentration (0.19J mg/L) less than the screening criteria in June 2018. Nitrate was not analyzed in October 2018.	• In the absence of SVOCs, PCBs, explosives, , perchlorate, propellants, and hexavalent chromium detected or exceeding criteria, continued sampling of these constituents is not warranted. • Although VOCs do not exceed criteria, a history of low VOC concentrations warrants monitoring to monitor vertical and lateral migration in this exit pathway well. • Continue to monitor VOCs, metals, and cyanide.
47	Fuze and Booster	FBQmw-171	Cyanide, anions, alkalinity, Cr[VI]	**Homewood** monitoring well with historical maximum cyanide concentration reported in 2016 and anomalous pH values outside the typical range of natural groundwater.	• Arsenic was analyzed in June 2018 and was not detected. • Hexavalent chromium was not detected in June or October 2018. • Cyanide had an estimated concentration of 0.0035J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Nitrate, nitrite, and sulfide either did not have a detected concentration or the concentration was below the screening criteria. Sulfate does not have screening criteria and had a concentration of 26 mg/L. • pH remains low but in reasonable range from 5.45 to 5.62 along with low alkalinity at 37-38 mg/L.	• In the absence of arsenic and hexavalent chromium, continued sampling of these constituents is not warranted. • Continue to monitor cyanide, anions, and alkalinity.
48	Fuze and Booster	FBQmw-172	Cyanide	**Homewood** monitoring well with historical maximum cyanide concentration reported in 2016 and free cyanide above screening levels in 2017.	• Cyanide had an estimated concentration of 0.0023J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
49	Fuze and Booster	FBQmw-174	Phthalates, explosives, pesticides, anions, alkalinity, Cr[VI]	**Homewood** source area well that has consistently been found to contain explosive constituents (2,4-DNT; 2,4,6-TNT; 4-amino-2,6-DNT). Monitored for pH values outside the typical range of natural groundwater.	The well was sampled in June 2018 only. • No SVOCs or pesticides were detected. • The explosives 2,4,6-TNT; 2,4-DNT; 2-amino-4,6-DNT; and 4-amino-2,6-DNT exceeded the screening criteria. • Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either did not have a detected concentration or the concentration was below the screening criteria. Sulfate does not have screening criteria and had a concentration of 12 mg/L. • pH remains low ranging from 5.16 to 5.27 along with alkalinity at 4.9 and 7.1	• In the absence of SVOCs, pesticides, and hexavalent chromium, continued sampling of these constituents is not warranted. • Continue to monitor explosives, anions, and alkalinity.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
50	Fuze and Booster	FBQmw-175	Anions, alkalinity, Cr[VI]	**Homewood** source area well with anomalous pH values outside the typical range of natural groundwater.	• Hexavalent chromium was not detected in June 2018, but was detected in October 2018 at an estimated concentration of 0.0044 mg/L that exceeded the screening criteria. • Chloride, nitrate, nitrite, and sulfide either did not have a detected concentration or the concentration was below the screening criteria. Sulfate does not have screening criteria and had a concentration of 17 mg/L. • pH remains low 5.12 in June along with low alkalinity at 5.5 mg/L.	• Continue to monitor anions, alkalinity, and hexavalent chromium.
51	Fuze and Booster	FBQmw-176	Cyanide	**Unconsolidated** source area well representing primary contaminant (cyanide) source area conditions at the AOC.	• Cyanide was not detected in June 2018. • Cyanide had a concentration of 0.025 mg/L in October 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
53	Admin./George Road	FWGmw-004	Phthalates, explosives, metals	**Unconsolidated** exit pathway well located near the south property line and downgradient from several Compliance Restoration sites. RDX and bis(2-ethylhexyl)phthalate were detected below screening levels in 2017.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron exceeded the screening criteria. Iron exceeded the screening criteria in June 2018 but not in October 2018.	• In the absence of SVOCs and explosives detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
54	SW	FWGmw-007	Phthalates, explosives, metals	**Unconsolidated** well located in the western portion of former RVAAP. Potential exit pathway well near Hinkley Creek.	• No SVOCs or explosives were detected in June or October 2018. • The only explosive detected was 4-nitrotoluene in June 2018 at an estimated concentration of 0.00054J mg/L, which is below the screening criteria. This explosive was not detected in October 2018. • No metals except iron and manganese exceeded the screening criteria. Iron exceeded the screening criteria in June 2018, and manganese exceeded the screening criteria in both samples.	• In the absence of SVOC detections and explosives exceedances, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
56	East Classification Yard	FWGmw-011	Phthalates, explosives, metals	**Unconsolidated** well located east of Ramsdell Quarry and former East Classification Yard. Serves as exit pathway well. Historical well result high for 3-nitrotoluene in 2017.	• No SVOCs or explosives (including 3-nitrotoluene) were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration. • Continue to monitor explosives and metals.
57	East Classification Yard	FWGmw-012	Phthalates, explosives, metals	**Upper Sharon** formation well paired with FWGmw-011; serves as exit pathway well for the Sharon aquifer.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• In the absence of phthalates detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
59	Admin./George Road	FWGmw-015	Phthalates, explosives, metals	**Unconsolidated** well. Located near the south property line and downgradient from several compliance restoration sites. Serves as first-water unconsolidated exit pathway well.	• No SVOCs or explosives were detected in June or October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in June and October 2018.	• In the absence of SVOCs and explosives detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
60	Admin./George Road	FWGmw-016	Phthalates, explosives, metals	**Upper Sharon** well paired with FWGmw-015 for vertical delineation. Located near the south property line and downgradient from several compliance restoration sites. Serves as upper Sharon formation exit pathway well. RDX was detected below screening levels in 2017.	• No SVOCs or explosives (including RDX) were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• In the absence of SVOCs and explosives detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
61	NACA Test Area	NTAmw-117	Cyanide	**Unconsolidated** monitoring well with well-specific historical maximum cyanide concentrations reported in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended
62	NACA Test Area	NTAmw-118	Cyanide	**Unconsolidated** monitoring well with AOC historical maximum cyanide concentrations reported in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended
63	NACA Test Area	NTAmw-119	VOCs, phthalates, nitroaromatics, PAHs, explosives, metals	**Deep unconsolidated** well that has historically been found to contain trace amounts of tetrachloroethene and naphthalene, as well as metals. Monitors second water-bearing zone in buried glacial valley. Historical constituent high for benzo(b)fluoranthene in 2017.	• No SVOCs were detected in June or October 2018 with the exception of naphthalene in June 2018. The estimated detected concentration was below the screening criteria. • No explosives were detected with the exception of 4-nitrotoluene in June 2018. This estimated concentration was below the screening criteria, and 4-nitrotoluene was not detected in October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018. • No VOCs were detected with the exception of acetone and methylene chloride. Concentrations for both were below the screening criteria.	• In the absence of detections or exceedances of phthalates and nitroaromatics, additional sampling of these constituents is not warranted. • VOC detections limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling is warranted for VOCs. • Continue to monitor PAHs, explosives, and metals.
64	NACA Test Area	NTAmw-120	SVOCs[1], explosives[1], perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Upper Sharon** well installed in 2016 at the central portion of the NACA Test Area to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents were not reported above screening levels in samples collected in 2017.	The well was sampled in June 2018 only. • No SVOCs were detected. • No explosives were detected with the exception of 4-nitrotoluene. This estimated concentration was below the screening criteria. • Hexavalent chromium and perchlorate were not detected.	• In the absence of detections or exceedances of SVOCs, explosives, propellants, and hexavalent chromium, no further sampling is recommended. • Rejected hexachlorocyclopentadiene results from 2018 require additional monitoring.
65	Demolition Area 2	DA2mw-115	Phthalates, explosives, cyanide, metals	**Upper Sharon** well paired with well DETmw-003; serves to monitor potential vertical migration in this area of the site. Historical well result high for total cyanide in 2017.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both chemicals exceeded the screening criteria in both sampling events. • Cyanide was not detected in either June or October 2018.	• In the absence of SVOCs, explosives, and cyanide detections, further sampling of those constituents is not warranted. • Continue to monitor metals.
66	Demolition Area 2	DETmw-003	VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, metals	**Unconsolidated** RCRA well. Initial nitrobenzene detection in 2017 was greater than its screening level. Benzo(b)fluoranthene and cyanide were reported over screening levels in 2017.	• The only SVOC detected was benzo(a)pyrene with an estimated concentration of 0.000019J mg/L, which is below the MCL. No other SVOCs were detected in June or October 2018. Hexachlorocyclopentadiene results from June 2018 were rejected. • Cyanide was not detected in June or October 2018. • No explosives, pesticides, or PCBs were detected in June or October 2018. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three chemicals exceeded the screening criteria in both sampling events. • No VOCs were detected except acetone. Acetone had estimated concentrations below the screening criteria.	• In the absence of the detection of explosives, pesticides, PCBs, and cyanide, further sampling of these constituents is not warranted for the CERCLA investigation. • Although acetone was detected, the concentration is several orders of magnitude lower than screening criteria; therefore additional sampling not warranted. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, and metals.
67	Demolition Area 2	DETmw-004	VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, metals	**Unconsolidated** RCRA well. Dry during both semi-annual events in 2017.	• Sample collected in October 2018 only. Well was dry during the June 2018 sampling event. • No SVOCs, VOCs, pesticides, or PCBs were detected. • No explosives or metals exceeded the screening criteria. • Cyanide was not detected.	• In the absence of VOC, SVOC, pesticide, PCB, and cyanide detections, additional sampling of these parameters is not warranted for the CERCLA investigation. • Detections of explosives did not exceed screening criteria by an order of magnitude. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
68	Ramsdell Quarry	RQLmw-007	VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, phosphorus, metals	**Upper Sharon** RCRA well. Historical well result high for benzo(b)fluoranthene in 2017. Cyanide detected above screening levels in 2016. Phosphorus reported over screening levels in 2017.	• Phosphorus was detected above the screening level in June and October 2018. • No explosives, PCBs, or pesticides were detected. • No VOCs were detected with the exception of 1,2-dichloroethene in June 2018 only and was not detected in October 2018. • Five SVOCs were detected, all at estimated concentrations below the screening criteria. Benzo(b)fluoranthene was not detected in June or October 2018. • The metals arsenic, iron, manganese, and nickel all exceeded screening criteria. • Cyanide had an estimated concentration of 0.005J mg/L in June 2018 and 0.0046J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• In the absence of detections of explosives, PCBs, and pesticides, additional sampling of these parameters is not warranted for the CERCLA investigation. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, phosphorus, and metals.
69	Ramsdell Quarry	RQLmw-008	VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, metals	**Upper Sharon** RCRA well. Historical well result high for 3-nitrotoluene in 2017 and cyanide in 2016.	• No VOCs, pesticides, or PCBs were detected in June or October 2018. • Three SVOCs were detected, all at concentrations below the screening criteria. • The only explosives detected were HMX and RDX. Only RDX had a concentration that exceeded the screening criteria. • The metals arsenic, iron, manganese, mercury, and zinc all exceeded screening criteria. • Cyanide had an estimated concentration of 0.0032J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of VOC, pesticide, and PCB detections, additional sampling of these parameters is not warranted for the CERCLA investigation. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, and metals.
70	Ramsdell Quarry	RQLmw-009	VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, metals	**Upper Sharon** RCRA well. First detection for cyanide reported in 2016.	• Three SVOCs were detected, all of which were at concentrations less than the screening criteria. • No explosives were detected with the exception of RDX. RDX was detected in October 2018 at a concentration less than the screening criteria. RDX was not detected in June 2018. • No metals except iron and manganese exceeded the screening criteria. Both chemicals exceeded the screening criteria in both sampling events. • No VOCs were detected with the exception of acetone and methylene chloride in October 2018. Neither was detected in June 2018. • No pesticides were detected with the exception of delta-BHC in October 2018. • No PCBs were detected in June or October 2018. • Cyanide had an estimated concentration of 0.0032J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of PCB detections, additional sampling of those parameters is not warranted for the CERCLA investigation. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, and metals.
71	Ramsdell Quarry	RQLmw-011	SVOCs, anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater and historically representing SVOC primary contaminant source area conditions at the AOC.	• Three SVOCs were detected, all of which were at concentrations less than the screening criteria. • Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 160 mg/L in June 2018 and an estimated concentration of 100 mg/L in October 2018. • pH and alkalinity remain low in June with pH at 4.72 and alkalinity at 38 mg/L; but respectively increase in October with a pH of 6.03 and alkalinity 120 mg/L.	• In the absence of detections of hexavalent chromium and exceedances of SVOCs, additional sampling of these constituents is not warranted. • In consideration of the pH anomalies, continue to monitor anions, pH, and alkalinity.
72	Ramsdell Quarry	RQLmw-012	Cyanide, anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater and well-specific historical maximum cyanide concentrations reported in 2016 and free cyanide above screening levels in 2017.	• Cyanide had an estimated concentration of 0.0023J mg/L in June 2018 and 0.0054J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 190 mg/L in June 2018 and 100 mg/L in October 2018. • pH remains low ranging from 4.94 to 5.43 along with alkalinity ranging from 6.7 to 32 mg/L.	• In the absence of detections of hexavalent chromium, additional sampling of this constituent is not warranted. • In consideration of the pH anomalies, continue to monitor anions, pH, alkalinity, and cyanide.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
73	Ramsdell Quarry	RQLmw-013	Anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater.	• Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 170 mg/L in June 2018 and 150 mg/L in October 2018. • pH remains low ranging from 3.3 to 4.12 along with alkalinity ranging from 3.2 to 5 mg/L.	• In the absence of detections of hexavalent chromium additional sampling of this constituent is not warranted • In consideration of the pH anomalies, continue to monitor anions, pH, and alkalinity.
75	Ramsdell Quarry	RQLmw-016	Cyanide	**Upper Sharon** monitoring well with historical maximum cyanide concentrations reported in 2016.	• Cyanide had an estimated concentration of 0.0025J mg/L in June 2018 and 0.003J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	
76	SE	SCFmw-004	Phthalates, explosives, pesticides, metals	**Sharon Conglomerate Member** well located downgradient from Load Lines 1 and 2, paired with LL1mw-087, and selected for monitoring the potential groundwater exit pathway off of former RVAAP in the deeper aquifer.	• No SVOCs, explosives, or pesticides were detected in June and October 2018 samples. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both sampling events.	• In the absence of SVOC explosive, or pesticide detections, additional sampling of these constituents is not warranted. • Continue to monitor metals.
77	Winklepeck Burning Grounds	WBGmw-006	Phthalates, explosives, metals	**Unconsolidated** well paired with WBGmw-021; source area well has been found to contain explosives (RDX).	• No SVOCs were detected in June or October 2018. • No explosives exceeded the screening criteria with the exception of RDX. RDX exceeded the screening criteria in June and October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both sampling events.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
78	Winklepeck Burning Grounds	WBGmw-009	Phthalates, explosives, metals	**Unconsolidated** well paired with WBGmw-020; source area well has been found to contain explosive constituents (RDX).	• No SVOCs were detected in June or October 2018. • No explosives exceeded the screening criteria with the exception of RDX. RDX exceeded the screening criteria in June and October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in only June 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
79	Winklepeck Burning Grounds	WBGmw-020	Phthalates, explosives, metals	**Upper Sharon** well paired with WBGmw-009; source area well for monitoring potential vertical migration in Sharon aquifer.	• No SVOCs were detected in June or October 2018. • No explosives were detected with the exception of RDX in October 2018. This detection was below the screening criteria. • No metals except iron and manganese exceeded the screening criteria. Both iron and manganese exceeded the screening criteria in June and October 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
80	Winklepeck Burning Grounds	WBGmw-021	Phthalates, explosives, metals	**Upper Sharon** well paired with WBGmw-006; source area well for monitoring potential vertical migration in Sharon aquifer.	• No SVOCs were detected in June or October 2018. • No explosives were detected with the exception of 4-nitrotoluene in June 2018. This detection was below the screening criteria. • No metals except iron and manganese exceeded the screening criteria. Both iron and manganese exceeded the screening criteria in June and October 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
81	Sand Creek Landfill	SCLmw-001	VOCs, SVOCs, explosives, PCBs, pesticides, cyanide, anions, propellants, metals	**Unconsolidated** new well installed in October 2018.	Analysis of data from new wells will be provided in the 2019 annual report and FWGW RI.	• Continue quarterly monitoring.
82	Sand Creek Landfill	SCLmw-002	VOCs, SVOCs, explosives, PCBs, pesticides, cyanide, anions, propellants, metals	**Unconsolidated** new well installed in October 2018.	Analysis of data from new wells will be provided in the 2019 annual report and FWGW RI.	• Continue quarterly monitoring.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
83	Sand Creek Landfill	SCLmw-003	VOCs, SVOCs, explosives, PCBs, pesticides, cyanide, anions, propellants, metals	**Unconsolidated** new well installed in October 2018	Analysis of data from new wells will be provided in the 2019 annual report and FWGW RI.	• Continue quarterly monitoring.

