AECOM

Final
Feasibility Study Report
Ridgway Training Range, Pennsylvania

Munitions Response Site PAE40-001-R-01
Pennsylvania Army National Guard

Army National Guard

Contract No. W9133L-14-D-0001
Delivery Order No. 0006

September 2020

Prepared for:
Army National Guard
NGB-AQ-W9133L
111 South George Mason Drive
Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:
AECOM
12420 Milestone Center Drive
Suite 150
Germantown
MD, 20876
USA

T: +1 (301) 250 2629
F: +1 (937) 998 1115
aecom.com

Project Name:

Feasibility Study Report through Decision Document for Six Army National Guard Munitions Response Sites, Ridgway Training Range, Pennsylvania

Site Location:

Ridgway Township, PA

Contract/Delivery Order:

Contract No. W9133L-14-D-0001
Delivery Order No. 0006

Report Name:

Feasibility Study Report
Ridgway Training Range, Pennsylvania
Munitions Response Site PAE40-001-R-01

Preparation Date (Month/Year):

September 2020

Prepared for:

Army National Guard
NGB-AQ-W9133L
111 South George Mason Drive Building 2, 4th Floor
Arlington, VA 22204-1373

Prepared by:

AECOM
12420 Milestone Center Drive
Suite 150
Germantown
MD 20876
USA
T: +1 (301) 250 2629
F: +1 (937) 998 1115
aecom.com

Registered Professional Geologist:

Stenberg, Laurie

Digitally signed by Stenberg, Laurie
DN: dc=com, dc=aecomnet, dc=na, ou=AECOMIsolated, ou=USDFARS, ou=AECOMUsers, ou=USGRM2, cn=Stenberg, Laurie
Date: 2020.07.15 13:09:15 -04'00'

Signature
Laurie Stenberg, P.G.
PA License #PG-001857G

This Page Intentionally Blank

Table of Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

AECOM	AECOM Technical Services, Inc.
ALM	Adult Lead Methodology
ARAR	Applicable or Relevant and Appropriate Requirement
ARNG	Army National Guard
BCY	bank cubic yards
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	CWM Hazard Evaluation Module
COC	Contaminant of concern
COI	Contaminant of interest
COPEC	Contaminant of Potential Ecological Concern
CWM	Chemical Warfare Material
DMM	Discarded Military Munitions
DoD	Department of Defense
DU	Decision Unit
EHE	Explosive Hazard Evaluation Module
FS	Feasibility Study
GRA	general response action
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
IEUBK	Integrated Exposure Uptake Biokinetic
ISM	Incremental sampling methodology
LTM	long-term management
LUC	Land Use Control
MC	munitions constituents
MD	munitions debris
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm	millimeter
MEC	Munitions and Explosives or Concern
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
NCP	National Contingency Plan
NDNODS	Non-DoD Non-Operational Defense Sites
O&M	operations and maintenance

PAARNG	Pennsylvania Army National Guard
PADEP	Pennsylvania Department of Environmental Protection
PbB	blood lead
PP	Proposed Plan
PV	Present Value
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
ROE	right-of-entry
RSL	Regional Screening Level
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SMDP	Scientific management decision points
TBC	to be considered
TCLP	toxicity characteristic leaching procedure
TMV	toxicity, mobility, or volume
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UU/UE	unlimited use/unrestricted exposure
XRF	x-ray fluorescence

This Page Intentionally Blank

Executive Summary

The purpose of this Feasibility Study (FS) is to provide decision makers an overview of the development and analysis of remedial alternatives that address the Ridgway Training Range (PAE40-001-R-01) Munitions Response Site (MRS).

The MRS encompasses 0.22 acres and is located in Ridgway Township, Pennsylvania, on the west side of Grant Road, approximately 2 miles northwest of Ridgway Borough and 5 miles southwest of Johnsonburg in Elk County, Pennsylvania. The MRS is surrounded by the 8-acre former Ridgway Weekend Training Site (**Figure ES-1**) and is located on privately-owned property. Access to the range is partially restricted from public access by a locked gate, concrete walls on the north and southern side, and a fence on the east side.

The Non-Department of Defense (DoD) Non-Operational Defense Site (NDNODS) Ridgway Training Range MRS was used by the Pennsylvania Army National Guard (PAARNG) for small-arms, live-fire weapons training from 1987 to 2005 (Parsons, 2012). From 1987 to 1990, the range was used approximately four to five times a year, but range use from 1990 to 2001 is unknown. From 2001 to 2005, the range was used approximately two to three times a year. During that period, it is estimated that approximately 64,000 small-caliber rounds were expended at the range. The range was last used in November 2005, and small-arms training was discontinued in March 2006 because it no longer met ARNG requirements (PADMVA, 2011). The MRS is currently unused. The area to the east of the MRS is currently a staging area for equipment associated with a private landscaping company who owns the property.

The Remedial Investigation (RI), conducted in July 2018, compiled and evaluated information and data relating to the potential contamination associated with historical small arms training activities conducted at the Ridgway Training Range MRS. The sampling approach was designed to characterize the nature and extent of munitions constituents (MC) contamination. For data interpretation purposes and for assessing risks, the MRS was divided into four decision units (DUs) – the Target Berm, Firing Point, Soil Pile, and French Drain Outfall area – that reflect the areas of potential contamination as indicated by site history and remaining physical evidence of the target areas (**Figure ES-2**).

MC sampling at the MRS was completed at discrete and incremental sample locations.

- Discrete Sampling Exceedances
    - Target Berm DU: Human health screening criteria exceedances for antimony, copper and lead, ecological screening criteria exceedances for the analytes above and zinc.
    - Soil Pile DU: Human health screening criteria exceedances for antimony, copper and lead, Ecological screening criteria exceedances for the analytes above and zinc.
    - Firing Point DU: Human health and ecological screening criteria exceedances for nitroglycerin.
    - French Drain DU: No human health screening criteria exceedances, ecological screening criteria exceedances for copper and lead
- ISM Sampling Exceedances

- Target Berm DU: Human health screening criteria exceedances for antimony, copper and lead, ecological screening criteria exceedances for the analytes above and zinc.
- Firing Point DU: Human health and ecological screening criteria exceedances for nitroglycerin.

ISM was not conducted at the Soil Pile DU. It was assumed that the Soil Pile DU would have exceedances similar to those of the Target Berm DU as the material used to create the soil pile was generated from the target berm.

The MRS was considered to pose a risk to human health and the environment based on the elevated concentrations and the possibility of receptor exposure. The MRS boundary was revised to include the farthest extent of lead concentration exceedances of its human health screening criterion based on x-ray fluorescence (XRF) data; the revised acreage is 0.32 acres (**Figure ES-3).**

The remedial action objective (RAO) is to protect workers, residents, visitors, and trespassers from exposure to contaminants in the soil. The contaminants of concern (COCs) present in soil at this MRS that present an unacceptable risk to human health are lead, antimony, copper, zinc, and nitroglycerin. This FS addresses the following general response actions (GRAs): no action, LUCs, and MC-contaminated soil removal. Various technologies and process options were identified, evaluated, and developed into the following remedial action alternatives:

- No Action
- Soil Excavation with Off-Site Disposal
- Soil Stabilization and Excavation with Off-Site Disposal

LUCs were not developed further because the MRS is privately owned, and the use of any category of LUC is not a viable option, as the landowner cannot be required to establish LUCs on the property. These alternatives underwent detailed analysis during the FS, and **Table ES-1** presents the comparison of the alternatives.

CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgeway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	7/5/2019
SCALE	1:126,720	CHK BY	AS	7/5/2019
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	7/5/2019

Ridgway Training Range Site Location Map

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure ES-1

Q:\Projects\ENV\GEARS\GEO\NGB IDIQ\NDNODS 6 SARs\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-1_Ridgway_SiteLocation.mxd

CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	10/16/2019
SCALE	1:600	CHK BY	AS	10/16/2019
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	10/16/2019

N

Decision Units - Ridgway Training Site

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure ES-2

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_ES-2_Ridgway_Decision_Units.mxd

CLIENT	Army National Guard			
PROJECT	Feasibility Study through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	10/16/2019
SCALE	1:480	CHK BY	JW	10/16/2019
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	10/16/2019

N

TITLE

Revised Ridgway MRS Boundary Revision

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure ES-3

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_ES-3_Ridgway_Revised_MRS_Boundary.mxd

This Page Intentionally Blank

TABLE ES-1
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR MC-CONTAMINATED SOIL
(PAE40-001-R-01 MRS)

Screening Criteria		Alternative 1 No Action	Alternative 2 MC-contaminated Soil Excavation with Off-Site Disposal	Alternative 3 MC-contaminated Soil Stabilization and Excavation with Off-Site Disposal
Threshold	Overall Protection of Human Health and the Environment	○	●	●
	Compliance with ARARs	○	●	●
Balancing	Long-Term Effectiveness	○	●	●
	Reduction of TMV Through Treatment	○	●	●
	Short-Term Effectiveness	●	●	●
	Implementability	●	◘	●
	Cost (x1,000)	$0	$497	$389
Modifying (a)	State Acceptance	TBD	TBD	TBD
	Community Acceptance	TBD	TBD	TBD

Notes:

● Favorable (‘YES’ for threshold criteria)
◘ Moderately Favorable
○ Not Favorable (‘NO’ for threshold criteria)

ARAR = Applicable or Relevant and Appropriate Requirement
LUC = Land Use Control
MC = munitions constituents
TBD = To Be Determined
TMV = toxicity, mobility, or volume

This Page Intentionally Blank

1 Introduction

This Feasibility Study (FS) report has been prepared in support of the Remedial Investigation (RI) / FS activities planned for the Ridgway Training Range Munitions Response Site (MRS; Army Environmental Database Restoration Number PAE40-001-R-01), located in Ridgway Township, Pennsylvania (**Figure 1-1**). Non-Department of Defense (DoD) Non-Operational Defense Sites (NDNODS) are defense sites that were used exclusively by the Army National Guard (ARNG) and were never owned, leased, or otherwise possessed or used by the United States (U.S.) Army or other DoD component.

Based on results of the RI (AECOM, 2019), the ARNG determined an FS should be conducted for the Ridgway Training Range MRS (**Figure 1-2**). The FS was performed pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and is part of the overall remedial action process.

Environmental work is being conducted at the MRS by the ARNG Directorate and the Pennsylvania ARNG (PAARNG). This project is being executed by AECOM Technical Services, Inc. (AECOM), under ARNG Contract Number W9133L-14-D-0001, Delivery Order No. 0006, issued 29 September 2016. Under this delivery order, AECOM is responsible for fully executing the FS at the Ridgway Training Range MRS.

1.1 Purpose

The purpose of this FS is to provide decision makers an overview of the development and analysis of remedial alternatives. The FS report is the basis for identifying a technically feasible and cost-effective remedial action that is protective of both human health and the environment. The overall objective of the remedial action alternatives considered for the MRS is to reduce or eliminate potential contact with munitions constituents (MC) in soil by current and/or future site receptors.

The scope of the FS consists of the following steps, compliant with the requirements of the NCP (Code of Federal Regulations [CFR], Title 40, Part 300.430):

- Identify potential Applicable or Relevant and Appropriate Requirements (ARARs) and to be considered (TBC) criteria and develop remedial action objectives (RAOs).
- Develop the general response actions (GRAs) to satisfy the RAOs, including identification of the volumes or areas of media to be addressed by the GRAs.
- Identify remedial technologies available to execute the GRAs and screen the technologies based on effectiveness, implementability, and relative cost.
- Assemble the selected remedial technologies into remedial alternatives using different GRA combinations, as appropriate.
- Conduct a detailed analysis of the alternatives based on the following criteria specified by the NCP (CFR, Title 40, Part 300.430[e][9]):

This Page Intentionally Blank

CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	10/15/2019
SCALE	1:126,720	CHK BY	AS	10/15/2019
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners	PM	RG	10/15/2019