Denotes wells where additional sampling is not recommended.

AOC = Area of Concern.
BHC = Hexachlorocyclohexane.
CBL = C Block
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
Cr[VI] = Hexavalent Chromium.
DFFO = Director's Final Findings and Orders.
DNB = Dinitrobenzene.
DNT = Dinitrotoluene.
FWCUG = Facility-wide Cleanup Goal.
FWGWMP = Facility-wide Groundwater Monitoring Plan.
HMX = Octahydro-1,3,5,7- tetranitro-1,3,5,7-tetrazocine.
MCL = Maximum Contaminant Level.
µg/L = Micrograms per Liter.
mg/L = Milligrams per Liter.
NACA = National Advisory Committee on Aeronautics.
PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
RCRA = Resource Conservation and Recovery Act.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
RSL = Regional Screening Level.
RVAAP = Ravenna Army Ammunition Plant.
S.U. = Standard Unit.
SE = Southeast.
SVOC = Semi-volatile Organic Compound.
TNT = 2,4,6-Trinitrotoluene.
USEPA = U.S. Environmental Protection Agency.
VOC = Volatile Organic Compound.

Table 3-2. FWGWMP Wells with Analytical Testing Suite

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals[7]
CBPmw-008						X		
CBPmw-009						X		
DA2mw-115								X
DET-003	X	X[2,3,4,5]	X	X	X	X		X
DET-004	X	X[2,3,4,5]	X	X	X	X		X
EBGmw-125						X		
EBGmw-131						X		
FBQmw-171						X	Sulfate/sulfide, nitrate/nitrite, alkalinity	
FBQmw-172						X		
FBQmw-174				X			Sulfate/sulfide, nitrate/nitrite, alkalinity	
FBQmw-175							Sulfate/sulfide, nitrate/nitrite, alkalinity	Cr[VI]
FBQmw-176						X		
FWGmw-004				X				X
FWGmw-007				X				X
FWGmw-011				X				X
FWGmw-012				X				X
FWGmw-015				X				X
FWGmw-016				X				X
FWGmw-018	X					X		X
FWGmw-019							Nitroguanidine[1], nitrocellulose[1]	
FWGmw-020	X					X		X
FWGmw-021				X				X
FWGmw-022							Nitroguanidine[1], nitrocellulose[1]	
FWGmw-023							Nitroguanidine[1], nitrocellulose[1]	
FWGmw-024				X				X
LL1mw-064								X
LL1mw-065				X				X
LL1mw-080				X				
LL1mw-081				X		X		
LL1mw-083				X			Sulfate/sulfide, nitrate/nitrite, alkalinity	
LL1mw-084				X			Sulfate/sulfide, nitrate/nitrite, alkalinity	X
LL1mw-086						X	Alkalinity	X
LL1mw-087				X				X

Table 3-2. FWGWMP Wells with Analytical Testing Suite (continued)

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals[6]
LL1mw-088				X			Alkalinity	X
LL1mw-089				X			Nitroguanidine[1], nitrocellulose[1]	
LL2mw-059				X				X
LL2mw-264						X		
LL2mw-267				X				X
LL2mw-272						X		
LL3mw-234						X		
LL3mw-237				X				
LL3mw-244				X				X
LL3mw-246				X			Perchlorate	X
LL4mw-200						X		
LL7mw-001						X		X
LL7mw-006				X				
LL10mw-003	X							
LL10mw-005								X
LL11mw-005						X		
LL12mw-183						X		
LL12mw-185							Nitrate	
LL12mw-187							Nitrate	X
LL12mw-242							Nitrate	X
LL12mw-245				X			Nitrate	X
LL12mw-247							Nitrate	X
NTAmw-119		X[4]		X				X
NTAmw-120		X[1,6]						
RQLmw-007	X	X[2,4,5]	X	X	X	X	Phosphorus	X
RQLmw-008	X	X[2,4,5]	X	X	X	X		X
RQLmw-009	X	X[2,4,5]	X	X	X	X		X
RQLmw-011							Sulfate/sulfide, nitrate/nitrite, alkalinity	
RQLmw-012						X	Sulfate/sulfide, nitrate/nitrite, alkalinity	
RQLmw-013							Sulfate/sulfide, nitrate/nitrite, alkalinity	
RQLmw-016						X		
SCFmw-004								X
WBGmw-006				X				X

Table 3-2. FWGWMP Wells with Analytical Testing Suite (continued)

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals[6]
WBGmw-009				X				X
WBGmw-020				X				X
WBGmw-021				X				X
SCLmw-001	X	X	X	X	X	X	Sulfate/sulfide, nitrate/nitrite, alkalinity, perchlorate, phosphorus, nitroguanidine, nitrocellulose	X
SCLmw-002	X	X	X	X	X	X	Sulfate/sulfide, nitrate/nitrite, alkalinity, perchlorate, phosphorus, nitroguanidine, nitrocellulose	X
SCLmw-003	X	X	X	X	X	X	Sulfate/sulfide, nitrate/nitrite, alkalinity, perchlorate, phosphorus, nitroguanidine, nitrocellulose	X

Notes:

X = Indicates well or constituent to be sampled as part of the 2019 FWGWMP. Wells and constituents will be sampled semi-annually unless indicated by footnotes described below.

[1] Indicates monitoring well or constituents to be sampled in the spring of 2019 due to missed tests or rejected results in 2018. Additional sampling during 2019 for these wells and constituents will be based on review of the spring 2019 results.

[2] SVOCs: phthalates

[3] SVOCs: nitroaromatics

[4] SVOCs: polycyclic aromatic hydrocarbons

[5] SVOCs: phenols

[6] SVOCs: hexachlorocyclopentadiene

[7] Metals sampling in Fall 2019 will only include wells with one or more metals exceeding screening criteria including a screen against approved background criteria.

Cr[VI] = Hexavalent Chromium.
FWGWMP = Facility-wide Groundwater Monitoring Program.
ID = Identification.
PCB = Polychlorinated Biphenyl.
SVOC = Semi-volatile Organic Compound.
VOC = Volatile Organic Compound.