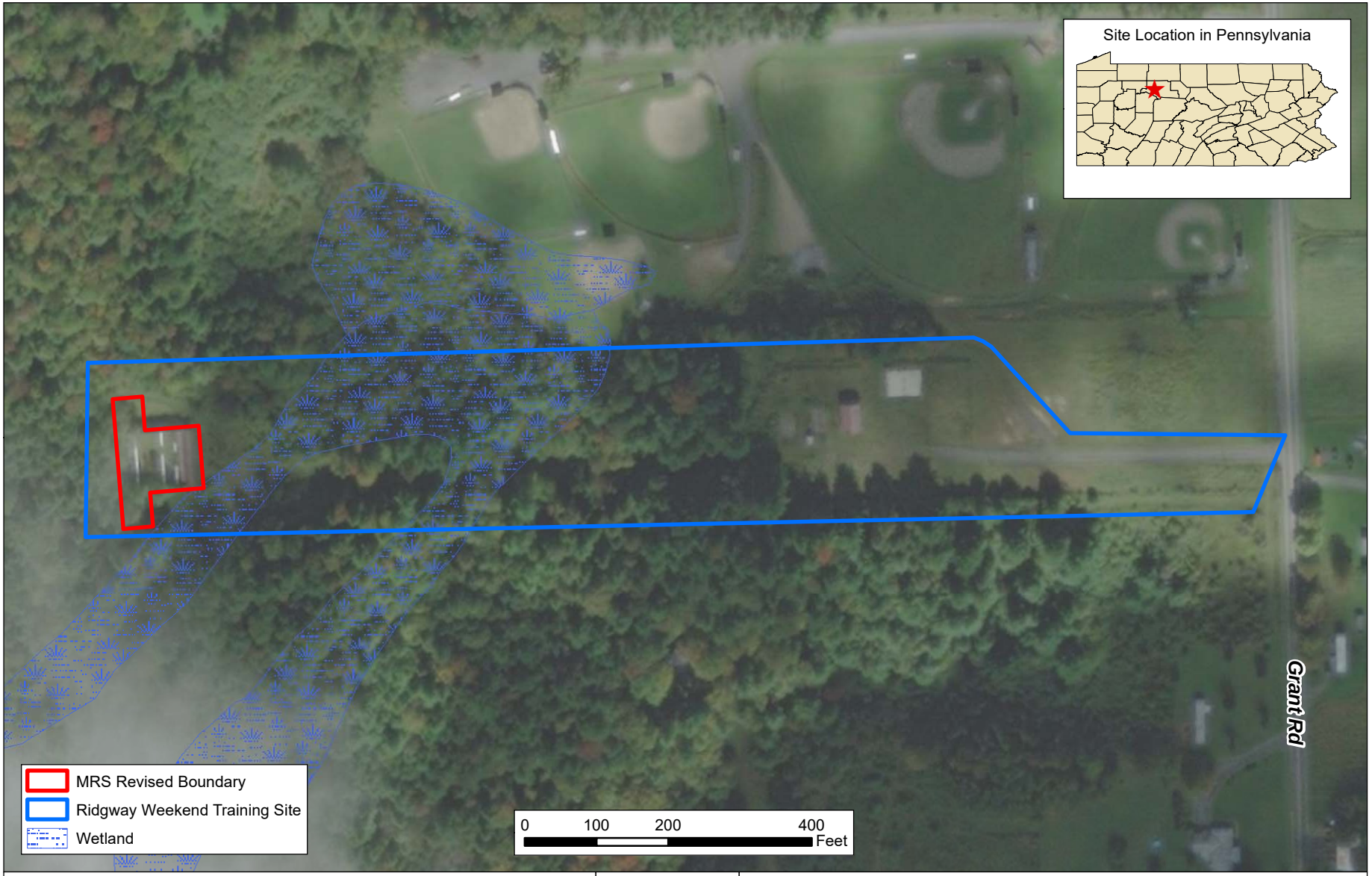
N

Ridgway Training Range Site Location Map

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-1

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-1_Ridgway_SiteLocation.mxd



CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	10/16/2019
SCALE	1:2,400	CHK BY	AS	10/16/2019
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	10/16/2019

N

TITLE

Ridgway Training Range Site Layout

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-2

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-2_Ridgway_SiteLayout.mxd

- Analyze considering two (2) threshold criteria:
  - Overall protection of human health and the environment
  - Compliance with ARARs
- Analyze considering additional five (5) balancing criteria:
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume (TMV) through treatment
  - Short-term effectiveness
  - Implementability (technical and administrative feasibility, and availability of materials and services)
  - Cost
- Analyze considering additional two (2) modifying criteria (to be evaluated after regulatory agency review and public comment subsequent to the public comment period):
  - State acceptance
  - Community acceptance
- Compare the analyzed alternatives

1.2 Summary of Remedial Investigation Findings

The key findings of the RI (AECOM, 2019) relevant to development of RAOs and development and analysis of remedial alternatives are briefly summarized below.

1.2.1 MRS Background

Description

The Ridgway Training Range MRS was originally a 0.22-acre site located in Ridgway Township, Pennsylvania, on the west side of Grant Road, approximately 2 miles northwest of Ridgway Borough, and 5 miles southwest of Johnsonburg in Elk County, Pennsylvania. The MRS is surrounded by the 8-acre former Ridgway Weekend Training Site (**Figure 1-2**). The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (Parsons, 2012). Allegheny National Forest borders the western edge of the MRS, with various coniferous trees and some deciduous trees, the most common being birch. A community baseball/athletic field abuts the northern edge of the Weekend Training Site. The range is primarily covered in grass, other vegetation, and the structures associated with the former baffled small-arms range. The MRS is located on privately owned property, and access to the range is partially restricted from public access by a locked gate, concrete walls on the north and southern side, and a fence on the east side. The Ridgway Rifle Club, a privately-owned gun club, is located approximately 0.83 miles south of the MRS.

According to the 2012 Site Inspection (SI) report (Parsons, 2012), PAARNG documentation indicates that the range was constructed in 1987 as a small-arms range with sheltered firing points and a baffle system to retain firing activities. Observations made during the 2012 SI confirmed that the range is a baffled outdoor range that is surrounded by 15-foot concrete walls on the northern and southern edges of the range. The eastern portion of the MRS contains 12 sheltered

firing positions covered by a metal roof; an 8-foot earthen berm is located on the western edge of the MRS. Above the earthen berm is a horizontal wooden baffle supported by large beams installed into the hillside. Within the range, two vertical wooden baffle walls are suspended from the top of the concrete sidewalls and hang down into the range floor area to prevent stray bullets from leaving the range

History

The NDNODS Ridgway Training Range MRS was used by the PAARNG for small-arms, live-fire weapons training from 1987 to 2005 (Parsons, 2012). Munitions use documentation was not found during the SI, but based on range type, timeframe of range use, and location, AECOM surmised that the following munitions were fired: .22 caliber, .38 caliber, .45 caliber, .50 caliber, 9 millimeter (mm), 5.56mm, and 7.62mm. In 1989, a temporary waiver was granted for one-time firing of 7.62mm machine gun rounds. The extent of the usage is unknown but is expected to be minimal (Earth Resources Technology, 2008).

Live-fire training occurred within the mostly enclosed 25-meter outdoor baffled M-16 rifle range. From 1987 to 1990, the range was used approximately four to five times a year, but range use from 1990 to 2001 is unknown. From 2001 to 2005, the range was used approximately two to three times a year. During that period, AECOM estimated that approximately 64,000 small-caliber rounds were expended at the range. The range was last used in November 2005, and small-arms training was discontinued in March of the following year because it no longer met ARNG requirements (PADMVA, 2011). Request for formal closure occurred on September 9, 2011.

The property was originally conveyed to the Commonwealth of Pennsylvania from private owners on 26 September 1969 (PADMVA, 2011). PADMVA has owned the property from 1969 to 2015. The property was approved for conveyance from the Commonwealth of Pennsylvania (with approval from the Pennsylvania Department of Military and Veterans Affairs [PADMVA]) through Act 56 of 2013 (House Bill 1112). Transfer of the property to a private owner was completed in 2015.

After taking over ownership in 2015, the current landowner installed a French drain parallel to the berm to improve drainage in front of the Target Berm. In doing so, the top 12 to 18 inches of soil from the foot of the Target Berm were removed and stored in a pile near the north sidewall.

Three environmental investigations have been completed at the Ridgway Training Range MRS since 2011. These investigations include the following:

- Ridgway WETS & Range, Environmental Baseline Survey Report (PADMVA, 2011)
- Final Pennsylvania Site Inspection Report, ARNG MMRP (Parsons, 2012)
- Final Remedial Investigation Report (AECOM, 2019)

1.2.2 Current and Future Land Use

The area adjacent to the MRS is currently used as a staging area for equipment associated with a private landscaping company who owns the property. The area within the MRS boundary is currently unused. Since the current landowner has owned the property, the range has been used with homemade munitions, distinct from historic use, which were fired into a trap. This use has

stopped and will not occur again until this project concludes. Future land use is unlikely to significantly change.

1.2.3 Nature and Extent of MC Contamination

For the purpose of the RI, the MRS was divided into four decision units (DUs) (the Target Berm, Firing Point, Soil Pile, and French Drain Outfall area) that reflect the source areas of potential contamination as indicated by site history and remaining physical evidence of the target areas, as well as post-use construction by the landowner. The potential wastes related to small arms training include bullets, bullet fragments, and the related metals (lead, antimony, copper, and zinc) and nitroglycerin that are commonly part of small arm munitions are referred to MC. The RI field activities included x-ray fluorescence (XRF) screening of discrete samples collected on a grid from each DU to evaluate the lateral extent of lead in soil. Composite surface soil samples using incremental sampling methodology (ISM) were obtained for evaluating risks. The ISM provides an improved measure of the DU-wide concentration of lead relative to calculating a DU concentration based on limited discrete samples. Based on the XRF results, discrete samples at depth were subsequently collected. Details of the sampling methodology and results are documented in the Final Remedial Investigation Work Plan/Uniform Federal Policy - Quality Assurance Project Plan (UFP-QAPP; AECOM, 2017) and the Final Remedial Investigation Report (AECOM, 2019). The findings at each DU are summarized below.

1.2.3.1 Target Berm DU

Exceedances of the human health criterion for lead were observed in XRF screening results at the Target Berm DU (**Figure 1-3**) and resulted in step-out sampling that enlarged the DU area by 0.126 acres (**Table 1-1)**. Step-out sampling decisions included the error range associated with each XRF field reading. The extent of elevated lead concentrations indicates MC transportation by movement of soil by the property owner, and potential overland runoff during rain events. The DU extended beyond the enclosed firing range walls and the current extent of the MRS. ISM sample results at the Target Berm indicate that antimony, copper, lead, and zinc are present in soil above human health screening criteria (**Table 1-3)**. Four locations at the Target Berm (location #80 #22, #91, and #45) were selected to represent distinct areas at the DU for discrete subsurface soil sampling based on XRF results exceeding human health criterion for lead. Discrete subsurface sampling at locations #22 and #91 indicated that antimony, copper, lead, and zinc at the Target Berm are present above their risk-based screening levels at the 12 to 18-inches below ground surface (bgs) depth interval and the 24 to 30-inch bgs interval (**Table 1-2)**, although MC concentrations generally decreased with depth. Deeper samples at these locations could not be collected due to refusal at a gravel layer within the berm. XRF data showed that lead is migrating from the Target Berm but does not extend into the drainage areas to the north and south of the MRS. Analytical results are summarized in **Tables 1-1, 1-2, and 1-3** and on **Figures 1-3 and 1-4**.

1.2.3.2 Firing Point DU

The data collected at the Firing Point were sufficient to delineate the extent of nitroglycerin contamination at the DU. Surface soil samples collected adjacent to the DU from uncovered soil east of the firing positions showed no exceedances for nitroglycerin, indicating that nitroglycerin is not being transported outside of the MRS. ISM sample results at the Firing Point indicate that nitroglycerin is present in soil above human health screening criteria. Three locations at the Firing

Point selected for discrete subsurface soil sampling showed nitroglycerin was elevated above human health screening criterion at the 12 to 18-inches bgs interval (**Figure 1-5**); the 24 to 30-inch bgs interval could not be sampled due to refusal at a gravel layer. Although nitroglycerin is elevated above human health screening criterion in Firing Point soil, it is not being transported beyond the DU boundary.

1.2.3.3 Soil Pile and French Drain Outfall DU

Discrete soil and sediment samples from the Soil Pile DU and French Drain Outfall DU, respectively, were collected to assess the potential spread of small arms MC contamination as a result of the installation of the French drain parallel and at the foot of the Target Berm. Discrete soil samples from the Soil Pile DU showed antimony, copper, lead, and zinc elevated above human health screening criteria (**Figure 1-6**). Small arms MC in the Soil Pile may be transported to the range floor via runoff due to precipitation but is not anticipated to be transported beyond the MRS due to the confining concrete walls. Discrete sediment samples from the French Drain Outfall DU did not exhibit antimony, copper, lead, or zinc above human health screening criteria, but did exhibit all four analyte levels elevated above ecological screening criteria (**Figure 1-7**).

The area showing the extent of contaminated soil is shown on **Figure 1-8**. Based on the results of the RI, the extent of MC-contaminated soil was determined to cover 0.146 acres (approximately 45% of the MRS) to a depth of 2.5 feet (AECOM, 2019). Note the Target Berm DU in **Figure 1-8** includes a small area that could not be investigated during the RI due to a surficial gravel layer at the base of the berm. It is currently unknown if this area contains MC-contaminated soil beneath the gravel, so this area should either be analyzed during future remedial activities or included in the chosen remedial alternative.