Table 3-3. Analytical Laboratory Test Methods

Constituents	Method[1]
PCBs	GC – SVOCs (8082A)
Pesticides	GC Semivolatile Organics (8081B)
SVOCs Including Phthalates, Phenols, or Nitroaromatics	GC/MS Semivolatile Organics (8270D)
PAHs	8270D SIM
VOCs	GC/MS Volatile Organics (8260B)
Nitroguanidine (Propellant)	Organic Compounds by HPLC (8330 modified)
Nitroaromatics and Nitramines (Explosives)	Explosives by HPLC (8330)
Nitrocellulose (Propellant)	Colorimetric Cadmium Reduction 353.2[2]
Nitrate/Nitrites Sulfate	General Chemistry (9056) General Chemistry (9056A)
Sulfide	General Chemistry (9034)
Total Alkalinity	General Chemistry (SM2320B)[3]
Cyanide (Total)	General Chemistry (9012B)
Metals (Aluminum, Iron, Magnesium, Potassium, Sodium, Phosphorus, Calcium)	Inductively Coupled Plasma (6010B)
Metals (Antimony, Beryllium, Thallium, Zinc, Cadmium, Manganese, Barium, Nickel, Silver, Vanadium, Chromium, Cobalt, Copper, Arsenic, Lead, Selenium)	Inductively Coupled Plasma/Mass Spectrometry (6020)
Hexavalent Chromium	General Chemistry (7196A)
Mercury	Liquid Waste Cold Vapor Technique (7470A)
Perchlorate	Ion Chromatography/MS (6860)

Notes:

[1] USEPA SW846
[2] USEPA Methods for Chemical Analysis of Water and Waste
[3] Standard Methods for the Examination of Water and Wastewater

GC = Gas Chromatography.
HPLC = High Performance Liquid Chromotography.
MS = Mass Spectrometry.
PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
SIM = Selective Ion Monitoring.
SVOC = Semi-volatile Organic Compound.
VOC = Volatile Organic Compound.

APPENDIX A

Ohio EPA Comments

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April 18, 2019

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Mr. Kevin Palombo
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, RVAAP-66 Facility-Wide Groundwater, Comment Resolution Meeting Minutes (Work Activity No. 267-000-859-036)

References: Revised Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater, dated 12/21/19
Remedial Investigation/Feasibility Study Report for Soil, Sediment, and Surface Water at RVAAP-06 C Block Quarry, dated 2/26/19
Draft Facility-Wide Groundwater Monitoring Program Addendum for 2019, dated 2/11/19
Responses to Comment Letter, dated 4/4/19

Dear Mr. Palombo:

The Army appreciates your feedback provided at the resolution meeting held on 4/17/19 regarding the *Draft Facility-Wide Groundwater Monitoring Program Addendum for 2019* (Leidos 2019). Notes from the meeting are as follows:

- The Army will work with the Ohio Environmental Protection Agency (Ohio EPA) to provide rationale of why certain wells are no longer included in semi-annual sampling.

- The C Block Quarry sample set was unique in that the groundwater samples from the wells were collected only once during 2018. The groundwater samples from these four wells were collected to support conclusions of the provided in the *Final Remedial Investigation/Feasibility Study Report for Soil, Sediment, and Surface Water at RVAAP-06 C Block Quarry* (Leidos 2019)

Below are responses to Ohio EPA's questions not answered during the 4/17/19 teleconference:

- Table 3-1, NTAmw-119: The Draft 2019 Addendum mistakenly had the phrase "…and recollect rejected propellant results from 2018" included in the last column of Table 3-1 for NTAmw-119. There were no rejected propellant results from NTAmw-119 groundwater samples in 2018. Please note that explosives (and propellants) will be analyzed from this well in 2019.

- Table 3-1, RQLmw-008 and RQLmw-009: Phosphorus was mistakenly included in Table 3-1 of the Draft 2019 Addendum. Groundwater from these two wells was not analyzed for phosphorus in 2018 and was not intended to be analyzed in 2019. Accordingly, the revised Table 3-1 provided on 4/4/19 deleted phosphorus from the sample suite from these two wells.

  Phosphorus was identified as a COPC in RQLmw-007 in an initial screen provided in Appendix C of the *Revised Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services* (TEC-Weston 2016). Consequently, phosphorus has been analyzed from groundwater in RQLmw-007 since 2016. All phosphorus results from RQLmw-007 have had estimated concentrations.

  Phosphorus is considered an essential nutrient and does not have a maximum contaminant level (MCL) to compare concentrations against. Therefore, although phosphorus continues to be analyzed from groundwater at RQLmw-007, it is recommended that it is not analyzed from groundwater at RQLmw-008 and RQLmw-009, as revised in the Table 3-1 provided on 4/4/19.

With the summary and details provided in this letter, the Army is requesting interim concurrence to conduct the sampling scheme provided in the Draft 2019 Addendum, including changes per the 4/4/19 Response to Comments letter. Currently, the Army's contractor is scheduled to begin field work on 4/22/19.

Please contact the undersigned at (703) 607-7589 or david.m.connolly8.civ@mail.mil if there are issues or concerns with this submission.

Sincerely,

Date: 2019.04.18 13:56:58 -04'00'

David Connolly
RVAAP Restoration Program Manager
Army National Guard Directorate

cc: Bob Princic, Ohio EPA, NEDO, DERR
Mark Johnson, Ohio EPA, NEDO, DERR
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Craig Coombs, USACE Louisville
Jay Trumble, USACE Louisville
Vasu Peterson, Leidos
Jed Thomas, Leidos
Gail Harris, Vista Sciences Corporation

NATIONAL GUARD BUREAU

April 4, 2019

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Mr. Kevin Palombo
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, RVAAP-66 Facility-Wide Groundwater, Responses to Comments on the Groundwater Monitoring Addendum for 2019 (Work Activity No. 267-000-859-036)

Dear Mr. Palombo:

The Army appreciates your time and comments (dated and received March 26, 2019) on the *Draft Facility-Wide Groundwater Monitoring Program Addendum for 2019*. Enclosed for your review are responses to your comments. Upon resolution of these comments, the Army will provide a Final version of the addendum for Ohio EPA concurrence.

This addendum was prepared for the Army in support of the RVAAP restoration program. Please contact the undersigned at (703) 607-7589 or david.m.connolly8.civ@mail.mil if there are issues or concerns with this submission.

Sincerely,

Date: 2019.04.04 15:38:35 -04'00'

David Connolly
RVAAP Restoration Program Manager
Army National Guard Directorate

cc: Bob Princic, Ohio EPA, NEDO, DERR
Mark Johnson, Ohio EPA, NEDO, DERR
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Jay Trumble, USACE Louisville
Vasu Peterson, Leidos
Jed Thomas, Leidos
Gail Harris, Vista Sciences Corporation

Subject: Former Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Facility-Wide Groundwater Addendum for 2019 (Work Activity No. 267-000-859-036)

Comments

Ohio EPA Comment 1: Table 3-1 of the FWGWMP Addendum Report for 2019

Table 3-1 indicates that sampling was recommended to be discontinued at 11 wells and that reduced contaminants were to be analyzed for at numerous other wells on the table.

The Army should verify that the discontinuation of these 11 wells and subsequent reduced sampling/analysis for the remaining FWGWMP wells for 2019 are supported by criteria in the 2016 RIWP and demonstrate how these wells meet that criteria (i.e., statistical trend analysis of historical results, certain number of non-detect results, etc.). Additionally, if these sampling changes result in the necessity to modify the existing RIWP, then a plan or schedule for modification of the approved RIWP should be provided to Ohio EPA for concurrence.

Army Response: All RI wells identified in Table 3-3 of the 2016 RIWP were sampled at least once, as noted in Note 1 of that table*:*

> *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.*

It is further noted in the comment responses that "Results of the initial sampling event and a list of wells planned for continued sampling will be provided in the 2017 Facility-Wide Groundwater Addendum." Subsequent to the 2016 RIWP, the sampling schemes presented in the 2017 and 2018 Addendums were designed in accordance with the same criteria as identified in Section 3.4 of this 2019 Addendum:

- FWGWMP Criterion 1: Wells representing critical exit pathway monitoring points (i.e., located along the CJAG boundary):
- FWGWMP Criterion 2: Wells representing primary AOC-specific contaminant source area conditions routinely monitored (e.g., RCRA monitoring well locations) or indicated to be potentially increasing or otherwise potentially unstable plume conditions:
- FWGWMP Criterion 3: Wells with non-metals (including cyanide) historical maximum concentrations from the 2016 or 2017 sampling events (Note: There were no historical maximum non-metals concentrations from the 2018 sampling events);
- FWGWMP Criterion 4: Co-located wells used to evaluate the vertical distribution of contaminants within the stratigraphic sequence (includes all wells installed to date).

The criteria above were used to develop the sampling scheme presented in the 2019 Addendum, with rationale for each specific well presented in Table 3-1. Wells and analytes that were in the 2018 Addendum but not in the 2019 Addendum were removed on similar basis as that identified in the 2016 RIWP, where wells and analytes had stable or decreasing trends (non-detects). Accordingly, a modification to the approved 2016 RIWP is not warranted.

Upon re-review of Tables 3-1 and 3-2, the 2019 sampling scheme presented in the Draft 2019 Addendum (dated February 11, 2019) will have minor revisions in the Final 2019 Addendum. The revised tables (with tracked changes) are presented in Attachment A of this response letter.

Subject: Former Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Facility-Wide Groundwater Addendum for 2019 (Work Activity No. 267-000-859-036)

Ohio EPA Comment 2: Monitoring Zone Review and Adjustments

Based on a review of the "Draft Facility-Wide Ground Water Monitoring Program Annual Report for 2018," Section 2.2.1 of that report indicates that a comprehensive review of all monitoring well logs was conducted to ensure the correct monitoring zones were identified for each monitoring well. Based on this review, the Army identified 33 wells that were found to have different monitoring zones than what was identified in the 2017 Annual Report. These 33 monitoring zone reassignments are summarized in Table 2-1 of the Annual Report for 2018.

Please provide an explanation how the re-evaluation of these wells will affect (or cause) the presence or absence of ground water data gaps in the Remedial Investigation (RI). Further re-evaluation of the current monitoring well placement in certain aquifers may affect potentiometric/flow interpretations in areas of the facility. This may result in the need for additional delineation wells at elevations consistent with evaluation of the proper aquifer around each affected AOC. These changes may also impact the wells selected for future sampling events conducted in 2019. Ohio EPA's full comment on this issue will be provided in our comment letter on the Annual Report for 2018.

Army Response: The corrected aquifer assignments were applied in the 2019 Addendum, and consideration of these reassignments were considered when developing the 2019 sampling scheme.

The pending Facility-wide Groundwater RI Report will assess potential data gaps within and potential risk posed by groundwater at the facility. These evaluations will be performed utilizing data collected as result of the data gap analysis completed in the RIWP as well as all data collected for the FWGWMP. Using this information, this RI Report will also provide recommendations on any necessary future groundwater monitoring.