CLIENT	Army National Guard				
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS				
REVISION NO		0	GIS BY	MS	4/9/2020
SCALE		1:180	CHK BY	AS	4/9/2020
SOURCE	ARNG; State of Pennsylvania, ESRI & Partners		PM	RG	4/9/2020

N

Bold = MC concentration exceeds ecological screening criteria

- Sample Grid
- MC Concentration exceeds human health screening criteria (400 mg/kg [USEPA Residential Soil RSL Value, 2018])
- MRS Revised Boundary
- Wetland (National Wetlands Inventory)
- Drainage Ditch

Notes:
Data displayed depicts lead detections
ppm = parts per million

TITLE

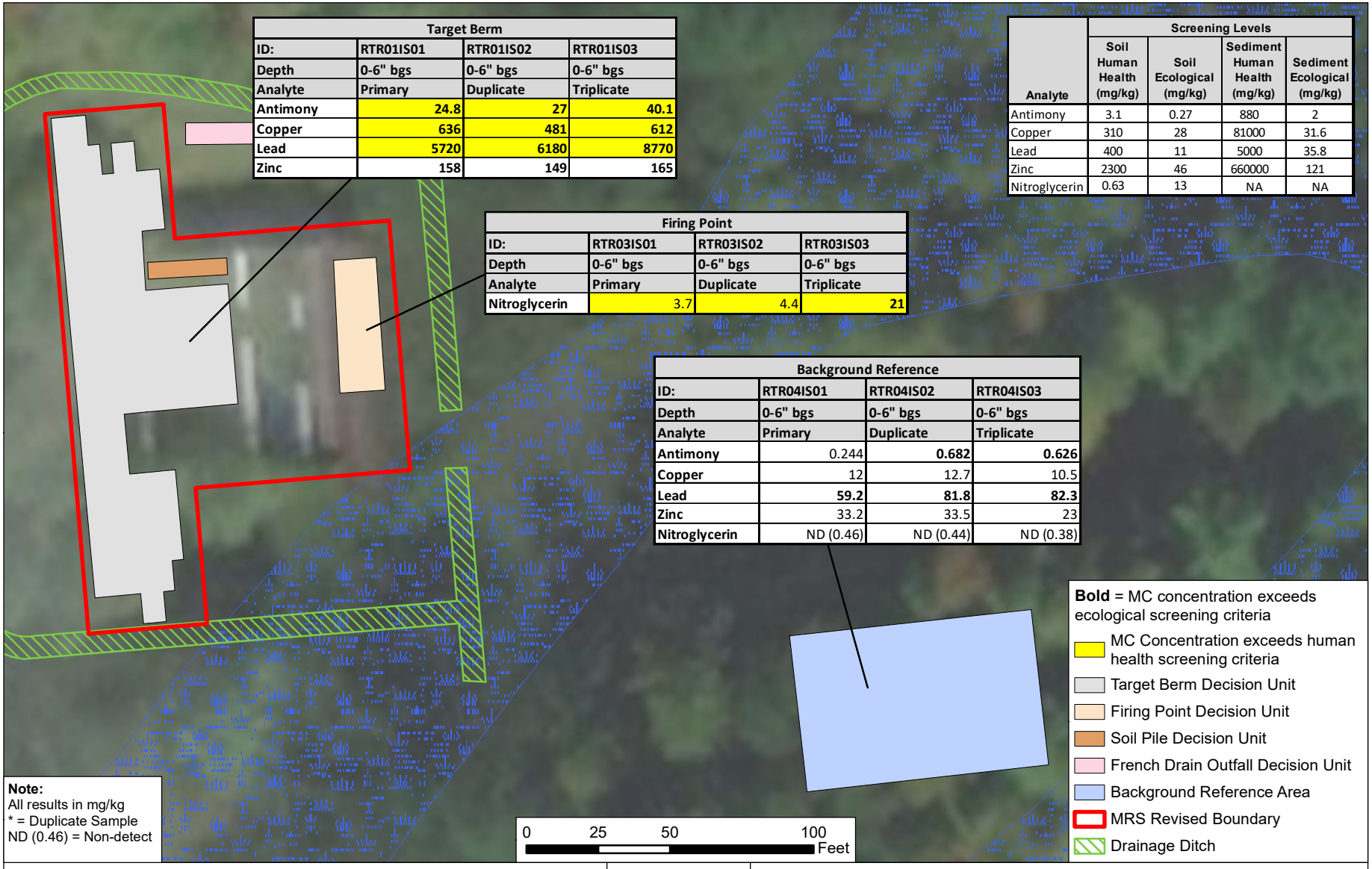
Target Berm XRF Sample Diagram

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-3

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-3_Ridgway_XRF_Diagram.mxd

This Page Intentionally Blank



Target Berm			
ID:	RTR01IS01	RTR01IS02	RTR01IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	**24.8**	**27**	**40.1**
Copper	**636**	**481**	**612**
Lead	**5720**	**6180**	**8770**
Zinc	158	149	165

Analyte	Screening Levels			
	Soil Human Health (mg/kg)	Soil Ecological (mg/kg)	Sediment Human Health (mg/kg)	Sediment Ecological (mg/kg)
Antimony	3.1	0.27	880	2
Copper	310	28	81000	31.6
Lead	400	11	5000	35.8
Zinc	2300	46	660000	121
Nitroglycerin	0.63	13	NA	NA

Firing Point			
ID:	RTR03IS01	RTR03IS02	RTR03IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Nitroglycerin	3.7	4.4	**21**

Background Reference			
ID:	RTR04IS01	RTR04IS02	RTR04IS03
Depth	0-6" bgs	0-6" bgs	0-6" bgs
Analyte	Primary	Duplicate	Triplicate
Antimony	0.244	**0.682**	**0.626**
Copper	12	12.7	10.5
Lead	**59.2**	**81.8**	**82.3**
Zinc	33.2	33.5	23
Nitroglycerin	ND (0.46)	ND (0.44)	ND (0.38)

Bold = MC concentration exceeds ecological screening criteria

MC Concentration exceeds human health screening criteria

Target Berm Decision Unit

Firing Point Decision Unit

Soil Pile Decision Unit

French Drain Outfall Decision Unit

Background Reference Area

MRS Revised Boundary

Drainage Ditch

Note:
All results in mg/kg
* = Duplicate Sample
ND (0.46) = Non-detect

0 25 50 100 Feet

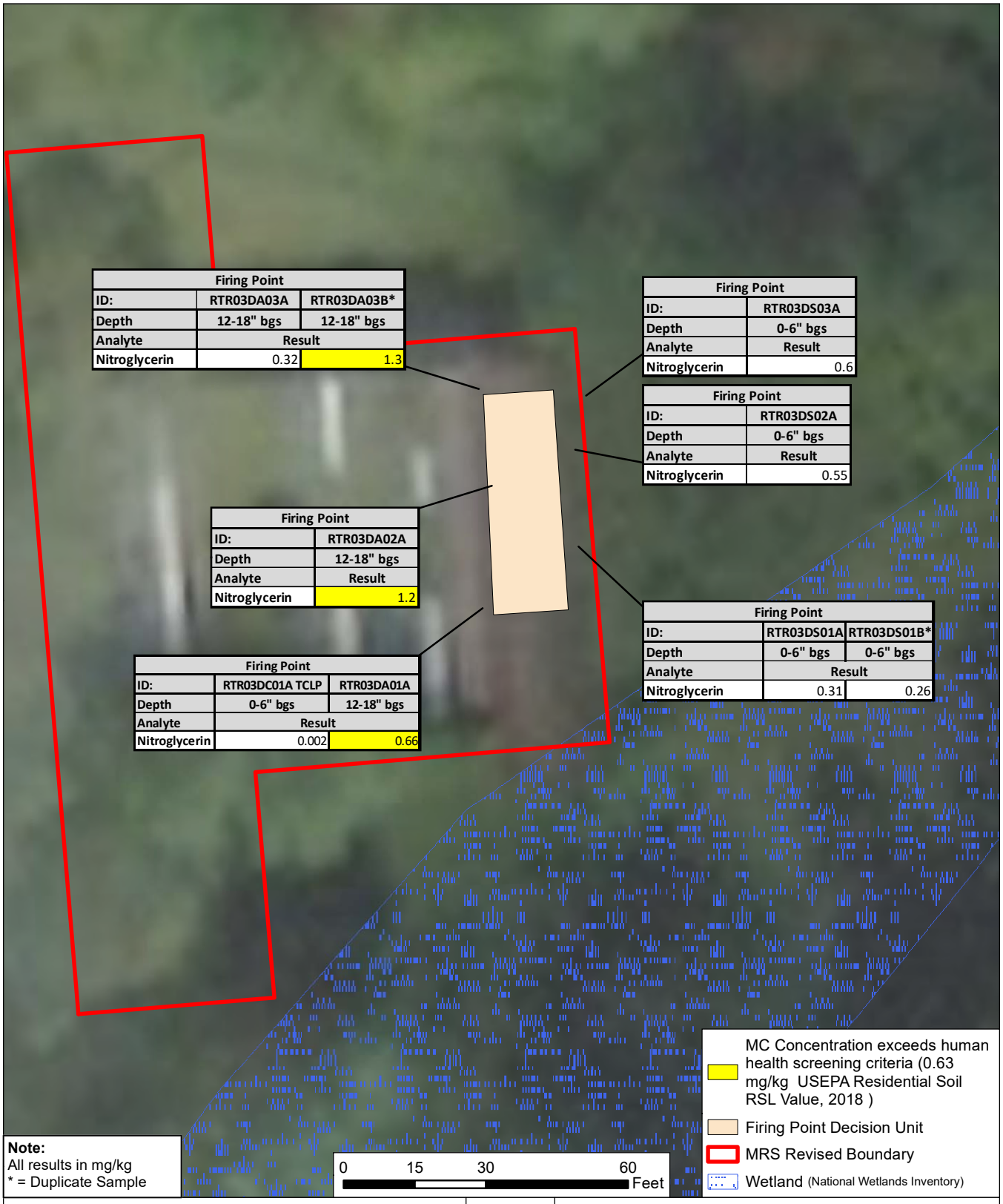
N

CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	4/1/2020
SCALE	1:600	CHK BY	AS	4/1/2020
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	4/1/2020

Ridgway ISM Results

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-4



CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site FS			
REVISION NO	0	GIS BY	MS	12/10/2019
SCALE	1:360	CHK BY	JW	12/10/2019
SOURCE	ARNG State of Pennsylvania, ESRI Partners	PM	RG	12/10/2019

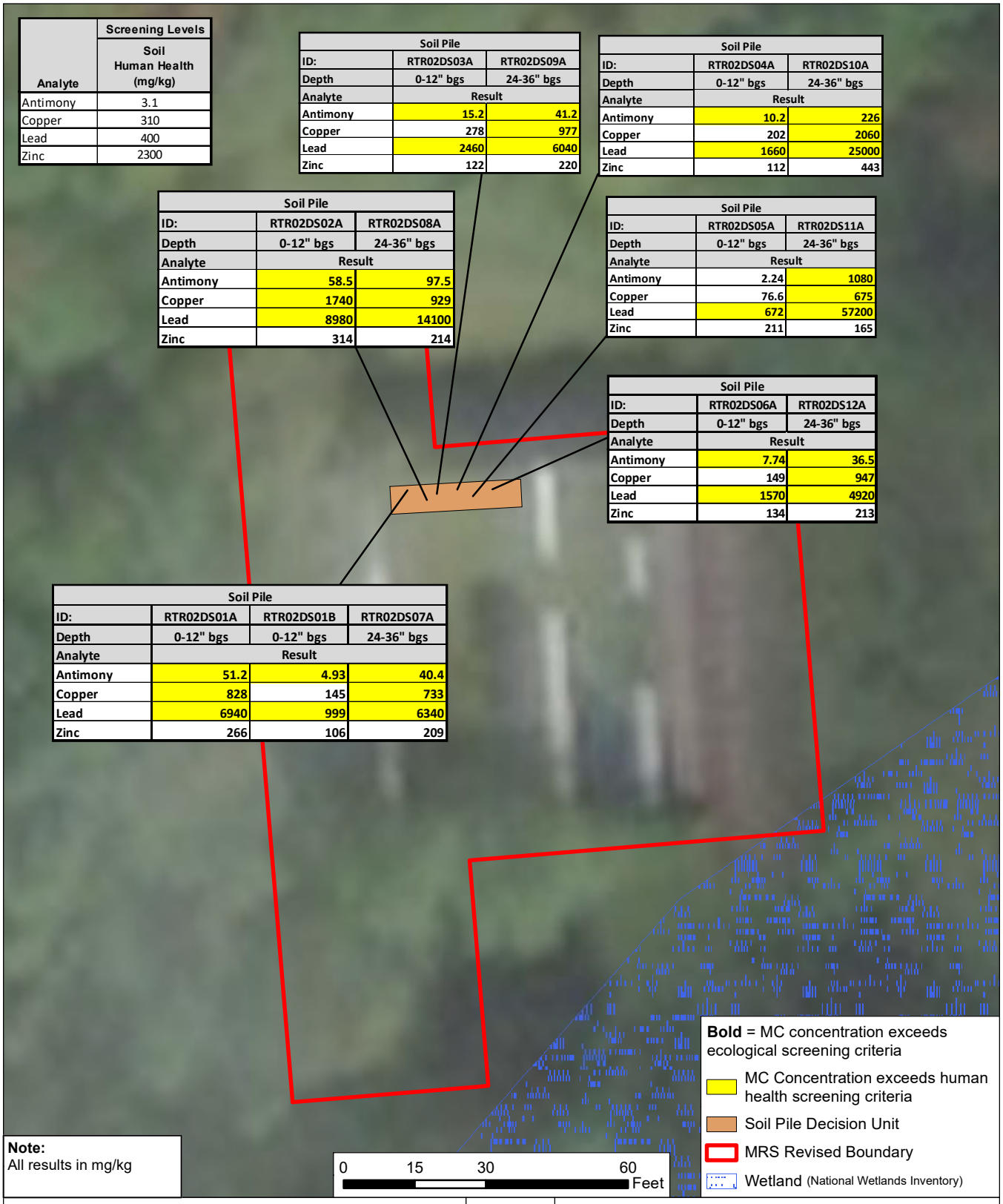
N

Firing Point Discrete Soil Sample Results

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-5

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-5_Firing_Point_Discrete_Soil_Sample_Results.mxd



Analyte	Screening Levels Soil Human Health (mg/kg)
Antimony	3.1
Copper	310
Lead	400
Zinc	2300

Soil Pile		
ID:	RTR02DS03A	RTR02DS09A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	**15.2**	**41.2**
Copper	**278**	**977**
Lead	**2460**	**6040**
Zinc	122	220

Soil Pile		
ID:	RTR02DS04A	RTR02DS10A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	**10.2**	**226**
Copper	**202**	**2060**
Lead	**1660**	**25000**
Zinc	112	443

Soil Pile		
ID:	RTR02DS02A	RTR02DS08A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	**58.5**	**97.5**
Copper	**1740**	**929**
Lead	**8980**	**14100**
Zinc	314	214

Soil Pile		
ID:	RTR02DS05A	RTR02DS11A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	2.24	**1080**
Copper	76.6	**675**
Lead	**672**	**57200**
Zinc	211	165

Soil Pile		
ID:	RTR02DS06A	RTR02DS12A
Depth	0-12" bgs	24-36" bgs
Analyte	Result	
Antimony	**7.74**	**36.5**
Copper	149	**947**
Lead	**1570**	**4920**
Zinc	134	213

Soil Pile			
ID:	RTR02DS01A	RTR02DS01B	RTR02DS07A
Depth	0-12" bgs	0-12" bgs	24-36" bgs
Analyte	Result		
Antimony	**51.2**	**4.93**	**40.4**
Copper	**828**	145	**733**
Lead	**6940**	**999**	**6340**
Zinc	266	106	209

Note:
All results in mg/kg

0 15 30 60 Feet

Bold = MC concentration exceeds ecological screening criteria

MC Concentration exceeds human health screening criteria

Soil Pile Decision Unit

MRS Revised Boundary

Wetland (National Wetlands Inventory)

CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site FS			
REVISION NO	0	GIS BY	MS	4/1/2020
SCALE	1:360	CHK BY	AS	4/1/2020
SOURCE	ARNG State of Pennsylvania, ESRI Partners	PM	RG	4/1/2020

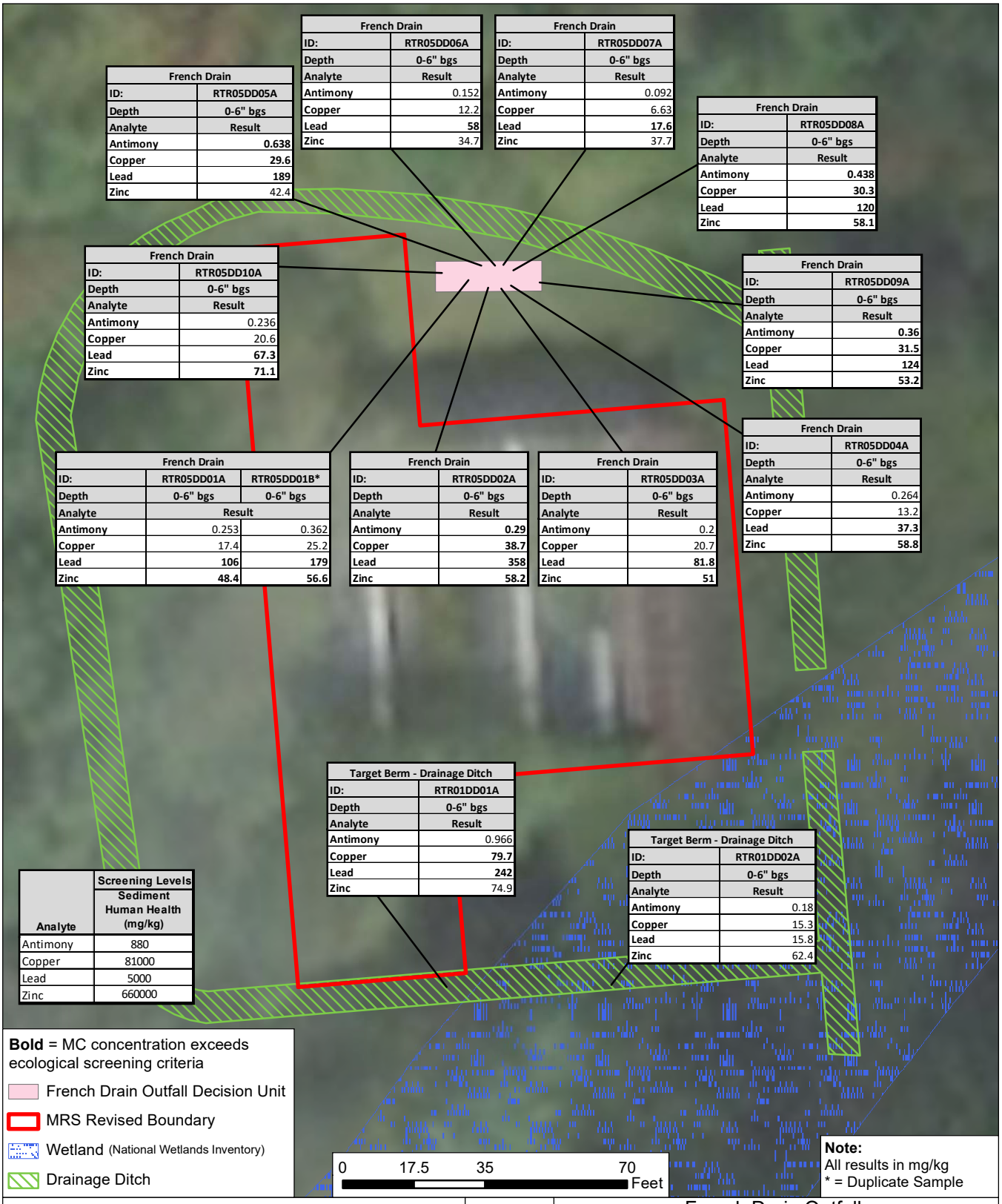
N

Soil Pile Discrete Soil Sample Results

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-6

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-6_Soil_Pile_Discrete_Soil_Sample_Results.mxd



CLIENT	Army National Guard			
PROJECT	NDNODS Ridgway Training Site FS			
REVISION NO	0	GIS BY	MS	4/1/2020
SCALE	1:420	CHK BY	JW	4/1/2020
SOURCE	ARNG State of Pennsylvania, ESRI Partners	PM	RG	4/1/2020

N

French Drain Outfall Discrete Sediment Sample Results

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-7

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-7_Discrete_Sediment_Sample_Results.mxd

Prepared for: Army National Guard

CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	2/11/2020
SCALE	1:600	CHK BY	AS	2/11/2020
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	2/11/2020

N

Area of MC-Contaminated Soil - Ridgway Training Site

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 1-8

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-8_Ridgway_Area_of_MC-Contaminated_Soil.mxd

This Page Intentionally Blank

Table 1-1
RI XRF Sample Results for
PAE40-001-R-01 MRS

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*	Notes
RTR01X01	13	16,486	518	
RTR01X02	20	14,327	413	
RTR01X03	19	15,167	358	
RTR01X04	19	18,070	488	Dried sample before analysis
RTR01X05	13	7,608	188	
RTR01X06	15	24,543	499	
RTR01X07	16	6,843	462	
RTR01X08	11	15,820	478	
RTR01X09	14	13,436	219	
RTR01X10	15	16,895	345	
RTR01X11	18	14,400	409	Dried sample before analysis
RTR01X12	17	11,575	317	
RTR01X13	17	500	31	
RTR01X14	14	3,966	84	
RTR01X15	12	15,603	354	
RTR01X16	14	9,943	312	
RTR01X17	16	12,206	260	
RTR01X18	12	19,016	411	
RTR01X19	14	16,572	528	
RTR01X20	19	10,040	613	
RTR01X21	17	13,003	265	
RTR01X22	16	20,661	493	
RTR01X23	14	8,138	180	
RTR01X24	18	9,966	333	
RTR01X25	16	119	12	
RTR01X26	12	16,236	332	
RTR01X27	16	18,337	478	
RTR01X28	19	6,687	366	
RTR01X29	17	8,829	288	
RTR01X30	16	15,640	400	
RTR01X31	18	13,698	365	
RTR01X32	15	14,375	400	
RTR01X33	18	1,532	53	Dried sample before analysis
RTR01X34	12	3,566	90	Dried sample before analysis
RTR01X35	17	6,938	123	Dried sample before analysis
RTR01X36	15	2,086	89	Dried sample before analysis
RTR01X37	18	4,334	120	Dried sample before analysis
RTR01X38	19	400	31	Dried sample before analysis
RTR01X39	14	5,247	215	Dried sample before analysis
RTR01X40	10	2,381	59	Dried sample before analysis
RTR01X41	19	2,987	67	Dried sample before analysis
RTR01X42	17	4,708	165	Dried sample before analysis
RTR01X43	10	673	44	Dried sample before analysis
RTR01X44	8	868	43	Dried sample before analysis
RTR01X45	14	2,088	83	Dried sample before analysis
RTR01X46	19	2,732	89	Dried sample before analysis
RTR01X47	18	2,402	74	Dried sample before analysis
RTR01X48	16	1,461	76	Dried sample before analysis
RTR01X49	14	2,083	57	Dried sample before analysis
RTR01X50	18	1,280	44	Dried sample before analysis
RTR01X51	19	1,161	50	Dried sample before analysis
RTR01X52	12	465	39	Dried sample before analysis
RTR01X53	18	841	39	Dried sample before analysis
RTR01X54	18	942	35	Dried sample before analysis
RTR01X55	18	1,171	44	Dried sample before analysis
RTR01X56	15	669	36	Dried sample before analysis
RTR01X57	15	1,151	43	Dried sample before analysis
RTR01X58	19	737	31	Dried sample before analysis
RTR01X59	16	338	21	Dried sample before analysis
RTR01X60	15	758	38	Dried sample before analysis
RTR01X61	18	264	17	Dried sample before analysis
RTR01X62	18	428	28	Dried sample before analysis
RTR01X63	15	471	24	Dried sample before analysis
RTR01X64	16	763	34	Dried sample before analysis
RTR01X65	18	717	34	Dried sample before analysis
RTR01X66	15	419	23	

Notes

* = Error: 2-sigma, 95 confidence

Sample meets or exceeds residential soil RBSL for lead

ppm = parts per million

Table 1-1
RI XRF Sample Results for
PAE40-001-R-01 MRS

Sample ID	Moisture (%)	Average Lead Result (ppm)	Max Error (+/-)*	Notes
RTR01X67	12	328	21	
RTR01X68	12	387	21	
RTR01X69	13	670	34	
RTR01X70	18	394	26	
RTR01X71	18	303	28	
RTR01X72	19	521	31	
RTR01X73	16	303	19	
RTR01X74	17	229	20	
RTR01X75	16	250	19	
RTR01X76	18	231	16	
RTR01X77	12	67	13	
RTR01X78	15	2,466	58	
RTR01X79	15	3,251	87	
RTR01X80	15	12,138	236	
RTR01X81	18	6,377	170	
RTR01X82	18	621	23	Dried sample before analysis
RTR01X83	19	925	26	Dried sample before analysis
RTR01X84	15	1,372	41	Dried sample before analysis
RTR01X85	18	1,624	50	Dried sample before analysis
RTR01X86	16	3,108	85	Duplicate readings of RTR01X82
RTR01X87	15	1,762	49	Duplicate readings of RTR01X83
RTR01X88	15	1,210	45	Duplicate readings of RTR01X84
RTR01X89	16	2,202	61	Duplicate readings of RTR01X85
RTR01X90	18	1,754	144	
RTR01X91	15	2,954	98	
RTR01X92	19	1,913	45	
RTR01X93	18	1,714	43	
RTR01X94	18	715	31	
RTR01X95	19	1,277	45	
RTR01X96	18	959	29	
RTR01X97	19	230	16	Dried sample before analysis
RTR01X98	15	352	19	Dried sample before analysis
RTR01X99	18	487	37	Dried sample before analysis
RTR01X100	18	389	22	
RTR01X101	15	305	15	
RTR01X102	17	215	16	Dried sample before analysis
RTR01X103	17	225	18	Dried sample before analysis
RTR01X104	18	207	17	Dried sample before analysis
RTR01X105	18	863	30	
RTR01X106	20	1,329	42	
RTR01X107	10	746	35	
RTR01X108	18	349	27	
RTR01X109	16	1,752	60	
RTR01X110	17	167	32	
RTR01X111	19	371	29	
RTR01X112	18	49	10	
RTR01X113	19	258	22	
RTR01X114	18	350	21	
RTR01X115	15	789	25	Dried sample before analysis
RTR01X116	10	209	19	Dried sample before analysis
RTR01X117	11	584	26	Dried sample before analysis
RTR01X118	14	1,459	47	Dried sample before analysis
RTR01X119	16	157	15	
RTR01X120	17	143	14	
RTR01X121	14	208	20	
RTR01X122	12	316	21	Dried sample before analysis
RTR01X123	10	3,381	90	Dried sample before analysis
RTR01X124	14	2,903	117	Dried sample before analysis
RTR01X125	19	6,683	164	Dried sample before analysis
RTR01X126	18	780	49	Dried sample before analysis
RTR01X127	16	294	18	
RTR01X128	19	64	10	
RTR01X129	12	61	15	
RTR01X130	18	56	10	
RTR01X131	18	226	26	Dried sample before analysis
RTR01X132	15	85	12	Dried sample before analysis
RTR01X133	18	726	24	Dried sample before analysis
RTR01X134	19	379	17	Dried sample before analysis
RTR01X135	19	82	9	Dried sample before analysis
RTR01X136	18	175	15	Dried sample before analysis
RTR01X137	16	323	13	Dried sample before analysis

Notes

* = Error: 2-sigma, 95 confidence

Sample exceeds residential soil RBSL for lead

ppm = parts per million

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

			Sample ID:																					
			Decision Unit - XRF Location:																					
			Media:																					
			Sample Depth (inches bgs):																					
			Date Collected:																					
Analyte	Human Health Screening Level (mg/kg) Soil / Sediment	Ecological Screening Level (mg/kg) Soil / Sediment	RTR01DA01A Target Berm - #80 Soil 12 - 18 7/12/2018				RTR01DA01B * Target Berm - #80 Soil 12 - 18 7/12/2018				RTR01DC02A Target Berm - #6 Soil 0 - 6 7/12/2018				RTR01DA03A Target Berm - #22 Soil 12 - 18 7/12/2018				RTR01DB03A Target Berm - #22 Soil 24 - 30 7/12/2018				RTR01DA04A Target Berm - #91 Soil 12 - 18 7/12/2018			
			Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																										
Antimony	3.1 / 880	0.27 / 2	**0.336**				**0.366**				--				**89.5**	N*A			**34.8**				**64.8**			
Copper	310 / 81000	28 / 31.6	17.3	B			16.5	B			--				**1830**	N*B			**961**	B			**298**	B		
Lead	400 / 5000	11 / 35.8	**55.8**	B	J	f	**110**	B	J	f	--				**17500**	N*BA			**6360**	B			**10600**	B		
Zinc	2300 / 660000	46 / 121	**81.2**				**63.4**				--				**292**	N*A			**189**				**117**			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																										
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																										
Arsenic (µg/L)	NA	NA	--				--				18	J			--				--				--			
Barium (µg/L)	NA	NA	--				--				542				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				6.92	J			--				--				--			
Chromium (µg/L)	NA	NA	--				--				3.5	J			--				--				--			
Selenium (µg/L)	NA	NA	--				--				22	J			--				--				--			
Silver (µg/L)	NA	NA	--				--				3.1	J			--				--				--			
Lead (µg/L)	NA	NA	--				--				720000				--				--				--			
Mercury (µg/L)	NA	NA	--				--				0.021	J			--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--			