ATTACHMENT A
2019 Addendum, Revised Tables 3-1 and 3-2

Table 3-1. Recommended FWGWMP Wells for 2019

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
1	Central Burn Pits	CBPmw-008	Cyanide only	**Unconsolidated** monitoring well sampled in 2018 for cyanide.	• Cyanide had an estimated concentration of 0.0045J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
2	Central Burn Pits	CBPmw-009	Cyanide only	**Upper Sharon** monitoring well sampled in 2018 for cyanide. The historical well result high for total cyanide was reported in 2017.	• Cyanide had an estimated concentration of 0.0046J mg/L in June 2018 and 0.0022J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
3	C Block Quarry	CBLmw-001	SVOCs, PCBs, explosives, cyanide, anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for in the first semi-annual field event only for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization of metals at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected. Nitrate was below screening criteria, and sulfate does not have a screening criteria. • Of the metals, only iron exceeded the screening criteria. • pH was 5.6 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, cyanide, anions, and hexavalent chromium, additional sampling of these parameters is not warranted. • Although iron was detected, sampling at CBL wells was limited to provide updated metals characterization. • Additional sampling is not recommended.
4	C Block Quarry	CBLmw-002	SVOCs, PCBs, explosives, cyanide, anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected. Nitrate was below screening criteria, and sulfate does not have a screening criteria. • No metals exceeded the screening criteria. • pH was 5.5 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite, additional sampling of these constituents is not warranted. • Although detected, nitrate and metals did not exceed the screening criteria. • Additional sampling is not recommended.
5	C Block Quarry	CBLmw-003	SVOCs, PCBs, explosives, cyanide, anions, pH, metals,	**Homewood monitoring well** sampled for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization at CBL.	• No detections of SVOCs, PCBs, explosives, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected. Nitrate was below screening criteria, and sulfate does not have a screening criterion. • No metals exceeded the screening criteria. • Cyanide was detected at an estimated concentration of 0.0037J mg/L, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • pH was 6.1 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, hexavalent chromium, sulfide, and nitrite, additional sampling of these constituents is not warranted. • Although detected, sulfate, nitrate, and metals did not exceed screening criteria and cyanide was below the MCL. • Additional sampling is not recommended.
6	C Block Quarry	CBLmw-004	SVOCs, PCBs, explosives, cyanide; anions, pH, metals, Cr[VI]	**Homewood monitoring well** sampled for SVOCs; PCBs; cyanide; metals, including hexavalent chromium; explosives; sulfate/sulfide; nitrate/nitrite; and pH. Samples collected to provide updated characterization at CBL.	The well was sampled in June 2018 only. • No detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite. • Sulfate and nitrate were detected; nitrate was below screening criteria. • No metals exceeded the screening criteria. • pH was 6 S.U.s.	• In the absence of detections of SVOCs, PCBs, explosives, cyanide, hexavalent chromium, sulfide, and nitrite, additional sampling of these constituents is not warranted. • Although detected, sulfate, nitrate, and metals did not exceed screening criteria. • Additional sampling is not recommended.
7	Erie Burning Grounds	EBGmw-125	Cyanide only	**Unconsolidated** monitoring well sampled in 2018 for cyanide. The historical well result high for total cyanide was reported in 2017.	• Cyanide had concentration of 0.02 mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
8	Erie Burning Grounds	EBGmw-131	Cyanide only	**Upper Sharon** monitoring well sampled for cyanide with historical maximum cyanide concentrations reported in 2016.	• Cyanide had an estimated concentration of 0.004J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
9	SE/Load Line 1	LL1mw-064	Explosives, metals	**Unconsolidated** monitoring well located downgradient from Load Line 1; sampled to monitor potential groundwater exit pathway.	• Explosives were not detected in June or October 2018. • No metals exceeded the screening criteria except iron and manganese.	• In the absence of explosives detections, additional sampling of explosives is not warranted. • Continue to monitor metals in this sentinel well.
10	SE/Load Line 1	LL1mw-065	Phthalates, explosives, metals	**Unconsolidated** monitoring well located downgradient from Load Line 1; sampled to monitor potential groundwater exit pathway.	• No SVOCs (phthalates) or explosives were detected in June or October 2018. • No metals exceeded the screening criteria except manganese, which exceeded the screening criteria in both June and October 2018.	• In the absence of detections of SVOCs, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
11	Load Line 1	LL1mw-080	Explosives	**Upper Sharon** well characterized for explosives.	• In June and October 2018, 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX exceeded the screening criteria. • In June 2018, only 1,3-DNB and 2,4-DNT exceeded the screening criteria with estimated concentrations. Neither chemical had a detected concentration in October 2018.	• Continue to monitor explosives.
12	Load Line 1	LL1mw-081	Explosives, cyanide	**Upper Sharon** well with historical maximum cyanide concentration reported in 2016. Semi-annual sampling in 2018 included for characterization of explosives. Initial nitrobenzene detection of 0.58 µg/L in 2017 exceeded the screening level.	• In June 2018, only 2-amino-4,6-DNT exceeded screening criteria. This explosive did not have a detected concentration in October 2018. No other explosives exceeded the screening criteria in June or October 2018. • Nitrobenzene did not have detections in June or October 2018. • Cyanide was not detected in June 2018. Cyanide had an estimated concentration of 0.0027J mg/L, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor explosives and cyanide.
13	Load Line 1	LL1mw-083	SVOCs (phthalates), explosives, pesticides, Cr[VI]6	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT; 2,4-DNT; 4-amino-2,6-DNT). Semi-annual sampling included characterization of groundwater pH conditions outside the range of naturally occurring conditions.	• No SVOCs were detected in June or October 2018. • No pesticides were detected in June or October 2018 except delta-BHC in October 2018 with an estimated concentration of 0.0002J mg/L. • The explosives 2,4,6-TNT; 2,4-DNT; 2,4-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX had exceedances of the screening criteria. All other explosives were below the screening criteria. • Hexavalent chromium was not detected in either sampling event. • Chloride, nitrate, nitrite, and sulfide were all either not detected or at concentrations below screening criteria. Sulfate does not have a screening criterion and had a concentration of 150 mg/L in June 2018 and an estimated concentration of 160J mg/L in October 2018.	• In the absence of detections or exceedances of SVOCs and hexavalent chromium, additional sampling for these constituents is not warranted • Continue to monitor explosives, anions, and alkalinity.
14	Load Line 1	LL1mw-084	SVOCs (phthalates), explosives, pesticides, cyanide, metals, Cr[VI]	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT; 2,4-DNT; 4-amino-2,6-DNT; RDX). Well result high for free cyanide reported in 2017. Semi-annual sampling included characterization of groundwater pH conditions outside the range of naturally occurring conditions	• No SVOCs were detected in June or October 2018. • No pesticides were detected in June or October 2018 except beta-BHC in June 2018. This estimated concentration was below the screening criteria. • The explosives 1,3-DNB; 2,4,6-TNT; 2,4-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX had exceedances of the screening criteria. All other explosives were below the screening criteria. • No metals except manganese and nickel exceeded screening criteria. Both manganese and nickel exceeded screening criteria in both sampling events. • Hexavalent chromium and cyanide were not detected in either sampling event. • Chloride, nitrate, nitrite, and sulfide were all either not detected or at concentrations below screening criteria. Sulfate does not have a screening criterion and had an estimated concentration of 160J mg/L.	• In the absence of detections or exceedances, SVOCs, pesticides, cyanide, anions, and hexavalent chromium do not warrant further sampling. • Continue to monitor explosives, anions, alkalinity, and metals.
15	SE/Load Line 1	LL1mw-086	SVOCs (phthalates), explosives, alkalinity, metals	Second water-bearing zone well (**deep unconsolidated**) downgradient from Load Line 1 for monitoring potential groundwater exit pathway. Semi-annual sampling included characterization of groundwater pH conditions outside the range of naturally occurring conditions.	• No SVOCs or explosives were detected in June or October 2018. • No metals except aluminum, iron, and manganese exceeded the screening criteria. Aluminum and iron exceeded the screening criteria in October 2018 and not June 2018. Manganese exceeded the screening criteria in both sampling events. • Cyanide was detected at an estimated concentration of 0.0043 mg/L, above the tap water RSL of 0.00015 mg/L in June 2018. Cyanide was not analyzed in October 2018.	• In the absence of detections of SVOCs and explosives, additional sampling of these constituents is not warranted. • Continue to monitor metals, cyanide, and alkalinity in this sentinel well.
16	SE	LL1mw-087	SVOCs (phthalates), explosives, metals	**Unconsolidated** well located approximately downgradient from Load Line 1. Monitors potential groundwater exit pathway.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Iron exceeded the screening criteria in June 2018 only, and manganese exceeded the screening criteria in both sampling events.	• In the absence of detections of SVOCs, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
17	Load Line 1	LL1mw-088	SVOCs (phthalates), explosives, pesticides, alkalinity, metals	**Unconsolidated** well located downgradient from Load Line 1 and LL1mw-086, which has historically had pesticides detection above screening levels. Sentinel well for monitoring groundwater exit pathway outside perimeter fence.	• No SVOCs or pesticides were detected in June or October 2018. • No explosives were detected in June or October 2018, except 4-nitrotoluene in June 2018. This concentration was below the screening criteria. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three chemicals exceeded the screening criteria in both sampling events.	• In the absence of detections in SVOCs and pesticides, sampling of these constituents is not warranted. • Continue to monitor explosives, alkalinity, and metals in this sentinel well.
18	Load Line 1	LL1mw-089	SVOCs[1], explosives[1], cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Unconsolidated** well located downgradient from Load Line 1 and LL1mw-086, which has historically had pesticides detection above screening levels. Sentinel well for monitoring groundwater exit pathway outside perimeter fence.	• No SVOCs were detected in June 2018. SVOCs were not analyzed in October 2018. • No explosives were detected in June 2018 except 2,4-DNT and 2,6-DNT, both of which exceeded the screening criteria. Explosives were not analyzed in October 2018. • Hexavalent chromium was not detected in June 2018. It was not analyzed in October 2018. • Cyanide was not detected in either sampling event. • Perchlorate was detected in June 2018, but the estimated concentration was below the screening criteria.	• In the absence of detections in SVOCs, cyanide, ~~propellants,~~ and hexavalent chromium, additional sampling of these constituents is not warranted. • Continue to monitor explosives and recollect rejected propellant results from 2018.
19	S/Load Line 2	LL2mw-059	Phthalates, explosives, metals	**Upper Sharon** well located downgradient from Load Lines 2 and 3 and serves as potential groundwater exit pathway off of former RVAAP; consistently found to contain explosives. 1,3,5-Trinitrobenzene; tetryl; and perchlorate were detected below screening levels in 2017. Historical well result high over screening levels for 1,3-DNB in 2017.	• No SVOCs were detected in June 2018. SVOCs were not analyzed in October 2018. • The explosives that exceeded screening criteria are 1,3-DNB; 2,4-DNT; 2-amino-4,6-DNT; and 4-amino-2,6-DNT. All four explosives exceeded screening criteria in June and October 2018, except for 1,3-DNB that did not have a detected concentration in June 2018. • No metals except manganese exceeded the screening criteria. Manganese only exceeded screening criteria in October 2018.	• In the absence of SVOC detections, additional sampling of phthalates is not warranted. • Continue to monitor explosives and metals.
20	Load Line 2	LL2mw-264	Cyanide	**Upper Sharon** monitoring well sampled for cyanide due to a well-specific historical maximum result in 2016.	• Cyanide had an estimated concentration of 0.0033J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
21	Load Line 2	LL2mw-267	Phthalates, explosives, metals	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4-DNT; RDX).	• No SVOCs were detected in June or October 2018. • The explosives that exceeded screening criteria are 2,4-DNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX. All four explosives exceeded screening criteria in October 2018 and did not have detected concentrations in June 2018. • No metals except iron and manganese exceeded the screening criteria. Both metals exceeded screening criteria in June and October 2018.	• In the absence of detected SVOCs, additional sampling of phthalates is not warranted. • Continue to monitor explosives and metals.
22	Load Line 2	LL2mw-272	SVOCs[1], explosives[1], cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Upper Sharon** well installed in 2016 on the southwest interior of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide reported in 2017 over the screening level.	• No SVOCs or explosives were detected in June 2018. SVOCs and explosives were not analyzed in October 2018. • Hexavalent chromium was not detected. • Cyanide had an estimated concentration of 0.0033J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Perchlorate was detected at an estimated concentration below the screening criteria. • Nitroguanidine and nitrocellulose were not detected at concentrations exceeding the screening criteria	• In the absence of detections or exceedances in SVOCs, explosives, propellants, and hexavalent chromium, additional sampling of these constituents is not warranted. • Continue to monitor cyanide.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