Notes:

* = Field duplicate

Bold = Sample exceeds Ecological Screening Level

Sample exceeds Human Health Screening Level

Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L

bgs = below ground surface

LQ = laboratory qualifier (LQ flag descriptions available in lab report)

VQ = validiation qualifier

RC = reason code

NA = not applicable

B = associated blank detection

U = non-detect

J = estimated

J- = estimated, negative bias

d = MS/MSD imprecision

f = field duplicate imprecision

m = MS/MSD percent recovery anomaly

s = surrogate failure

z = preparation/method blank anomaly

N= pre-digestion spiked sample recovery is not within control limits

*= the duplicate sample analysis relative percent different (RPD) is not within control limits

A= post-digestion spiked sample recovery is not within control limits

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

			Sample ID:	RTR01DB04A				RTR01DA05A				RTR01DS01A				RTR01DS02A				RTR01DD01A				RTR01DD02A				RTR02DS01A			
			Decision Unit - XRF Location:	Target Berm - #91				Target Berm - #45				Target Berm - NA				Target Berm - NA				Target Berm - NA				Target Berm - NA				Soil Pile - NA			
			Media:	Soil				Soil				Soil				Soil				Sediment				Sediment				Soil			
			Sample Depth (inches bgs):	24 - 30				12 - 18				0-6				0-6				0-6				0-6				0 - 12			
			Date Collected:	7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/9/2018			
Analyte	Human Health Screening Level (mg/kg) Soil / Sediment	Ecological Screening Level (mg/kg) Soil / Sediment		Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																															
Antimony	3.1 / 880	0.27 / 2		**5.47**				0.195				**46.2**				**4.14**				**0.966**				0.18				**51.2**	N*	J	d
Copper	310 / 81000	28 / 31.6		**65.1**	B			20.8	B			**600**				**57**				**79.7**				15.3	B			**828**	NA	J	f
Lead	400 / 5000	11 / 35.8		**824**	B			**41.2**	B			**7990**				**1130**				**242**				**15.8**	B			**6940**	N*A	J	d
Zinc	2300 / 660000	46 / 121		**107**				**62.2**				**159**				**93.2**				**74.9**				**62.4**				**266**	N	J	f
Explosives by USEPA SW-846 Method 8330B (mg/kg)																															
Nitroglycerin	0.63 / NA	13 / NA		--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																															
Arsenic (µg/L)	NA	NA		--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA		--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA		--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA		--				--				--				--				--				--				--			
Nitroglycerin	NA	NA		--				--				--				--				--				--				--			

Notes:

* =	Field duplicate
Bold =	Sample exceeds Ecological Screening Level
	Sample exceeds Human Health Screening Level
	Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L
bgs =	below ground surface
LQ =	laboratory qualifier (LQ flag descriptions available in lab report)
VQ =	validiation qualifier
RC =	reason code
NA =	not applicable
B =	associated blank detection
U =	non-detect
J =	estimated
J- =	estimated, negative bias
d =	MS/MSD imprecision
f =	field duplicate imprecision
m =	MS/MSD percent recovery anomaly
s =	surrogate failure
z =	preparation/method blank anomaly

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

			RTR02DS01B				RTR02DS02A				RTR02DS03A				RTR02DS04A				RTR02DS05A				RTR02DS06A				RTR02DS07A			
Sample ID:																														
Decision Unit - XRF Location:			Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA			
Media:			Soil				Soil				Soil				Soil				Soil				Soil				Soil			
Sample Depth (inches bgs):			0 - 12				0 - 12				0 - 12				0 - 12				0 - 12				0 - 12				24 - 36			
Date Collected:			7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	**4.93**		J	d	**58.5**		J	d	**15.2**		J	d	**10.2**		J	d	**2.24**		J	d	**7.74**		J	d	**40.4**		J	d
Copper	310 / 81000	28 / 31.6	**145**		J	f	**1740**				**278**				**202**				**76.6**				**149**				**733**			
Lead	400 / 5000	11 / 35.8	**999**		J	d	**8980**		J	d	**2460**		J	d	**1660**		J	d	**672**		J	d	**1570**		J	d	**6340**		J	d
Zinc	2300 / 660000	46 / 121	**106**		J	f	**314**				**122**				**112**				**211**				**134**				**209**			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				25	U			--				--				--				--				--			
Barium (µg/L)	NA	NA	--				430	B	B	z	--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				1.9	J			--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				20	U			--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				23	J			--				--				--				--				--			
Silver (µg/L)	NA	NA	--				1.8	J			--				--				--				--				--			
Lead (µg/L)	NA	NA	--				6460				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				0.05	J			--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
Sample exceeds Human Health Screening Level
Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

Analyte	Human Health Screening Level (mg/kg) Soil / Sediment	Ecological Screening Level (mg/kg) Soil / Sediment	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Sample ID:			RTR02DS08A				RTR02DS09A				RTR02DS10A				RTR02DS11A				RTR02DS12A				RTR03DS01A				RTR03DS01B			
Decision Unit - XRF Location:			Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Soil Pile - NA				Firing Point - NA				Firing Point - NA			
Media:			Soil				Soil				Soil				Soil				Soil				Soil				Soil			
Sample Depth (inches bgs):			24 - 36				24 - 36				24 - 36				24 - 36				24 - 36				0 - 6				0-6			
Date Collected:			7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018				7/9/2018			
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	**97.5**		J	d	**41.2**		J	d	**226**		J	d	**1080**		J	d	**36.5**		J	d	--				--			
Copper	310 / 81000	28 / 31.6	**929**				**977**				**2060**				**675**				**947**				--				--			
Lead	400 / 5000	11 / 35.8	**14100**		J	d	**6040**		J	d	**25000**		J	d	**57200**		J	d	**4920**		J	d	--				--			
Zinc	2300 / 660000	46 / 121	**214**				**220**				**443**				**165**				**213**				--				--			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				0.31	J	J+	s	0.26	J	J+	s
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
Sample exceeds Human Health Screening Level
Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

			Sample ID:	RTR03DS02A				RTR03DS03A				RTR03DA01A				RTR03DA02A				RTR03DA03A				RTR03DA03B*				RTR03DC01A			
			Decision Unit - XRF Location:	Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA				Firing Point - NA			
			Media:	Soil				Soil				Soil				Soil				Soil				Soil				Soil			
			Sample Depth (inches bgs):	0-6				0-6				12 - 18				12 - 18				12 - 18				12 - 18				0-6			
			Date Collected:	7/9/2018				7/9/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	Human Health Screening Level (mg/kg) Soil / Sediment	Ecological Screening Level (mg/kg) Soil / Sediment		Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																															
Antimony	3.1 / 880	0.27 / 2		--				--				--				--				--				--				--			
Copper	310 / 81000	28 / 31.6		--				--				--				--				--				--				--			
Lead	400 / 5000	11 / 35.8		--				--				--				--				--				--				--			
Zinc	2300 / 660000	46 / 121		--				--				--				--				--				--				--			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																															
Nitroglycerin	0.63 / NA	13 / NA		0.55	U			0.6	U			0.66	JM	J+	m	1.2				0.32	J			1.3		J+	s	0.002	U		
Toxicity Characteristics Leaching Procedure (various methods)																															
Arsenic (µg/L)	NA	NA		--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA		--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA		--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA		--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA		--				--				--				--				--				--				--			
Nitroglycerin	NA	NA		--				--				--				--				--				--				0.002	U		

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
Sample exceeds Human Health Screening Level
Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

			RTR05DD01A				RTR05DD01B				RTR05DD02A				RTR05DD03A				RTR05DD04A				RTR05DD05A				RTR05DD06A			
Sample ID:																														
Decision Unit - XRF Location:			French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA			
Media:			Sediment				Sediment				Sediment				Sediment				Sediment				Sediment				Sediment			
Sample Depth (inches bgs):			0-6				0-6				0-6				0-6				0-6				0-6				0-6			
Date Collected:			7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																														
Antimony	3.1 / 880	0.27 / 2	0.253	N			0.362				0.29				0.2				0.264				0.638				0.152			
Copper	310 / 81000	28 / 31.6	17.4	NB			25.2	B			**38.7**	B			20.7	B			13.2	B			29.6	B			12.2	B		
Lead	400 / 5000	11 / 35.8	**106**	NBA	J	f	**179**	B	J	f	**358**	B			**81.8**	B			**37.3**	B			**189**	B			**58**	B		
Zinc	2300 / 660000	46 / 121	48.4				56.6				58.2				51				58.8				42.4				34.7			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																														
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																														
Arsenic (µg/L)	NA	NA	--				--				--				--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
Sample exceeds Human Health Screening Level
Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

Table 1-2
RI Discrete Soil and Sediment Sample Results for
PAE40-001-R-01 MRS

			RTR05DD07A				RTR05DD08A				RTR05DD09A				RTR05DD10A			
Sample ID:			RTR05DD07A				RTR05DD08A				RTR05DD09A				RTR05DD10A			
Decision Unit - XRF Location:			French Drain - NA				French Drain - NA				French Drain - NA				French Drain - NA			
Media:			Sediment				Sediment				Sediment				Sediment			
Sample Depth (inches bgs):			0-6				0-6				0-6				0-6			
Date Collected:			7/12/2018				7/12/2018				7/12/2018				7/12/2018			
Analyte	**Human Health Screening Level (mg/kg) Soil / Sediment**	**Ecological Screening Level (mg/kg) Soil / Sediment**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**	**Result**	**LQ**	**VQ**	**RC**
Total Metals by USEPA SW-846 Method 6020A (mg/kg)																		
Antimony	3.1 / 880	0.27 / 2	0.092	J			0.438				0.36				0.236			
Copper	310 / 81000	28 / 31.6	6.63	B			30.3	B			31.5	B			20.6	B		
Lead	400 / 5000	11 / 35.8	17.6	B			**120**	B			**124**	B			**67.3**	B		
Zinc	2300 / 660000	46 / 121	37.7				58.1				53.2				71.1			
Explosives by USEPA SW-846 Method 8330B (mg/kg)																		
Nitroglycerin	0.63 / NA	13 / NA	--				--				--				--			
Toxicity Characteristics Leaching Procedure (various methods)																		
Arsenic (µg/L)	NA	NA	--				--				--				--			
Barium (µg/L)	NA	NA	--				--				--				--			
Cadmium (µg/L)	NA	NA	--				--				--				--			
Chromium (µg/L)	NA	NA	--				--				--				--			
Selenium (µg/L)	NA	NA	--				--				--				--			
Silver (µg/L)	NA	NA	--				--				--				--			
Lead (µg/L)	NA	NA	--				--				--				--			
Mercury (µg/L)	NA	NA	--				--				--				--			
Nitroglycerin	NA	NA	--				--				--				--			

Notes:

* = Field duplicate
Bold = Sample exceeds Ecological Screening Level
Sample exceeds Human Health Screening Level
Sample exceeds TCLP EPA Regulatory Level of 5.0mg/L
bgs = below ground surface
LQ = laboratory qualifier (LQ flag descriptions available in lab report)
VQ = validiation qualifier
RC = reason code
NA = not applicable
B = associated blank detection
U = non-detect
J = estimated
J- = estimated, negative bias
d = MS/MSD imprecision
f = field duplicate imprecision
m = MS/MSD percent recovery anomaly
s = surrogate failure
z = preparation/method blank anomaly

This Page Intentionally Blank

Table 1-3. RI Incremental Sampling Results Summary for PAE40-001-R-01 MRS

			Location:	Background Reference											
			Sample ID:	RTR04IS01				RTR04IS02				RTR04IS03			
			Sample Depth (inches bgs):	0-6				0-6				0-6			
			Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	Human Health Screening Level	Ecological Screening Level		Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)															
Antimony	3.1	0.27		0.244	N	J-	m	**0.682**		J-	m	**0.626**		J-	m
Copper	310	28		12		J	s	12.7		J	s	10.5		J	s
Lead	400	11		**59.2**	NA			**81.8**				**82.3**			
Zinc	2,300	46		33.2		J	m	33.5		J	m	23		J	m
Explosives by USEPA SW-846 Method 8330B (mg/kg)															
Nitroglycerin	0.63	13		0.460	ULMM	UJ	l	0.44	UL	UJ	l	0.38	U	UJ	s

			Location:	Target Berm											
			Sample ID:	RTR01IS01				RTR01IS02				RTR01IS03			
			Sample Depth (inches bgs):	0-6				0-6				0-6			
			Date Collected:	7/11/2018				7/11/2018				7/11/2018			
Analyte	Human Health Screening Level	Ecological Screening Level		Result	LQ	VQ		Result	LQ	VQ	RC	Result	LQ	VQ	RC
Total Metals by USEPA SW-846 Method 6020A (mg/kg)															
Antimony	3.1	0.27		**24.80**	NA	J-	m	**27**		J-	m	**40.1**		J-	m
Copper	310	28		**636**	N*EA	J	s	**481**		J	s	**612**		J	s
Lead	400	11		**5720**	NA			**6180**				**8770**			
Zinc	2,300	46		**158**	NEA	J	m	**149**		J	m	**165**		J	m

			Location:	Firing Point											
			Sample ID:	RTR03IS01				RTR03IS02				RTR03IS03			
			Sample Depth (inches bgs):	0-6				0-6				0-6			
			Date Collected:	7/12/2018				7/12/2018				7/12/2018			
Analyte	Human Health Screening Level	Ecological Screening Level		Result	LQ	VQ	RC	Result	LQ	VQ	RC	Result	LQ	VQ	RC
Explosives by USEPA SW-846 Method 8330B (mg/kg)															
Nitroglycerin	0.63	13		3.70	L	J	l	4.4	LMM	J	l	**21**	L	J	l

Notes:

Bold = Sample exceeds Ecological Screening Level

Sample exceeds Human Health Screening Level

bgs = below ground surface

LQ = Laboratory qualifier (LQ flags available in lab report)

VQ = Validiation qualifier

RC = Reason Code

U = non-detect

J = estimated

J- = estimated, negative bias

UJ= non-detect, estimated detection limit

l = LCS recovery failure

m = MS/MSD percent recovery anomaly

s = surrogate failure

N= pre-digestion spiked sample recovery is not within control limits

*= the duplicate sample analysis relative percent different (RPD) is not within control limits

A= post-digestion spiked sample recovery is not within control limits

E = reported value is estimated because of the presence of interference (as indicated by serial dilution)

L= flagged compound did not meed DoD criteria in the coresponding Laboratory Control Sample (LCS) and/or Laboratory Control Sample Duplicate (LCSD) prepared and/or analyzed concurrently with this sample.