23	Load Line 2/Facility-wide	FWGmw-017	VOCs, SVOCs, explosives, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Basal Sharon Conglomerate** exit pathway well installed at the post boundary southeast of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents reported with detected concentrations include acetone and naphthalene under their respective screening levels.	• No explosives were detected in June or October 2018. • Hexavalent chromium was not detected. • No VOCs were detected except acetone and methylene chloride in both samples. All concentrations were below screening criteria. • No SVOCs were detected in June 2018. SVOCs were detected in the field duplicate collected in October 2018. The primary sample associated with the field duplicate did not have detected concentrations of those SVOCs. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• Monitoring well abandoned in 2018. • Chemicals were either not detected or below screening criteria except iron and manganese. • Additional sampling in this location/aquifer is not recommended.
24	Facility-wide	FWGmw-024	VOCs, SVOCs, explosives, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI]	**Upper Sharon** exit pathway well installed at the post boundary southeast of Load Line 2 to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents (other than hexavalent chromium) reported with detected concentrations include naphthalene and nitrobenzene. Nitrobenzene was reported below its FWCUG but over the tap water RSL in April 2017. Hexavalent chromium was also reported over the tap water RSL in April 2017.	• The only explosive detected was 4-nitrotoluene in June 2018 at a concentration less than the screening criteria. No other explosives, including nitrobenzene, were detected in June or October 2018. • No SVOCs were detected with the exception of methylnaphthalene and naphthalene, each in one of the sampling events. The concentrations were less than the screening criteria, and SVOCs were not detected during the other sampling event. • No VOCs were detected in either sampling event with the exception of acetone in June 2018, which was at a concentration less than the screening criteria. Acetone was not detected in October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018. • Perchlorate and hexavalent chromium were not detected.	• In the absence of detections or exceedances of VOCs, SVOCs propellants, and hexavalent chromium, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
25	Load Line 3	LL3mw-234	Cyanide	**Upper Sharon** well with historical well-specific maximum cyanide concentration observed in 2016.	• Cyanide and was not detected in June 2018. • Cyanide had an estimated concentration of 0.0023J mg/L in October 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
26	Load Line 3	LL3mw-237	Explosives	**Upper Sharon** well sampled for potentially increasing explosives concentrations. Primary source area well for explosives constituents. Exit pathway well.	• Four explosives exceeded screening criteria: 2,4,6-TNT; 2,4-DNT; 2-amino-4,6-DNT; and 4-amino-2,6-DNT. 2,4,6-TNT and 2,4-DNT were only detected in June 2018. 2-Amino-4,6-DNT and 4-amino-2,6-DNT were detected and exceeded the screening criteria in June and October 2018.	• Continue to monitor explosives.
27	Load Line 3	LL3mw-244	Phthalates, explosives, pesticides, metals, Cr[VI]	**Upper Sharon** well located downgradient from Load Lines 3 and 12; consistently found to contain low level explosive constituents (2-amino-4,6-DNT; 4-amino-2,6-DNT; RDX) and hexavalent chromium. Exit pathway well with detected explosive constituents nitrobenzene and RDX below screening levels in 2017.	• SVOCs and pesticides were not detected in June or October 2018. • No explosives exceeded screening criteria except 2-amino-4,6-DNT and 4-amino-2,6-DNT. Both exceeded the screening criteria in June and October 2018. • No metals exceeded the screening criteria with the exception of antimony. The concentration of antimony was below the screening criteria. • Hexavalent chromium was not detected.	• In the absence of phthalates, pesticides, and hexavalent chromium, further sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
28	Load Line 3	LL3mw-246	Phthalates, explosives, perchlorate, metals	**Upper Sharon** well located downgradient from Load Lines 3 and 12 and affected well LL3mw-244; serves as potential groundwater exit pathway; low levels of explosives consistently identified in well. RDX; 4-amino-2,6-DNT; and perchlorate were detected below screening levels in 2017.	• SVOCs were not detected in June or October 2018. • No explosives exceeded screening criteria except 2-amino-4,6-DNT and 4-amino-2,6-DNT. Both exceeded the screening criteria in June and October 2018. • No metals exceeded the screening criteria except mercury. Mercury had an estimated concentration in June 2018 that exceeded the screening criteria; however, the duplicate sample did not have a detection of mercury. Mercury was not detected in October 2018. • Perchlorate was detected in June and October 2018 but the concentrations were below screening criteria.	• In the absence of SVOCs, further sampling for phthalates is not warranted. • Continue to monitor explosives, perchlorate, and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
29	Load Line 3/Facility-wide	FWGmw-021	VOCs, SVOCs, PCBs, explosives, pesticides, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Upper Sharon** exit pathway well installed at the post boundary southwest of Load Line 3 in 2016 to further characterize the nature and extent of facility-wide groundwater impacts. Nitrobenzene, RDX, acetone, naphthalene, and perchlorate were detected below screening levels in 2017. 2-amino-4,6-DNT; 4-amino-2,6-DNT; total cyanide; and Aroclor-1254 were reported over screening levels in 2017.	• No SVOCs or PCBs (including Aroclor-1254) were detected in June or October 2018. • No VOCs were detected except acetone and methylene chloride. Each was detected in one sampling event at concentrations below the screening criteria. • No explosives were detected except 2-amino-4,6-DNT; 4-amino-2,6-DNT; and RDX. 2-amino-4,6-DNT and 4-amino-2,6-DNT exceeded their screening criteria with estimated concentrations in June 2018 but did not have detected concentrations in October 2018. • No metals except iron and manganese exceeded the screening criteria. Both metals exceeded the screening criteria in both samples. • Hexavalent chromium was not detected. • Cyanide had an estimated concentration of 0.0033J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Perchlorate was detected in June 2018 at a concentration below the screening criteria.	• In the absence of detections of SVOCs, PCBs, cyanide, and hexavalent chromium, additional sampling of these constituents is not warranted. • VOC detections limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling is warranted for VOCs. • Continue to monitor explosives and metals.
30	Load Line 4	LL4mw-193	Cyanide	**Unconsolidated** well sampled for cyanide due to well-specific historical high concentrations in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended.
31	Load Line 4	LL4mw-200	Cyanide	**Unconsolidated** well with historical well-specific maximum cyanide concentration observed in 2016. Exit pathway well for Load Line 4.	• Cyanide had an estimated concentration of 0.0063 mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
32	Load Line 7	LL7mw-001	VOCs, phthalates, explosives, cyanide	**Homewood** source area well that has historically been found to contain chlorinated solvents (specifically 1,1-dichloroethane; 1,1-dichloroethene; and 1,1,1-trichloroethane). Historical well result high for total cyanide in 2017.	• SVOCs were not detected in June or October 2018. • No explosives were detected with the exception of RDX. RDX was detected at a concentration below the screening criteria in October 2018. RDX was not detected in June 2018. • No metals except iron and manganese exceeded the screening criteria. Both metals exceeded the screening criteria in both samples. • Four VOCs were detected: 1,1,1-trichloroethane; 1,1-dichloroethane; 1,1-dichloroethene; and acetone. These VOCs were detected in June and October 2018, all at concentrations below the screening criteria. • Cyanide had an estimated concentration of 0.0038J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of detections or exceedances of SVOCs and explosives, additional sampling of those constituents is not warranted. • Although VOCs were detected, concentrations do not exceed screening criteria and 1,1,1-trichloroethane; 1,1-dichloroethane; and 1,1-dichloroethene remain consistent since 2010, demonstrating stability. • Continue to sample for metals and cyanide.
33	Load Line 7	LL7mw-006	Explosives	**Homewood** source area well representing primary contaminant (RDX) source area conditions at Load Line 7. Historical well result high for RDX in 2017.	• No explosives were detected with the exception of RDX and HMX. All detected concentrations were below the screening criteria.	• Continue to monitor explosives.
34	Load Line 10	LL10mw-003	VOCs, phthalates, nitroaromatics, metals	**Homewood** well that has had historically consistent occurrence of VOCs (specifically carbon tetrachloride). Historical well results high or first detection for nitrobenzene, carbon, tetrachloride, and chloroform in 2017.	• No SVOCs were detected in June or October 2018. • No metals exceeded the screening criteria in June or October 2018. • No VOCs exceeded screening criteria with the exception of carbon tetrachloride. Carbon tetrachloride exceeded the screening criteria in June and October 2018.	• In the absence of SVOCs and metals detected or exceeding criteria, further sampling of these constituents is not warranted. • Continue to monitor VOCs.
35	Load Line 10	LL10mw-005	VOCs, phthalates, nitroaromatics, metals	**Homewood** well paired with FWGmw-022; serves to assess potential vertical contaminant migration in this area of the site.	• No SVOCs exceeded the screening criteria in June or October 2018. • No VOCs were detected in either sampling event with the exception of acetone and methylene chloride in October 2018, which was at a concentration less than the screening criteria. Acetone and methylene chloride were not detected in October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both samples.	• In the absence of SVOC exceedances, continued sampling of these constituents is not warranted. • VOC detections limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling warranted at this well. • Continue to monitor metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
36	Facility-wide	FWGmw-019	VOCs, SVOCs[1], PCBs, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Basal Sharon Conglomerate** vertical delineation well installed between Load Line 9 and Load Line 10 to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide, Aroclor-1254, and chloroform were detected above screening levels in 2017.	• No SVOCs or explosives were detected in June 2018. These were not analyzed in October 2018. • No PCBs (including Aroclor-1254) were detected in June or October 2018. • No VOCs were detected except acetone and methylene chloride. Each was detected in one sampling event at a concentration below the screening criteria. • Hexavalent chromium, cyanide, and perchlorate were not detected.	• In the absence of SVOC, explosive, PCB, cyanide, perchlorate, and hexavalent chromium detections, further sampling of these constituents is not warranted. • VOC detections were limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling is warranted at this well with the exception of rejected propellants results from 2018, which require additional monitoring.
37	Facility-wide	FWGmw-022	VOCs, SVOCs[1], PCBs, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Upper Sharon** vertical delineation well installed between Load Line 9 and Load Line 10 to further characterize the nature and extent of facility-wide groundwater impacts. Aroclor-1254, total cyanide, and chloroform were detected above screening levels in 2017.	• No SVOCs or explosives were detected in June 2018. These were not analyzed in October 2018. • No PCBs (including Aroclor-1254) were detected in June or October 2018. • No VOCs were detected except acetone and methylene chloride. Each was detected in one sampling event at a concentration below the screening criteria. • Hexavalent chromium, cyanide, and perchlorate were not detected.	• 2018 results indicate detections limited to acetone and methylene chloride, which were more than an order of magnitude lower than any screening criteria; therefore, no additional sampling of 2018 constituents warranted at this well. • Rejected propellant results from 2018 require additional monitoring.
38	Load Line 11	LL11mw-005	Cyanide	**Unconsolidated** well with AOC historical maximum concentration for cyanide in 2016 results.	• Cyanide had an estimated concentration of 0.0021J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide
39	Load Line 12	LL12mw-183	PAHs, cyanide	**Upper Sharon** monitoring well with well-specific historical maximum cyanide reported in 2016. Cyanide and benz(a)anthracene concentrations reported over screening levels in 2017.	• No SVOCs were detected in June or October 2018 samples with the exception of naphthalene. Naphthalene was detected at an estimated concentration in October 2018 that was below the screening criteria. Naphthalene was not detected in June 2018. Benz(a)anthracene was not detected in June or October 2018. • Cyanide had an estimated concentration of 0.0048 mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of PAH detections exceeding screening criteria, further sampling of these constituents is not warranted. • Continue to monitor cyanide
40	Load Line 12	LL12mw-185	Cyanide, nitrate, arsenic	**Unconsolidated** well that has been found to contain elevated levels of nitrate and is downgradient from potential arsenic source. Initial nitrate and total cyanide detections in 2016 over screening levels.	• Arsenic was the only metal analyzed in June and October 2018. Both samples had arsenic concentrations below the screening criteria. • Nitrate was detected above the screening criteria in both the June and October 2018 sample. • Cyanide was not detected in the June or October 2018 samples.	• Arsenic and cyanide were either not detected or did not exceed screening criteria and do not warrant further sampling. • Continue to monitor nitrate.