This Page Intentionally Blank

1.2.4 Risk Assessment Summary

Analytical data generated during the RI were compared with risk-screening criteria to evaluate whether past munitions-related practices have resulted in contaminant releases exceeding human health or ecological screening criteria.

Human Health

Due to MC concentrations in soil at three DUs exceeding human health screening criteria, a Human Health Risk Assessment (HHRA) was conducted. Cancer risk and non-cancer hazard calculations were conducted for the following scenarios: outdoor worker, teen trespasser, child and adult visitor, child and adult hypothetical resident, construction worker, and utility worker. Also, the U.S. Environmental Protection Agency (USEPA)'s ALM and IEUBK models were used to estimate blood lead (PbB) concentrations from exposure to lead in soil. **Table 1-4** presents the human health contaminants of concern (COCs) for soil that may cause adverse health effects at the MRS. Soil-related exposure pathways that were evaluated in the HHRA were incidental ingestion and dermal contact with soil. The inhalation exposure pathway was incomplete because the soil constituents of potential concern did not have inhalation toxicity values.

TABLE 1-4 Human Health Risk Assessment Soil COCs

Receptor	Exposure Medium	Constituent of Concern
Target Berm DU		
Child Visitor	Surface Soil	Lead [a, b]
	Total Soil	Lead [a, b]
Outdoor Worker	Surface Soil	Lead [b]
	Total Soil	Lead [b]
Construction/Utility Worker	Surface Soil	Lead [b, c]
Hypothetical Child Resident	Surface Soil	Antimony Lead [b]
	Total Soil	Antimony Lead [b]
Soil Pile DU		
Child Visitor	Surface Soil	Lead [a, b]
	Total Soil	Antimony Lead [a, b]
Construction Worker [c]	Total Soil	Antimony Lead [b, c]
Utility Worker [c]	Total Soil	Lead [b, c]
Outdoor Worker	Surface Soil	Lead [b]
	Total Soil	Lead [b]

Receptor	Exposure Medium	Constituent of Concern
Hypothetical Child Resident	Surface Soil	Antimony Lead [(b)]
	Total Soil	Antimony Lead [(b)]
Hypothetical Adult Resident	Total Soil	Antimony
Firing Point DU		
Hypothetical Child Resident	Surface Soil	Nitroglycerin

Notes:

(a) IEUBK model results for the hypothetical child resident were used to be protective of the child visitor and hypothetical adult resident (lifetime exposure) at the MRS.

(b) Lead modeling results are based on target PbB threshold of 10 µg/dL.

(c) If a target PbB threshold of 5 µg/dL was used, then lead would be identified as a surface soil and total soil COC for the construction and utility worker scenarios.

Ecological

Because MC concentrations in soil at all four DUs exceeded the ecological screening criteria, a Screening-Level Ecological Risk Assessment (SLERA) was conducted. The purpose of the SLERA was to identify the potential risks to ecological receptors exposed to site-related contaminants of interest (COIs) in environmental media and determine which contaminants of potential ecological concern (COPECs), if any, could exert adverse effects to potential ecological receptor populations. The results of the risk characterization determined the following scientific management decision points (SMDP):

1. Exposure to COPECs in on-site soil at 3 DUs resulted in substantial impact (*de manifestis*) to both soil invertebrate and terrestrial wildlife populations; action should be taken that can eliminate or reduce exposure to an acceptable level.
2. At the French Drain Outfall DU, the potential for adverse effects to the benthic macroinvertebrate community is *de minimus*, and the potential for adverse effects to the aquatic and semi-aquatic wildlife community is *de minimus*.

1.2.5 Munitions Response Site Prioritization Protocol

In accordance with the DoD Primer for Munitions Response Site Prioritization Protocol (MRSPP; DoD, 2007), the overall rating of 4 was assigned to the Ridgway Training Range MRS (PAE40-001-R-01). The Explosive Hazard Evaluation Module (EHE), the Chemical Warfare Material (CWM) Hazard Evaluation Module (CHE) ratings were each No Known or Suspected Hazard, but the Health Hazard Evaluation (HHE) rating was C, indicating an HMM media combination. No

new information has been found since the RI regarding the MRS, and therefore, the MRSPP rating is unchanged (**Appendix B**).

1.2.6 Conclusions and Recommendations

Based on the results of the RI, the MRS has been sufficiently characterized. The MRS boundary was revised to include the farthest extent of lead concentration exceedances of its human health screening criterion based on XRF data; the revised acreage is 0.32 acres (**Figure 1-9)**. The presence of unacceptable risks to human health and ecological receptors due to MC-contaminated soil warrants an FS for the Ridgway Training Range MRS. Therefore, the RI recommended an FS be conducted to evaluate possible actions appropriate to the MRS.

This Page Intentionally Blank

CLIENT	Army National Guard			
PROJECT	Feasibility Study through Decision Document for Ridgway Training Range			
REVISION NO	0	GIS BY	MS	10/16/2019
SCALE	1:480	CHK BY	JW	10/16/2019
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	10/16/2019

N

TITLE

Revised Ridgway MRS Boundary Revision

AECOM 12420 Milestone Center Drive Germantown, MD 20876

Figure 1-9

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-9_Ridgway_Revised_MRS_Boundary.mxd

This Page Intentionally Blank

2 Identification and Screening of Technologies

The development of remedial action alternatives involves establishing the RAO, developing GRAs, and identifying and screening remedial technologies and process options.

2.1 Remedial Action Objective

RAOs are site-specific objectives that are established based on the nature and extent of contamination, potential for human and environmental exposure, and ARARs. The RAO and ARARs for the Ridgway Training Range MRS are presented first. The possible response actions to achieve the RAO are then discussed.

2.1.1 Munitions Constituents

Lead concentrations exceeded the human health screening criteria (400 milligrams per kilogram [mg/kg]), toxicity characteristic leaching procedure (TCLP) criteria (5 milligrams per liter [mg/L]), and ecological screening criteria (11 mg/kg). Antimony exceeded the human health screening criteria (3.1 mg/kg), and ecological screening criteria (0.27 mg/kg). The Ridgway Training Range MRS was considered to pose a risk to human health and the environment based on these elevated lead and antimony concentrations and the possibility of receptor exposure.

- The RAO for MC is to prevent human exposure to lead and antimony above the human health screening criteria for lead (400 mg/kg) within Ridgway Training Range MRS. Because the limits of detection for antimony are difficult to achieve in the field, the HH criterion for antimony (3.1 mg/kg) is not appropriate to use as a remediation criterion. It is anticipated that because antimony is associated with lead as they are derived from the same source (i.e., spent bullets), the cleanup goal for antimony will be concurrently achieved. The primary remedial goal is to prevent contact with MC-contaminated soil. The MC RAO will address the likelihood of exposure to workers, residents, visitors, and trespassers during work and construction such that an acceptable condition of negligible risk of injury or exposure due to dermal contact or incidental ingestion with MC-contaminated soil is achieved. The human health screening criteria limits for antimony are hard to measure in the field and it is anticipated that the antimony limit of 3.1 mg/kg will be achieved concurrently with the achievement of the human health screening level for lead of 400 mg/kg as measured in soil. This is appropriate given the limited size of the revised MRS, the lack of critical habitats within, and the high degree of development (i.e., range infrastructure and range floor enhancements) within the MRS.

2.1.2 ARARs

Federal and state environmental statutes and regulations were evaluated to determine whether they were ARARs (**Table 2-1**).

As defined in the NCP, “Applicable Requirements” are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a

CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable (40 CFR 300.5).

"Relevant and Appropriate Requirements" are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and are well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable (40 CFR 300.5).

Section 121(d) of CERCLA requires that remedial actions be evaluated to determine if they meet any standard requirement, criteria, or limitation under any federal environmental law; any promulgated standard, requirement, criteria or limitation under a state environmental or facility siting law that is more stringent than any federal standard, requirement, criteria, or limitation; and any standards, criteria, or limitations that are determined to be ARARs. The NCP requires compliance with ARARs during and upon completion of remedial actions. Under limited circumstances, ARARs for on-site remedial actions may be waived.

ARARs are identified on a site-specific basis using a two-part analysis: (1) determining whether a given requirement is applicable or if it is not applicable, (2) determining whether a requirement is relevant and appropriate (USEPA, 1988). To determine whether a requirement is relevant and appropriate, characteristics of the remedial action, the hazardous substances present, and the physical characteristics of the site must be compared to those addressed in the statutory or regulatory requirement. In some cases, a requirement may be relevant but not appropriate, given site-specific circumstances; such a requirement would not be an ARAR for the site. In other cases, only part of a requirement will be considered relevant and appropriate. When it is determined that a requirement is both relevant and appropriate, the requirement must be complied with to the same degree as if it were applicable (USEPA, 1988).

Remedial actions may have to comply with three (3) functional groups of ARARs:

- Chemical-specific ARARs are health- or risk-based restrictions on the amount or concentration of a chemical that may be found in or discharged to the environment. The chemical ARARs may be used to set cleanup levels for the chemicals of concern in the designated media, or to set a safe level of discharge (e.g., air emission or wastewater discharge) where a discharge occurs as a part of the remedial action.
- Action-specific ARARs generally set performance, design, or other similar operational controls or restrictions on particular activities related to management of hazardous substances or pollutants. These requirements address specific activities that are used to accomplish a remedy. Action-specific requirements do not determine the remedial action; rather, they indicate how a selected remedial action alternative must be designed, operated, or managed.

Table 2-1
POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Standard, Requirement, Criteria or Limitation	Citations	Description	ARAR Type	Applicability to Site
Solid and Hazardous Waste Management				
Pennsylvania Hazardous Sites Cleanup Act	Act of October 18, 1988, P.L 756 (35 P.S. §§ 6020.501-6020.513)	Where there is a release or substantial threat of release of a contaminant which presents a substantial danger to the public health or safety or the environment. Requires investigation and an appropriate response, if contaminant or hazardous substance are present	Action	ARAR/Applicable to soils containing elevated levels of lead at concentrations where the restrictions on land disposal are exceeded.
Pennsylvania Administration of Land Recycling Program	25 Pa. Code 250.2-250.708	Medium-Specific Concentrations (MSCs) for Lead in Soil, Direct Contact Numeric Values, Residential (0-15 feet) and Non-Residential, Surface Soil (0-2 feet)	Action	ARAR/Applicable to soils containing levels of lead above MSCs where the restrictions on land use are exceeded.
Pennsylvania Solid Waste Management Act	Act of Jul. 7, 1980, P.L. 380, No. 97, Cl. 35, Section 401-405	Provides procedures for managing contaminated soil when soil-disturbing activities occur or are planned.	Location	ARAR/Applicable to any actions where soil is disturbed in portions of the site within an impacted area.
Hazardous Waste Management Regulation	40 CFR 260-270, Article VII	These chapters apply to the identification and listing, generation, transportation, storage, treatment and disposal of hazardous waste and contains the requirements under RCRA for a state to implement a federally approved hazardous waste program	Location	ARAR/Applicable to soils containing elevated levels of lead at concentrations where the restrictions on land disposal exceeded.

Table 2-1
POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Standard, Requirement, Criteria or Limitation	Citations	Description	ARAR Type	Applicability to Site
Stream and Wetland				
Clean Streams Law	Act of June 22, 1937, P.L. 1987, as amended, 35 P.S. §§ 691.401-691.402	Whenever the department finds that any activity, not otherwise requiring a permit under this act, including but not limited to the handling, storage, transportation, disposing of materials or substances, creates a danger of pollution of the waters of the Commonwealth or that regulation of the activity is necessary to avoid such pollution, the department may, by rule or regulation, require that such activity be conducted only pursuant to a permit issued by the department or may otherwise establish the conditions under which such activity shall be conducted, or the department may issue an order to a person or municipality regulating a particular activity.	Location	ARAR/Applicable and Relevant if there is a danger of soil excavation activities leaching contamination into drainage areas located inside the MRS during excavation
25 Pa. Code 102.11 – Erosion and Sediment Control Best Management Practices (BMPs); General requirements	25 Pa. Code §§102.11 et seq.	(a) A person conducting or proposing to conduct an earth disturbance activity shall design, implement and maintain BMPs to minimize the potential for accelerated erosion and sedimentation in order to protect, maintain, reclaim, and restore water quality and existing and designated uses. Various BMPs and their design standards are listed in the Erosion and Sediment Pollution Control Program Manual (Manual), commonwealth of Pennsylvania, Department of Environmental Protection, No. 363-2134-008 (January 1996), as amended and updated. (b) BMPs and design standard other than those listed in the Manual may be used when a person conducting or proposing to conduct an earth disturbance activity demonstrates to the Department or a county conservation district that the alternate BMP or design standard minimizes accelerated erosion and sedimentation to achieve the regulatory standards in subsection (a)	Location	ARAR/ Relevant and Appropriate as MC removal activities would require excavation of some kind. 25 Pa. Code 102 requires persons proposing or conducting earth disturbance activities to develop, implement and maintain BMPs to minimize the potential for accelerated erosion and sedimentation.