41	Load Line 12	LL12mw-187	Phthalates, nitrate, metals	**Unconsolidated** well that has been found to contain elevated levels of nitrate. Historical constituent high for nitrate in 2017.	• SVOCs were not detected in June and October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both samples. • Nitrate was detected above the screening criteria in both the June and October 2018 sample.	• In the absence of SVOC detections, further sampling is not warranted. • Continue to monitor nitrate and metals.
42	Load Line 12	LL12mw-242	Phthalates, explosives, nitrate, metals	**Unconsolidated** well located downgradient from a potential arsenic source area near LL12mw-113.	• SVOCs and explosives were not detected in June and October 2018. • Of the total metals, only arsenic, iron, and manganese exceeded screening criteria. All three exceeded the screening criteria in both sampling events. • Nitrate was detected in June 2018 but below the screening criteria. Nitrate was not detected in October 2018.	• In the absence of SVOC and explosive detections, further sampling of these constituents is not warranted. • Continue to monitor nitrate and metals.
43	Load Line 12	LL12mw-245	Phthalates, explosives, nitrate, metals	**Unconsolidated** well located downgradient from potential nitrate source in the area of LL12mw-185.	• No SVOCs were detected in June or October 2018. • No explosives were detected in June or October 2018 with the exception of 2,4-DNT. 2,4-DNT had an estimated concentration in June 2018 below the screening criteria and was not detected in October 2018. • Of the metals, arsenic, iron, manganese, and mercury exceeded the screening criteria. Arsenic and mercury exceeded the screening criteria only in October 2018. • Nitrate was not detected in June or October 2018.	• In the absence of SVOCs, additional sampling for phthalates is not warranted. • Although nitrates not detected, a history of nitrate detections in recent years and nearby wells warrant further monitoring. • Continue to monitor explosives, nitrate, and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
44	SE	LL12mw-247	Phthalates, explosives, cyanide, nitrate, metals, Cr[VI]	**Unconsolidated** well located downgradient from Load Line 12. Total and free cyanide were reported over screening levels in 2017. Nitrobenzene and nitrate detected below screening levels in 2017. Monitors potential groundwater exit pathway.	• No SVOCs or explosives were detected in June or October 2018. • No metals except aluminum, iron, and manganese exceeded the screening criteria. Iron and manganese exceeded the screening criteria in both samples. • Hexavalent chromium and cyanide were not detected. • Nitrate was not detected in June or October 2018.	• In the absence of detections of SVOCs, explosives, cyanide, and hexavalent chromium, additional sampling of these constituents is not warranted. • Although nitrate not detected, a history of nitrate detections in recent years and nearby wells warrants further monitoring at this exit pathway well. • Continue to monitor metals and nitrate.
45	Load Line 12/Facility-wide	FWGmw-018	VOCs, SVOCs, PCBs, explosives, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI][1]	**Basal Sharon Conglomerate** exit pathway well installed at the post boundary south of Load Line 12 to further characterize the nature and extent of facility-wide groundwater impacts. Ethylbenzene, total xylene, benzyl alcohol, and naphthalene were detected below screening levels in 2017. Aroclor-1254 was reported over its screening level.	• No SVOCs, explosives, or PCBs were detected in June or October 2018. • No VOCs were detected except acetone, methylene chloride, and toluene. Each was detected in one sampling event at concentrations below the screening criteria. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three metals exceeded the screening criteria in both samples. • Perchlorate and hexavalent chromium were not detected. • Cyanide had an estimated concentration of 0.0097J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of detections or exceedances in SVOCs, explosives, perchlorate, PCBs, and hexavalent chromium, additional monitoring of these constituents is not warranted. • Although VOCs were not detected, a history of low VOC concentrations warrants monitoring in this exit pathway well. • Continue to monitor VOCs, metals and cyanide.
46	Load Line 12/Facility-wide	FWGmw-020	VOCs, SVOCs[1], PCBs, explosives,, cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], metals, Cr[VI]	**Upper Sharon** exit pathway well installed at the post boundary southeast of Load Line 12 to further characterize the nature and extent of facility-wide groundwater impacts. Acetone and naphthalene were detected below screening levels in 2017. Cyanide was detected over its screening level.	• No SVOCs, explosives, or PCBs were detected in June or October 2018. • No VOCs were detected except acetone and toluene. Each was detected in one sampling event at concentrations below the screening criteria. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three metals exceeded the screening criteria in both samples. • Perchlorate and hexavalent chromium were not detected. • Cyanide had an estimated concentration of 0.0035J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Nitrate was detected at a concentration (0.19J mg/L) less than the screening criteria in June 2018. Nitrate was not analyzed in October 2018.	• In the absence of SVOCs, PCBs, explosives, , perchlorate, propellants, and hexavalent chromium detected or exceeding criteria, continued sampling of these constituents is not warranted. • Although VOCs do not exceed criteria, a history of low VOC concentrations warrants monitoring to monitor vertical and lateral migration in this exit pathway well. • Continue to monitor VOCs, metals, and cyanide.
47	Fuze and Booster	FBQmw-171	Cyanide, anions, alkalinity, Cr[VI]	**Homewood** monitoring well with historical maximum cyanide concentration reported in 2016 and anomalous pH values outside the typical range of natural groundwater.	• Arsenic was analyzed in June 2018 and was not detected. • Hexavalent chromium was not detected in June or October 2018. • Cyanide had an estimated concentration of 0.0035J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018. • Nitrate, nitrite, and sulfide either did not have a detected concentration or the concentration was below the screening criteria. Sulfate does not have screening criteria and had a concentration of 26 mg/L. • pH remains low but in reasonable range from 5.45 to 5.62 along with low alkalinity at 37-38 mg/L.	• In the absence of arsenic and hexavalent chromium, continued sampling of these constituents is not warranted. • Continue to monitor cyanide, anions, and alkalinity.
48	Fuze and Booster	FBQmw-172	Cyanide	**Homewood** monitoring well with historical maximum cyanide concentration reported in 2016 and free cyanide above screening levels in 2017.	• Cyanide had an estimated concentration of 0.0023J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Cyanide was not detected in October 2018.	• Continue to monitor cyanide.
49	Fuze and Booster	FBQmw-174	Phthalates, explosives, pesticides, anions, alkalinity, Cr[VI]	**Homewood** source area well that has consistently been found to contain explosive constituents (2,4-DNT; 2,4,6-TNT; 4-amino-2,6-DNT). Monitored for pH values outside the typical range of natural groundwater.	The well was sampled in June 2018 only. • No SVOCs or pesticides were detected. • The explosives 2,4,6-TNT; 2,4-DNT; 2-amino-4,6-DNT; and 4-amino-2,6-DNT exceeded the screening criteria. • Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either did not have a detected concentration or the concentration was below the screening criteria. Sulfate does not have screening criteria and had a concentration of 12 mg/L. • pH remains low ranging from 5.16 to 5.27 along with alkalinity at 4.9 and 7.1	• In the absence of SVOCs, pesticides, and hexavalent chromium, continued sampling of these constituents is not warranted. • Continue to monitor explosives, anions, and alkalinity.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
50	Fuze and Booster	FBQmw-175	Anions, alkalinity, Cr[VI]	**Homewood** source area well with anomalous pH values outside the typical range of natural groundwater.	• Hexavalent chromium was not detected in June 2018, but was detected in October 2018 at an estimated concentration of 0.0044 mg/L that exceeded the screening criteria. • Chloride, nitrate, nitrite, and sulfide either did not have a detected concentration or the concentration was below the screening criteria. Sulfate does not have screening criteria and had a concentration of 17 mg/L. • pH remains low 5.12 in June along with low alkalinity at 5.5 mg/L.	• Continue to monitor anions, alkalinity, and hexavalent chromium.
51	Fuze and Booster	FBQmw-176	Cyanide	**Unconsolidated** source area well representing primary contaminant (cyanide) source area conditions at the AOC.	• Cyanide was not detected in June 2018. • Cyanide had a concentration of 0.025 mg/L in October 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
52	Facility-wide	FWGmw-023	VOCs[1], SVOCs[1], cyanide, perchlorate[1], nitroguanidine[1], nitrocellulose[1], and Cr[VI][1]	**Upper Sharon** well installed east of the Fuze and Booster Quarry to further characterize the nature and extent of facility-wide groundwater impacts. Total cyanide, chloroform, and ethylbenzene were reported over screening levels in 2017.	• No SVOCs, VOCs, or explosives were detected in June or October 2018. • Hexavalent chromium and cyanide were not detected. • Perchlorate was detected at an estimated concentration below the screening criteria.	• In the absence of detections of VOCs, SVOCs, explosives, propellants, cyanide, and hexavalent chromium as well as exceedance of screening criteria of perchlorate, additional monitoring of these constituents is not warranted. • Rejected propellants results from 2018 require additional monitoring.
53	Admin./George Road	FWGmw-004	Phthalates, explosives, metals	**Unconsolidated** exit pathway well located near the south property line and downgradient from several Compliance Restoration sites. RDX and bis(2-ethylhexyl)phthalate were detected below screening levels in 2017.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron exceeded the screening criteria. Iron exceeded the screening criteria in June 2018 but not in October 2018.	• In the absence of SVOCs and explosives detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
54	SW	FWGmw-007	Phthalates, explosives, metals	**Unconsolidated** well located in the western portion of former RVAAP. Potential exit pathway well near Hinkley Creek.	• No SVOCs or explosives were detected in June or October 2018. • The only explosive detected was 4-nitrotoluene in June 2018 at an estimated concentration of 0.00054J mg/L, which is below the screening criteria. This explosive was not detected in October 2018. • No metals except iron and manganese exceeded the screening criteria. Iron exceeded the screening criteria in June 2018, and manganese exceeded the screening criteria in both samples.	• In the absence of SVOC detections and explosives exceedances, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
55	Northeast of Load Line 1	FWGmw-010	Cyanide	**Unconsolidated** monitoring well with new well-specific historical high cyanide concentrations in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended.
56	East Classification Yard	FWGmw-011	Phthalates, explosives, metals	**Unconsolidated** well located east of Ramsdell Quarry and former East Classification Yard. Serves as exit pathway well. Historical well result high for 3-nitrotoluene in 2017.	• No SVOCs or explosives (including 3-nitrotoluene) were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration. • Continue to monitor explosives and metals.
57	East Classification Yard	FWGmw-012	Phthalates, explosives, metals	**Upper Sharon** formation well paired with FWGmw-011; serves as exit pathway well for the Sharon aquifer.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• In the absence of phthalates detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
58	Facility-wide	FWGmw-013	Cyanide	**Upper Sharon** well with historical well-specific maximum cyanide concentration reported in 2017.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended.
59	Admin./George Road	FWGmw-015	Phthalates, explosives, metals	**Unconsolidated** well. Located near the south property line and downgradient from several compliance restoration sites. Serves as first-water unconsolidated exit pathway well.	• No SVOCs or explosives were detected in June or October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in June and October 2018.	• In the absence of SVOCs and explosives detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
60	Admin./George Road	FWGmw-016	Phthalates, explosives, metals	**Upper Sharon** well paired with FWGmw-015 for vertical delineation. Located near the south property line and downgradient from several compliance restoration sites. Serves as upper Sharon formation exit pathway well. RDX was detected below screening levels in 2017.	• No SVOCs or explosives (including RDX) were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018.	• In the absence of SVOCs and explosives detections, additional sampling of these constituents is not warranted. • Although explosives were not detected, this exit pathway well will continue to monitor migration potential. • Continue to monitor explosives and metals.
61	NACA Test Area	NTAmw-117	Cyanide	**Unconsolidated** monitoring well with well-specific historical maximum cyanide concentrations reported in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended
62	NACA Test Area	NTAmw-118	Cyanide	**Unconsolidated** monitoring well with AOC historical maximum cyanide concentrations reported in 2016.	• Cyanide was not detected in June or October 2018.	• Additional sampling is not recommended