Table 2-1
POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Standard, Requirement, Criteria or Limitation	Citations	Description	ARAR Type	Applicability to Site
Water Quality Standards	Chapter 93 (25 P.S.§§ 93.6-93.8b)	a)Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life. (b) In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances that produce color, tastes, odors, turbidity or settle to form deposits.	Chemical	ARAR/Applicable and relevant if there is a danger of soil excavation activities leaching contamination into drainage areas located inside the MRS during excavation
Air Quality				
Construction, Modification, Reactivation and Operation of Sources	Chapter 127, 25 Pa. Code §§ 127.36 and 127.801	This chapter on "Construction, Modification, Reactivation and Operation of Sources" requires the use of Best Available Technology (BAT) for control of new sources, plan approval and operating permit requirements, and special requirements for sources in nonattainment areas		ARAR/Applicable and relevant if there is a concern of dust from contaminated soil becoming airborne and affecting air quality during or after remediation

Notes:
ARAR = Applicable or Relevant and Appropriate Requirement
CFR = Code of Federal Regulations
MC = Munitions Constituents
RCRA = Resource Conservation and Recovery Act

This Page Intentionally Blank

- Location-specific ARARs are restrictions placed on the types of activities that may occur in particular locations. Location-specific ARARs generally prevent damage to unique or sensitive areas, such as floodplains, historic places, wetlands, and fragile ecosystems, and restrict other activities that are potentially harmful because of where they take place.

The statutes and regulations that were considered to be location-specific ARARs are presented in **Table 2-1**. The table includes comments regarding the applicability or relevance and appropriateness of the ARAR. Dependent on the chosen alternative, final ARARs (statutes and regulations) will be determined by the PAARNG in consultation with the Pennsylvania Department of Environmental Protection (PADEP), and/or other appropriate federal and state agencies and documented in the Record of Decision (ROD).

2.2 General Response Actions

GRAs are broad classes of medium-specific actions intended to satisfy the RAO. The following GRAs (excluding No Action) are applicable for satisfying the RAO previously discussed in **Section 2.1**:

- No Action
- Land Use Controls (LUCs)
- Soil Excavation and Off-Site Disposal (as Hazardous Waste)
- Soil Stabilization and Excavation with Off-Site Disposal

2.2.1 No Action

The No Action GRA is required to satisfy the NCP requirement of 40 CFR 300.430(e)(6), which is to consider No Action as a baseline response against which the other remedial response actions are compared. The No Action GRA does not include any actions that would fulfill the RAO.

2.2.2 Land Use Controls

In general, LUCs are mechanisms to restrict the use of or limit access to real property to prevent or reduce the risk of exposure to MC-contaminated soil. The three (3) general categories of LUC mechanisms available to achieve this objective are physical, legal, and administrative. The MRS is privately owned, so the use of any category of LUC is unlikely, as the landowner cannot be compelled to establish and enforce LUCs in place on the property. The ARNG has no mechanism to implement or enforce the use of LUCs on the property. Establishing LUCs on the property would require the establishment of a legal mechanism allowing ARNG to implement or enforce the use of LUCs. Land owners typically are not inclined to agree to legal obligations to limit how they use their property, particularly if the restriction is tied to the property through the deed, potentially jeopardizing the property re-sale value.

Due to these reasons, LUCs are not a feasible solution to fulfill the RAO.

2.2.3 MC Mitigation

MC Mitigation can be accomplished by the combined activities of in-situ stabilization, MC-contaminated soil removal, transport, and disposal. This action would not require LUCs.

2.3 Identification and Screening of Remedial Technologies

2.3.1 Identification and Screening of Technologies

Technologies were identified that are relevant to executing the GRAs identified in **Section 2.2**. **Table 2-2** shows the relationship between the GRAs and the potential technologies, including the various technology goals, technology names and technology process options (different ways a technology can be implemented). As an initial screening, remedial technologies and process options were evaluated based on their technical implementability and general applicability to the conditions at the MRS. All of the remedial technologies and process options identified in **Table 2-2** are technically feasible and applicable to the MRS and retained for evaluation.

2.3.2 Evaluation of Technologies

This section identifies and screens the remedial technologies available to execute the GRAs identified in **Section 2.2**. A brief description of each of these technologies/process options is summarized in **Table 2-3** and discussed below.

Using the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988), the various technologies and technology process options identified in **Table 2-4** were evaluated with respect to three (3) criteria: effectiveness, implementability, and cost.

- **Effectiveness**: Based on demonstrated ability of technologies to achieve remediation goals, potential impacts to human health and the environment during implementation, and reliability of the technology/process option to mitigate conditions at the site. The effectiveness analysis is based on engineering judgment, and each process option is evaluated as to whether effectiveness is low, medium, or high relative to other process options in the same technology.
- **Implementability**: Based on factors such as: safety; constructability; regulatory and public support; compatibility with reasonably anticipated future land use; and availability of material, equipment, technical expertise, or off-site treatment and disposal facilities. The implementability analysis is based on engineering judgment, and each process option is evaluated as to whether implementability is low, medium, or high relative to other process options in the same technology.
- **Cost**: Based on overall cost, including capital costs and long-term management (LTM) costs. Capital costs are based on the amount of equipment needed and the cost of performing the process option. LTM costs are based on the relative cost after initial implementation of the process option. The cost analysis is based on engineering judgment, and each process option is evaluated as to whether costs are low, medium, or high relative to other process options in the same technology. A comprehensive discussion of costing procedures used during the FS is contained in *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000).

TABLE 2-2
GRAs AND POTENTIALLY APPLICABLE TECHNOLOGIES

General Response Action	Potentially Applicable Technologies		
	Goal	**Technology**	**Process Option**
No Action	Baseline Comparison	None	None
Land Use Controls	Reduce Exposure to MC-contaminated Soil	Physical Mechanisms	Signs
			Fences
		Legal Mechanisms	Deed Restrictions (Limitations on Land Use)
			Negative Easements / Restrictive Covenants
			Land Use Plans / Ordinances / Permits
		Administrative Mechanisms	Public Awareness Programs
MC-contaminated Soil Mitigation	MC-contaminated Soil Removal	Excavation	Manual Excavation
			Mechanized Excavation
		On-Site Extraction	Soil Washing
			Acid Leaching
		Treatment	Phytoextraction
			In-situ Stabilization
	MC-contaminated Soil Disposal	Hazardous Waste Transport and Disposal	Transport and Offsite Disposal
		Non-hazardous Waste Transport and Disposal	

Notes:
GRA = general response action
MC = munitions constituents

This Page Intentionally Blank

TABLE 2-3
POTENTIALLY APPLICABLE TECHNOLOGIES AND PROCESS OPTION DESCRIPTIONS

Potentially Applicable Technologies			Description
Purpose	**Technology**	**Process Option**	
No Action	None	None	No remedial action to address the MC-contaminated Soil.
Land Use Controls	Physical Mechanisms	Signs	Install signage around affected areas to warn potential receptors of MC-contaminated soil risks within the MRS. Must be periodically inspected and maintained.
		Fences	Install fencing around affected areas to physically control access to the areas. The fencing must be periodically inspected and maintained.
	Legal Mechanisms	Deed Restrictions (Limitations on Land Use)	Limitations on land use are typically included in the property deed and describe restrictions on the use of property. Third parties (not the property owner) identify the restrictions and assure they are included in the deed. Such restrictions prohibit current and future landowners from engaging in land use activities that would otherwise increase the risk of exposure to MC-contaminated soil, such as excavation if subsurface MC-contaminated soil is suspected.
		Negative Easements / Restrictive Covenants	Negative easements (also referred to as restrictive covenants) are obligations not to use land in specified ways that would otherwise result in unacceptable risk of exposure to MC-contaminated soil. Negative easements are similar to deed restrictions except that negative easements do not bind to land through deeds.
		Land Use Plans / Ordinances / Permits	Land Use Plans describe the manner by which land can be developed and used and can be written in a manner to minimize potential contact with MC-contaminated soil. The plans can become legally binding through the zoning process enforced by municipal authorities. Ordinances are legislation enacted by a municipal authority and can be written in a manner to reduce the risk of exposure to MC-contaminated soil. Permits are documents that must be secured prior to conducting activities such as construction. Through the process of securing a permit controls can be established that would reduce the risk of exposure to MC-contaminated soil.

TABLE 2-3
POTENTIALLY APPLICABLE TECHNOLOGIES AND PROCESS OPTION DESCRIPTIONS

Potentially Applicable Technologies			Description
Purpose	**Technology**	**Process Option**	
Land Use Controls	Administrative Mechanisms	Public Awareness Programs	Public education programs educate the public about procedures to follow in the event that known or suspected MC-contaminated soil is observed, intended to reduce the risk of exposure to MC-contaminated soil. and the potential risks associated with exposure to MC-contaminated soil. Public education programs vary in scope, but may include these common elements: community awareness meetings, informational pamphlets, fact sheets, formal education sessions, and websites.
MC-contaminated Soil Removal	Excavation	Manual Excavation	Removes contaminated soils from their current location where human or environmental exposure can occur. Hand excavation can support on-site consolidation of contaminated soil or moving soil to other locations for treatment or disposal. Hand excavation consists of digging contaminated soil using commonly available hand tools, such as shovels, pick axes, and trowels.
		Mechanized Excavation	Removes contaminated soils from their current location where human or environmental exposure can occur. Mechanized excavation can support on-site consolidation of contaminated soil or moving soil to other locations for treatment or disposal. This method uses commonly available mechanical excavating equipment such as a backhoe or excavator.
	On-Site Extraction	Soil Washing	Uses washing solutions such as water, surfactant, and chelating agent to remove or reduce soil contaminant concentrations and facilitate on-site reuse of the treated soil.
		Acid Leaching	Converts lead sulfate and lead dioxide to lead carbonate, which is soluble in fluosilicic acid. Lead is recovered from the leaching solution by electrowinning, and the acid is recycled back into the leaching process. Further leaching with nitric acid may increase lead movement.
	Treatment	Phytoextraction	Lead can be uptaken by plant roots and subsequently accumulate in plant tissue, which can be harvested and properly disposed of.
		In-situ Stabilization	Renders lead less prone to leaching and may reduce bioavailability. Potential binders include portland cement, lime-fly ash, thermoplastic binders (asphalt), and sorbents such as activated carbon, clays, zeolites, and anhydrous sodium silicate.

TABLE 2-3
POTENTIALLY APPLICABLE TECHNOLOGIES AND PROCESS OPTION DESCRIPTIONS

Potentially Applicable Technologies			Description
Purpose	**Technology**	**Process Option**	
MC-contaminated Soil Disposal	Hazardous Waste Transport and Disposal	Transport and Offsite Disposal	Removes soil from the site and disposes of it as hazardous waste by testing to confirm hazardous status.
	Non-hazardous Waste Transport and Disposal		Removes soil from the site and disposes of it as non-hazardous waste either by testing to confirm a non-hazardous status or treatment to change hazardous soil to non-hazardous.

Notes:

cm = centimeter
GPS = Global Positioning System
LUC = Land Use Control
MC = munitions constituents
MRS = munitions response site

This Page Intentionally Blank

These evaluation criteria were used to screen and identify technologies and process options that are judged to be effective and workable at the MRS and to eliminate those that will not work. The technologies screening results are presented in the following sections for each of the following categories:

- LUCs
- MC-contaminated Soil Removal
- MC-contaminated Soil Treatment and Disposal

Land Use Controls

Physical, legal, and administrative LUC mechanisms are available. LUC technology screening results are summarized in **Table 2-4** and individually discussed below for each technology and technology process option.

Physical Mechanisms

Physical mechanisms are engineered structures to control access to areas where MC-contaminated soil may be present. Physical mechanisms options include:

- Fences
- Warning signs

Fencing may be installed around affected areas to physically control access to the areas. Signs may be installed around affected areas to warn people about the presence of MC-contaminated soil. The fencing and signs must periodically be inspected and maintained.

The MRS are privately owned property managed under NDNODS. The U.S. Army cannot unilaterally impose the requirement to construct signs or fences on the property. Therefore, the viability of physical LUCs at the MRS is low, and this technology is not retained.

Legal Mechanisms

Legal mechanisms are non-physical means to restrict land use or control access to areas where MC-contaminated soil may be present. Legal mechanisms options include:

- Deed restrictions (limitations on land use) negative easements / restrictive covenants
- Land use plans / ordinances / permits

Limitations on land use are typically included in the property deed and describe restrictions on the use of property. Third parties (not the property owner) identify the restrictions and assure they are included in the deed. Deed restrictions may also be referred to as a private land-use restrictions, restrictive covenants, negative easements, or equitable servitudes. Such restrictions prohibit current and future landowners from engaging in land use activities that would otherwise increase the risk of exposure to MC-contaminated soil, such as excavation if subsurface MC-contaminated soil is suspected.