63	NACA Test Area	NTAmw-119	VOCs, phthalates, nitroaromatics, PAHs, explosives, metals	**Deep unconsolidated** well that has historically been found to contain trace amounts of tetrachloroethene and naphthalene, as well as metals. Monitors second water-bearing zone in buried glacial valley. Historical constituent high for benzo(b)fluoranthene in 2017.	• No SVOCs were detected in June or October 2018 with the exception of naphthalene in June 2018. The estimated detected concentration was below the screening criteria. • No explosives were detected with the exception of 4-nitrotoluene in June 2018. This estimated concentration was below the screening criteria, and 4-nitrotoluene was not detected in October 2018. • No metals except iron and manganese exceeded the screening criteria. Both exceeded the screening criteria in June and October 2018. • No VOCs were detected with the exception of acetone and methylene chloride. Concentrations for both were below the screening criteria.	• In the absence of detections or exceedances of phthalates and nitroaromatics, additional sampling of these constituents is not warranted. • VOC detections limited to acetone and methylene chloride, more than an order of magnitude lower than screening criteria; therefore, no additional sampling is warranted for VOCs. • Continue to monitor PAHs, explosives, and metals ~~and recollect rejected propellant results from 2018~~.
64	NACA Test Area	NTAmw-120	SVOCs[1], explosives[1], perchlorate[1], nitroguanidine[1], nitrocellulose[1], Cr[VI][1]	**Upper Sharon** well installed in 2016 at the central portion of the NACA Test Area to further characterize the nature and extent of facility-wide groundwater impacts. Non-metals constituents were not reported above screening levels in samples collected in 2017.	The well was sampled in June 2018 only. • No SVOCs were detected. • No explosives were detected with the exception of 4-nitrotoluene. This estimated concentration was below the screening criteria. • Hexavalent chromium and perchlorate were not detected.	• In the absence of detections or exceedances of SVOCs, explosives, propellants, and hexavalent chromium, no further sampling is recommended. • Rejected hexachlorocyclopentadiene results from 2018 require additional monitoring.
65	Demolition Area 2	DA2mw-115	Phthalates, explosives, cyanide, metals	**Upper Sharon** well paired with well DETmw-003; serves to monitor potential vertical migration in this area of the site. Historical well result high for total cyanide in 2017.	• No SVOCs or explosives were detected in June or October 2018. • No metals except iron and manganese exceeded the screening criteria. Both chemicals exceeded the screening criteria in both sampling events. • Cyanide was not detected in either June or October 2018.	• In the absence of SVOCs, explosives, and cyanide detections, further sampling of those constituents is not warranted. • Continue to monitor metals.
66	Demolition Area 2	DETmw-003	VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, metals	**Unconsolidated** RCRA well. Initial nitrobenzene detection in 2017 was greater than its screening level. Benzo(b)fluoranthene and cyanide were reported over screening levels in 2017.	• The only SVOC detected was benzo(a)pyrene with an estimated concentration of 0.000019J mg/L, which is below the MCL. No other SVOCs were detected in June or October 2018. Hexachlorocyclopentadiene results from June 2018 were rejected. • Cyanide was not detected in June or October 2018. • No explosives, pesticides, or PCBs were detected in June or October 2018. • No metals except arsenic, iron, and manganese exceeded the screening criteria. All three chemicals exceeded the screening criteria in both sampling events. • No VOCs were detected except acetone. Acetone had estimated concentrations below the screening criteria.	• In the absence of the detection of explosives, pesticides, PCBs, and cyanide, further sampling of these constituents is not warranted for the CERCLA investigation. • Although acetone was detected, the concentration is several orders of magnitude lower than screening criteria; therefore additional sampling not warranted. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, and metals.
67	Demolition Area 2	DETmw-004	VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, metals	**Unconsolidated** RCRA well. Dry during both semi-annual events in 2017.	• Sample collected in October 2018 only. Well was dry during the June 2018 sampling event. • No SVOCs, VOCs, pesticides, or PCBs were detected. • No explosives or metals exceeded the screening criteria. • Cyanide was not detected.	• In the absence of VOC, SVOC, pesticide, PCB, and cyanide detections, additional sampling of these parameters is not warranted for the CERCLA investigation. • Detections of explosives did not exceed screening criteria by an order of magnitude. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, nitroaromatics, PAHs, phenols, PCBs, explosives, pesticides, cyanide, and metals.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
68	Ramsdell Quarry	RQLmw-007	VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, phosphorus, metals	**Upper Sharon** RCRA well. Historical well result high for benzo(b)fluoranthene in 2017. Cyanide detected above screening levels in 2016. Phosphorus reported over screening levels in 2017.	• Phosphorus was detected above the screening level in June and October 2018. • No explosives, PCBs, or pesticides were detected. • No VOCs were detected with the exception of 1,2-dichloroethene in June 2018 only and was not detected in October 2018. • Five SVOCs were detected, all at estimated concentrations below the screening criteria. Benzo(b)fluoranthene was not detected in June or October 2018. • The metals arsenic, iron, manganese, and nickel all exceeded screening criteria. • Cyanide had an estimated concentration of 0.005J mg/L in June 2018 and 0.0046J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• In the absence of detections of explosives, PCBs, and pesticides, additional sampling of these parameters is not warranted for the CERCLA investigation. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, phosphorus, and metals.
69	Ramsdell Quarry	RQLmw-008	VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, ~~phosphorus,~~ metals	**Upper Sharon** RCRA well. Historical well result high for 3-nitrotoluene in 2017 and cyanide in 2016.	• No VOCs, pesticides, or PCBs were detected in June or October 2018. • Three SVOCs were detected, all at concentrations below the screening criteria. • The only explosives detected were HMX and RDX. Only RDX had a concentration that exceeded the screening criteria. • The metals arsenic, iron, manganese, mercury, and zinc all exceeded screening criteria. • Cyanide had an estimated concentration of 0.0032J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of VOC, pesticide, and PCB detections, additional sampling of these parameters is not warranted for the CERCLA investigation. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, ~~phosphorus,~~ and metals.
70	Ramsdell Quarry	RQLmw-009	VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, ~~phosphorus,~~ metals	**Upper Sharon** RCRA well. First detection for cyanide reported in 2016.	• Three SVOCs were detected, all of which were at concentrations less than the screening criteria. • No explosives were detected with the exception of RDX. RDX was detected in October 2018 at a concentration less than the screening criteria. RDX was not detected in June 2018. • No metals except iron and manganese exceeded the screening criteria. Both chemicals exceeded the screening criteria in both sampling events. • No VOCs were detected with the exception of acetone and methylene chloride in October 2018. Neither was detected in June 2018. • No pesticides were detected with the exception of delta-BHC in October 2018. • No PCBs were detected in June or October 2018. • Cyanide had an estimated concentration of 0.0032J mg/L in June 2018, above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. Cyanide was not detected in October 2018.	• In the absence of PCB detections, additional sampling of those parameters is not warranted for the CERCLA investigation. • However, in accordance with the DFFO, analytical parameters for this RCRA well include the same parameters as 2018: VOCs, phthalates, PAHs, phenols, PCBs, explosives, pesticides, cyanide, ~~phosphorus,~~ and metals.
71	Ramsdell Quarry	RQLmw-011	SVOCs, anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater and historically representing SVOC primary contaminant source area conditions at the AOC.	• Three SVOCs were detected, all of which were at concentrations less than the screening criteria. • Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 160 mg/L in June 2018 and an estimated concentration of 100 mg/L in October 2018. • pH and alkalinity remain low in June with pH at 4.72 and alkalinity at 38 mg/L; but respectively increase in October with a pH of 6.03 and alkalinity 120 mg/L.	• In the absence of detections of hexavalent chromium and exceedances of SVOCs, additional sampling of these constituents is not warranted. • In consideration of the pH anomalies, continue to monitor anions, pH, and alkalinity.
72	Ramsdell Quarry	RQLmw-012	Cyanide, anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater and well-specific historical maximum cyanide concentrations reported in 2016 and free cyanide above screening levels in 2017.	• Cyanide had an estimated concentration of 0.0023J mg/L in June 2018 and 0.0054J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L. • Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 190 mg/L in June 2018 and 100 mg/L in October 2018. • pH remains low ranging from 4.94 to 5.43 along with alkalinity ranging from 6.7 to 32 mg/L.	• In the absence of detections of hexavalent chromium, additional sampling of this constituent is not warranted. • In consideration of the pH anomalies, continue to monitor anions, pH, alkalinity, and cyanide.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
73	Ramsdell Quarry	RQLmw-013	Anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater.	• Hexavalent chromium was not detected. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 170 mg/L in June 2018 and 150 mg/L in October 2018. • pH remains low ranging from 3.3 to 4.12 along with alkalinity ranging from 3.2 to 5 mg/L.	• In the absence of detections of hexavalent chromium additional sampling of this constituent is not warranted • In consideration of the pH anomalies, continue to monitor anions, pH, and alkalinity.
74	Ramsdell Quarry	RQLmw-014	Explosives, anions, alkalinity, Cr[VI]	**Upper Sharon** source area well with anomalous pH values outside the typical range of natural groundwater. Historically reported as the primary contaminant (2-nitrotoluene) source area conditions at the AOC.	• No explosives were detected in June or October 2018. • Hexavalent chromium was not detected in June or October 2018. • Chloride, nitrate, nitrite, and sulfide either had no detections or had detections below screening criteria. Sulfate does not have screening criteria and had a concentration of 51 mg/L in June 2018 and 120 mg/L in October 2018. • pH at acceptable ranges from 5.73 to 5.94 along with alkalinity at 35 to 79 mg/L.	• In the absence of detections of explosives and hexavalent chromium, additional sampling of these constituents is not warranted. • In consideration of the reasonable range of pH in 2018, this well is not recommended for additional sampling.
75	Ramsdell Quarry	RQLmw-016	Cyanide	**Upper Sharon** monitoring well with historical maximum cyanide concentrations reported in 2016.	• Cyanide had an estimated concentration of 0.0025J mg/L in June 2018 and 0.003J mg/L in October 2018, both above the screening criteria of 0.00015 mg/L but below the MCL of 0.2 mg/L.	• Continue to monitor cyanide.
76	SE	SCFmw-004	Phthalates, explosives, pesticides, metals	**Sharon Conglomerate Member** well located downgradient from Load Lines 1 and 2, paired with LL1mw-087, and selected for monitoring the potential groundwater exit pathway off of former RVAAP in the deeper aquifer.	• No SVOCs, explosives, or pesticides were detected in June and October 2018 samples. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both sampling events.	• In the absence of SVOC explosive, or pesticide detections, additional sampling of these constituents is not warranted. • Continue to monitor metals.
77	Winklepeck Burning Grounds	WBGmw-006	Phthalates, explosives, metals	**Unconsolidated** well paired with WBGmw-021; source area well has been found to contain explosives (RDX).	• No SVOCs were detected in June or October 2018. • No explosives exceeded the screening criteria with the exception of RDX. RDX exceeded the screening criteria in June and October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in both sampling events.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
78	Winklepeck Burning Grounds	WBGmw-009	Phthalates, explosives, metals	**Unconsolidated** well paired with WBGmw-020; source area well has been found to contain explosive constituents (RDX).	• No SVOCs were detected in June or October 2018. • No explosives exceeded the screening criteria with the exception of RDX. RDX exceeded the screening criteria in June and October 2018. • No metals except manganese exceeded the screening criteria. Manganese exceeded the screening criteria in only June 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
79	Winklepeck Burning Grounds	WBGmw-020	Phthalates, explosives, metals	**Upper Sharon** well paired with WBGmw-009; source area well for monitoring potential vertical migration in Sharon aquifer.	• No SVOCs were detected in June or October 2018. • No explosives were detected with the exception of RDX in October 2018. This detection was below the screening criteria. • No metals except iron and manganese exceeded the screening criteria. Both iron and manganese exceeded the screening criteria in June and October 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
80	Winklepeck Burning Grounds	WBGmw-021	Phthalates, explosives, metals	**Upper Sharon** well paired with WBGmw-006; source area well for monitoring potential vertical migration in Sharon aquifer.	• No SVOCs were detected in June or October 2018. • No explosives were detected with the exception of 4-nitrotoluene in June 2018. This detection was below the screening criteria. • No metals except iron and manganese exceeded the screening criteria. Both iron and manganese exceeded the screening criteria in June and October 2018.	• In the absence of SVOC detections, additional sampling of these constituents is not warranted. • Continue to monitor explosives and metals.
81	Sand Creek Landfill	SCLmw-001	VOCs, SVOCs, explosives, PCBs, pesticides, cyanide, anions, propellants, metals	**Unconsolidated** new well installed in October 2018.	Analysis of data from new wells will be provided in the 2019 annual report and FWGW RI.	• Continue quarterly monitoring.
82	Sand Creek Landfill	SCLmw-002	VOCs, SVOCs, explosives, PCBs, pesticides, cyanide, anions, propellants, metals	**Unconsolidated** new well installed in October 2018.	Analysis of data from new wells will be provided in the 2019 annual report and FWGW RI.	• Continue quarterly monitoring.

Table 3-1. Recommended FWGWMP Wells for 2019 (continued)

No.	RVAAP-66 Area	Well Location	2018 Sampling	2018 FWGWMP Sampling Rationale	2018 Results	2019 FWGWMP Sampling Recommendations
83	Sand Creek Landfill	SCLmw-003	VOCs, SVOCs, explosives, PCBs, pesticides, cyanide, anions, propellants, metals	**Unconsolidated** new well installed in October 2018	Analysis of data from new wells will be provided in the 2019 annual report and FWGW RI.	• Continue quarterly monitoring.

Denotes wells where additional sampling is not recommended.

AOC = Area of Concern.
BHC = Hexachlorocyclohexane.
CBL = C Block
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
Cr[VI] = Hexavalent Chromium.
DFFO = Director's Final Findings and Orders.
DNB = Dinitrobenzene.
DNT = Dinitrotoluene.
FWCUG = Facility-wide Cleanup Goal.
FWGWMP = Facility-wide Groundwater Monitoring Plan.
HMX = Octahydro-1,3,5,7- tetranitro-1,3,5,7-tetrazocine.
MCL = Maximum Contaminant Level.
µg/L = Micrograms per Liter.
mg/L = Milligrams per Liter.
NACA = National Advisory Committee on Aeronautics.
PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
RCRA = Resource Conservation and Recovery Act.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
RSL = Regional Screening Level.
RVAAP = Ravenna Army Ammunition Plant.
S.U. = Standard Unit.
SE = Southeast.
SVOC = Semi-volatile Organic Compound.
TNT = 2,4,6-Trinitrotoluene.
USEPA = U.S. Environmental Protection Agency.
VOC = Volatile Organic Compound.

Table 3-2. FWGWMP Wells with Analytical Testing Suite

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals[6]
CBPmw-008						X		
CBPmw-009						X		
DA2mw-115								X
DET-003	X	X[2,3,4,5]	X	X	X	X		X
DET-004	X	X[2,3,4,5]	X	X	X	X		X
EBGmw-125						X		
EBGmw-131						X		
FBQmw-171						X	Sulfate/sulfide, nitrate/nitrite, alkalinity	
FBQmw-172						X		
FBQmw-174				X			Sulfate/sulfide, nitrate/nitrite, alkalinity	
FBQmw-175							Sulfate/sulfide, nitrate/nitrite, alkalinity	Cr[VI]
FBQmw-176						X		
FWGmw-004				X				X
FWGmw-007				X				X
FWGmw-011				X				X
FWGmw-012				X				X
FWGmw-015				X				X
FWGmw-016				X				X
FWGmw-018	X					X		X
FWGmw-019							Nitroguanidine[1], nitrocellulose[1]	
FWGmw-020	X					X		X
FWGmw-021				X				X
FWGmw-022							Nitroguanidine[1], nitrocellulose[1]	
FWGmw-023							Nitroguanidine[1], nitrocellulose[1]	
FWGmw-024				X				X
LL1mw-064								X
LL1mw-065		~~X~~[2]		X				X
LL1mw-080				X				
LL1mw-081				X		X		
LL1mw-083				X			Sulfate/sulfide, nitrate/nitrite, alkalinity	
LL1mw-084				X			Sulfate/sulfide, nitrate/nitrite, alkalinity	X
LL1mw-086						X	Alkalinity	X
LL1mw-087				X				X

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Table 3-2. FWGWMP Wells with Analytical Testing Suite (continued)

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals[6]
LL1mw-088				X			Alkalinity	X
LL1mw-089				X			Nitroguanidine[1], nitrocellulose[1]	
LL2mw-059				X				X
LL2mw-264						X		
LL2mw-267				X				X
LL2mw-272						X		
LL3mw-234						X		
LL3mw-237				X				
LL3mw-244				X				X
LL3mw-246				X			Perchlorate	X
LL4mw-200						X		
LL7mw-001						X		X
LL7mw-006				X				
LL10mw-003	X							
LL10mw-005								X
LL11mw-005						X		
LL12mw-183						X		
LL12mw-185							Nitrate	
LL12mw-187							Nitrate	X
LL12mw-242							Nitrate	X
LL12mw-245				X			Nitrate	X
LL12mw-247							Nitrate	X
NTAmw-119		X[4]		X				X
NTAmw-120		X[1,6]						
RQLmw-007	X	X[2,4,5]	X	X	X	X	Phosphorus	X
RQLmw-008	X	X[2,4,5]	X	X	X	X		X
RQLmw-009	X	X[2,4,5]	X	X	X	X		X
RQLmw-011		~~X~~					Sulfate/sulfide, nitrate/nitrite, alkalinity	
RQLmw-012						X	Sulfate/sulfide, nitrate/nitrite, alkalinity	
RQLmw-013							Sulfate/sulfide, nitrate/nitrite, alkalinity	
RQLmw-016						X		
SCFmw-004								X
WBGmw-006				X				X

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Table 3-2. FWGWMP Wells with Analytical Testing Suite (continued)

Well ID	VOCs	SVOCs	PCBs	Explosives	Pesticides	Cyanide	Other	Metals[6]
WBGmw-009				X				X
WBGmw-020				X				X
WBGmw-021				X				X
SCLmw-001	X	X	X	X	X	X	Sulfate/sulfide, nitrate/nitrite, alkalinity, perchlorate, phosphorus, nitroguanidine, nitrocellulose	X
SCLmw-002	X	X	X	X	X	X	Sulfate/sulfide, nitrate/nitrite, alkalinity, perchlorate, phosphorus, nitroguanidine, nitrocellulose	X
SCLmw-003	X	X	X	X	X	X	Sulfate/sulfide, nitrate/nitrite, alkalinity, perchlorate, phosphoros, nitroguanidine, nitrocellulose	X

Notes:

X = Indicates well or constituent to be sampled as part of the 2019 FWGWMP. Wells and constituents will be sampled semi-annually unless indicated by footnotes described below.

[1] Indicates monitoring well or constituents to be sampled in the spring of 2019 due to missed tests or rejected results in 2018. Additional sampling during 2019 for these wells and constituents will be based on review of the spring 2019 results.

[2] SVOCs: phthalates

[3] SVOCs: nitroaromatics

[4] SVOCs: polycyclic aromatic hydrocarbons

[5] SVOCs: phenols

[6] SVOCs: hexachlorocyclopentadiene

[6,7] Metals sampling in Fall 2019 will only include wells with one or more metals exceeding screening criteria including a screen against approved background criteria.

Cr[VI] = Hexavalent Chromium.
FWGWMP = Facility-wide Groundwater Monitoring Program.
ID = Identification.
PCB = Polychlorinated Biphenyl.
SVOC = Semi-volatile Organic Compound.
VOC = Volatile Organic Compound.

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

March 26, 2019

RE: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859036

Mr. David Connolly
Army National Guard Directorate
Environmental Programs Division
ARNGD-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Subject: Ohio EPA Comments on the "Draft Facility-Wide Groundwater Monitoring Addendum for 2019," Dated February 14, 2019

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the "Draft Facility-Wide Groundwater Monitoring Addendum for 2019" at the Former Ravenna Army Ammunition Plant (RVAAP), Portage and Trumbull Counties, Ohio. This document was received at Ohio EPA, Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on February 14, 2019. The report was prepared for the U.S. Army Corps of Engineers (USACE) on behalf of the National Guard Bureau by Leidos under Contract Number W912QR-16-D-0003.

Comments on the document based on Ohio EPA review are provided below. Please provide responses to the enclosed comments in accordance with the Directors Findings and Orders.

The "Draft Facility-wide Groundwater Monitoring Program (FWGWMP) Addendum for 2019" summarizes ground water monitoring objectives and approach to be followed during the 2019 sampling events, including:

- As an update to the FWGWMP Addendum for 2019, wells selected for inclusion in the 2019 sampling events are based on wells representing critical exit pathway monitoring points, wells representing primary area of concern (AOC)-specific contaminant source area conditions that are potentially increasing or have unstable plume conditions, wells with 2018 sampling results representing historical maximum concentrations of one or more site related compounds (SRCs), and wells co-located to establish vertical extent of contaminants within the stratigraphic sequence.
- Wells sampled in 2018 that do not meet the above criteria were not recommended for sampling in 2019.

- 2019 FWGWMP sampling will generally include wells found to have one or more screening exceedances during the 2018 sampling events.
- A total of 72 wells (including five Resource Conservation and Recovery Act (RCRA) wells) have been selected for sampling during 2019.
- Monitoring well sampling and analytical testing is to be completed in accordance with the 2016 Remedial Investigation Work Plan (RIWP) (TEC-Weston).
- Table 3-1 provides a summary of the proposed wells to be sampled during 2019, and rationale for inclusion (or removal) from the FWGWMP.
- 11 wells were denoted on Table 3-1 as not being recommended for additional sampling during the 2019 FWGWMP. Numerous other wells were recommended for decreased constituent sampling.

COMMENTS

1. **Table 3-1 of the FWGWMP Addendum Report for 2019:**

Table 3-1 indicates that sampling was recommended to be discontinued at 11 wells and that reduced contaminants were to be analyzed for at numerous other wells on the table.

The Army should verify that the discontinuation of these 11 wells and subsequent reduced sampling/analysis for the remaining FWGWMP wells for 2019 are supported by criteria in the 2016 RIWP and demonstrate how these wells meet that criteria (i.e., statistical trend analysis of historical results, certain number of non-detect results, etc.). Additionally, if these sampling changes result in the necessity to modify the existing RIWP, then a plan or schedule for modification of the approved RIWP should be provided to Ohio EPA for concurrence.

2. **Monitoring Zone Review and Adjustments:**

Based on a review of the "Draft Facility-Wide Ground Water Monitoring Program Annual Report for 2018," Section 2.2.1 of that report indicates that a comprehensive review of all monitoring well logs was conducted to ensure the correct monitoring zones were identified for each monitoring well. Based on this review, the Army identified 33 wells that were found to have different monitoring zones than what was identified in the 2017 Annual Report. These 33 monitoring zone reassignments are summarized in Table 2-1 of the Annual Report for 2018.

Please provide an explanation how the re-evaluation of these wells will affect (or cause) the presence or absence of ground water data gaps in the Remedial Investigation (RI). Further re-evaluation of the current monitoring well placement in certain aquifers may

affect potentiometric/flow interpretations in areas of the facility. This may result in the need for additional delineation wells at elevations consistent with evaluation of the proper aquifer around each affected AOC. These changes may also impact the wells selected for future sampling events conducted in 2019. Ohio EPA's full comment on this issue will be provided in our comment letter on the Annual Report for 2018.

This "Draft Facility-wide Groundwater Monitoring Addendum for 2019" was reviewed by personnel from Ohio EPA, DERR, the DERR risk assessment section and the Division of Materials and Waste Management (DMWM). Additional information is necessary to approve the document. If you have questions or would like to set up a meeting to discuss these comments, please call me at (330) 963-1292.

Sincerely,

Bob Princic for

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

KP/sc

ec: David Connolly, ARNG
Kevin Sedlak, ARNG
Katie Tait, OHARNG RTLS
Craig Coombs, USACE
Nat Peters, USACE
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