Negative easements (also referred to as restrictive covenants) are obligations not to use land in specified ways that would otherwise result in unacceptable risk of exposure to MC-contaminated

soil. Negative easements are similar to deed restrictions (limitations on land use) except that negative easements do not bind to land through deeds.

Land use plans describe the manner by which land can be developed and used and can be written in a manner to minimize potential contact with MC-contaminated soil. The plans can become legally binding through the zoning process enforced by municipal authorities. Ordinances are legislation enacted by a municipal authority and can be written in a manner to reduce the risk of exposure to MC-contaminated soil. Permits are documents that must be secured prior to conducting activities such as construction. Through the process of securing a permit, controls can be established that would reduce the risk of exposure to MC-contaminated soil.

The MRS are privately owned property managed under NDNODS. The U.S. Army cannot unilaterally impose the requirement for legal LUCs. Therefore, the viability of legal mechanisms at the MRS is low, and this technology is not retained.

Administrative Mechanisms

Administrative mechanisms generally are focused on public awareness programs. Administrative mechanisms options may include:

- Public notices
- Public awareness program

Public notices communicate to the public information intended to reduce the risk of exposure to MC-contaminated soil. Examples include notices in newspapers, but may also include notices communicated by mail, radio, television or internet-based social media sites.

Public awareness programs educate the public about procedures to follow in the event that known or suspected MC-contaminated soil is observed and are intended to reduce the risk of exposure to MC-contaminated soil. Commonly, the programs seek to educate the public to follow these procedures if known or suspected MC-contaminated soil is observed: recognize the known or suspected MC-contaminated soil, retreat from the known or suspected MC-contaminated soil and report the known or suspected MC-contaminated soil, and the potential risks associated with exposure to MC-contaminated soil. The education program includes details concerning how to report potential MC-contaminated soil. Public awareness programs vary in scope but may include these common elements: community awareness meetings, informational pamphlets, fact sheets, formal education sessions, and websites. While not part of the remedy, 5-year reviews would be completed to assess if the LUCs were implemented and evaluate the effectiveness and protectiveness of the remedy to human health and the environment.

Administrative LUCs can be difficult to implement because land owners typically are not inclined to agree to limit how they use their property. Limitations may potentially jeopardize the property re-sale value, assuming disclosure of the limitation to perspective property buyers. The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose any restrictions and therefore, the viability of legal mechanisms at the MRS is low, and this technology is not retained.

TABLE 2-4
LAND USE CONTROLS AND CONSTRUCTION SUPPORT
DETAILED SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Potentially Applicable Technologies			Effectiveness	Implementability	Cost	Representative Systems	Screening Comments
Purpose	**Technology**	**Process Option**					
Land Use Controls	Physical Mechanisms	Signs	**Medium:** Can be effective, particularly in situations where signs can be placed at the locations where the public is likely to see the sign, such as at trail heads. Less effective in situations where there are multiple routes to access the area of MC-contaminated soil or if potential receptors choose to ignore the signs.	**Low:** Although, easily implemented, the MRS property is not owned by DoD.	**Low:** Recurring maintenance is a requirement but, overall, costs are low.	Signs	**Low / Not Retained:** The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose the requirement to construct signs on the property.
		Fences	**Medium-High:** Reduces the probability of MC-contaminated soil exposure compared to signs, by creating a physical barrier. However, fences can be breached relatively easily if the potential receptor is determined to do so.	**Low:** Although, easily implemented, the MRS property is not owned by DoD.	**Low-Medium:** Recurring maintenance is a requirement but, overall, costs can be low, depending on the amount (length) of fencing required.	Fences	**Low / Not Retained:** The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose the requirement to construct fences on the property.
	Legal Mechanisms	Deed Restrictions (Limitations on Land Use)	**Medium:** Can be effective because they are legally binding. However, if property owners don't carefully read the deed they may be unaware of land use restrictions described in the deed.	**Low:** Can be difficult to implement because land owners typically are not inclined to agree to legal obligations to limit how they use their property, particularly if the restriction is tied to the property through the deed, potentially jeopardizing the property re-sale value. The MRS property is not owned by DoD.	**Low-High:** The cost range is large and depends on how rigorously the property owner may strive to avoid the deed restriction, potentially including seeking legal representation.	Legal	**Low / Not Retained:** The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose legal restrictions.
		Negative Easements / Restrictive Covenants	**Medium:** Can be effective; however, this assumes property owners are aware of the land use restrictions and agree to abide by them.	**Low:** Can be difficult to implement because land owners typically are not inclined to agree to limit how they use their property. Limitations may potentially jeopardizing the property re-sale value, assuming disclosure of the limitation to perspective property buyers. The MRS property is not owned by DoD.	**Low-High:** The cost range is large and depends on how rigorously the property owner may strive to avoid the land use restriction, potentially including seeking legal representation.	Legal	**Low / Not Retained:** The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose legal restrictions.
		Land Use Plans / Ordinances / Permits	**Medium-High:** Can be effective for activities such as excavation associated with planned new construction since this activity is the traditional domain of this LUC technology. However, there is uncertainty whether other intrusive land use activities, such as tilling associated with gardening, could be controlled.	**Low:** Can be difficult to implement due to the democratic nature of municipal authorities which is a time-consuming characteristic. The MRS property is not owned by DoD.	**Low-High:** The cost range is large and depends on how rigorously the property owner may strive to influence the municipal authority concerning the nature of the land use restrictions.	Legal	**Low / Not Retained:** The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose legal restrictions.

TABLE 2-4
LAND USE CONTROLS AND CONSTRUCTION SUPPORT
DETAILED SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Potentially Applicable Technologies			Effectiveness	Implementability	Cost	Representative Systems	Screening Comments
Purpose	**Technology**	**Process Option**					
Land Use Controls	Administrative Mechanisms	Public Awareness Programs / Notices	**High:** Educational components work very well when tailored to the specific populations at risk of exposure through behavior modification. Multiple formats are available for use to convey information to target groups, and periodic inspections can be used to verify effectiveness in the future at both MRSs.	**Low:** Can be difficult to implement because land owners typically are not inclined to agree to limit how they use their property. Limitations may potentially jeopardizing the property re-sale value, assuming disclosure of the limitation to perspective property buyers. The MRS property is not owned by DoD.	**Low:** Costs are variable based on level of effort.	Administrative to produce informational materials and provide training materials.	**Low / Not Retained:** The MRS is a non-DoD property managed under NDNODS without the ability for the Army to unilaterally impose legal restrictions.

Notes:

DoD = Department of Defense
LUC = Land Use Control
MRS = Munitions Response Site
NDNODS = Non-DoD Non-Operational Defense Sites
RI = Remedial Investigation

MC-Contaminated Soil Removal

MC contamination above screening values can be removed from the surface and subsurface manually, by mechanized means, extracted from the soil by washing or leaching, and treated with phytoremediation or stabilized in-situ. Common MC removal technologies are summarized below:

- Manual Excavation: Removes affected soils from their current location where human or environmental exposure can occur. Excavation can support moving soil to other locations for treatment or disposal. Hand excavation consists of digging contaminated soil using commonly available hand tools, such as shovels, pickaxes, and trowels.
- Mechanized Excavation: Removes affected soils from their current location, where human or environmental exposure can occur. Excavation can support moving soil to other locations for treatment or disposal. This method uses commonly available mechanical excavating equipment, such as a backhoe or excavator.
- Soil Washing: Uses washing solutions such as water, surfactant, and chelating agent to remove or reduce soil contaminant concentrations and facilitate on-site reuse of treated soil.
- Acid Washing: Converts lead sulfate and lead dioxide to lead carbonate, which is soluble in fluosilicic acid. Lead is recovered from the leaching solution by electrowinning, and the acid is recycled back to the leaching process. Further leaching with nitric acid may increase lead movement.
- Phytoextraction: Plant root systems can uptake lead, which can accumulate in plant tissue. The plant tissue can be harvested, analyzed, and disposed of based on the analytical results.
- In-situ Stabilization Prior to Excavation: Renders lead less prone to leaching and may reduce bioavailability. Potential binders include Portland cement, lime-fly ash, thermoplastic binders (asphalt), and sorbents such as activated carbon, clays, zeolites, and anhydrous sodium silicate.

Table 2-5 summarizes the MC removal technology screening results. The following MC removal technologies were retained for development into one (1) remedial alternative:

- Mechanized Excavation
- In-situ Stabilization Prior to Excavation

MC-Contaminated Soil Treatment and Disposal

MC disposal refers to the transportation and disposal of waste at a licensed facility, which is further discussed below:

- Transport and Offsite Disposal: Removes affected soil from the site and disposes of it as non-hazardous waste, either by testing to confirm a non-hazardous status or treatment to change the status from hazardous to non-hazardous by such means as soil stabilization for example.

Table 2-5 summarizes the MC disposal technology screening results.

This Page Intentionally Blank

TABLE 2-5
MC-CONTAMINATED SOIL REMOVAL AND DISPOSAL
DETAILED SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Potentially Applicable Technologies			Effectiveness	Implementability	Cost	Representative Systems	Screening Comments
Purpose	**Technology**	**Process Option**					
MC-contaminated Soil Removal	Excavation	Manual Excavation	**Low:** Removal of contaminated soils from the MRS can effectively eliminate the exposure risks for on-site human health and ecological receptors at small sites. Effectiveness is highly limited due to the quantity of soil expected to be removed.	**High:** Hand excavation is easy to conduct and requires simple tools rather than heavy equipment. However, efficiency can be low when excavating large areas and deep excavations.	**High:** Capital: High LTM: Low	Shovel	**Low / Not retained:** Hand excavation can be very costly and time-consuming when excavating large areas.
		Mechanized Excavation	**High:** Removal of contaminated soils from the MRS can effectively eliminate the exposure risks for on-site human health and ecological receptors.	**Medium:** Mechanized excavation requires heavy and specialized equipment and skilled operators. This method would be more efficient than hand excavation, and it provides a higher level of safety for workers.	**Medium:** Capital: High LTM: Low	Tracked mini-excavator, excavator, or wheeled backhoe. Multiple manufacturers.	**High / Retained:** High effectiveness and efficiency and relatively low cost.
	On-Site Extraction	Soil Washing	**Medium:** Effective method for removing lead from contaminated soil. The efficiency may vary depending on the site-specific conditions (i.e., soils). The process produces residuals such as contaminated solids, wastewater, and wastewater sludge that need further treatment.	**Low:** Soil washing requires a very specialized treatment unit and skilled operator to implement. The process also requires large quantities of water and a power supply, and usually includes a complicated soil separation process.	**High:** Capital: High LTM: Low	Surfactants Chelating Agent	**Low / Not Retained:** High cost and low implementability.
		Acid Leaching	**Low:** The efficiency may vary depending on the site-specific conditions, and the application is limited. The process produces residuals such as contaminated solids, wastewater, and wastewater sludge that need further treatment.	**Low:** Acid leaching requires a very specialized treatment unit and skilled operator to implement.	**High:** Capital: High LTM: Low	Electrowinning	**Low / Not Retained:** High cost and low implementability.
	Treatment	Phytoextraction	**Low:** The effects of uptake or degradation of lead can only be achieved at a certain phase of plant growth. MC would remain in soil, and the risk of receptor exposure through potentially complete pathways would continue to exist for a long period of time. The removal effectiveness varies with site-specific conditions.	**Low:** Plants need to be maintained and harvested to achieve MC removal. The harvested plants may require further treatment.	**High:** Capital: High LTM: High	Trees Shrubbery	**Low / Not Retained:** Low effectiveness and implementability with high cost.
		In-situ Stabilization	**Medium-High:** The application of stabilization/fixation can reduce the mobility of MC in the soil; however, MC would remain in soil. The stabilization effectiveness varies with site-specific characteristics.	**Low-Medium:** The process of mixing the binders/stabilizers with contaminated soil can be complicated and may require specialized equipment.	**Medium:** Capital: Medium LTM: Medium	Portland Cement Lime Fly Ash, Thermoplastic binders Sorbents (carbon, clays, zeolites, and anhydrous sodium silicate)	**Medium-High / Retained:** Will be required for the excavated soil to pass TCLP testing for disposal as a non-hazardous waste.

TABLE 2-5
MC-CONTAMINATED SOIL REMOVAL AND DISPOSAL
DETAILED SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

Potentially Applicable Technologies			Effectiveness	Implementability	Cost	Representative Systems	Screening Comments
Purpose	**Technology**	**Process Option**					
MC-contaminated Soil Disposal	Hazardous Waste Transport and Disposal	Transport and Offsite Disposal	**High:** Effectively eliminates the exposure risks for on-site human health and ecological receptors by complete removal of contaminated soil from the MRS.	**Medium:** Contaminated soil would be shipped off site for disposal. Easy implementability using commercially available vendors with required equipment. Potential difficulty in locating disposal facility that will accept entire quantity of excavated material.	**High:** Capital: High LTM: None	Approved Subtitle C off-site landfill	**High / Retained:** High effectiveness and high initial cost.
	Non-hazardous Waste Transport and Disposal	Transport and Offsite Disposal	**High:** Effectively eliminates the exposure risks for on-site human health and ecological receptors by complete removal of contaminated soil from the MRS.	**High:** Stabilized soil would be shipped off site for non-hazardous disposal. Easy to implement using commercially available vendors with required equipment. Soil can be handled in large quantities.	**Low:** Capital: Low LTM: None	Approved off-site landfill	**High / Retained:** High effectiveness and low cost.

Notes:
LTM = long term monitoring
MC = munitions constituents
MRS = Munitions Response Site
TCLP = toxicity characteristic leaching procedure

2.4 Summary

Table 2-6 summarizes the technologies screening results. The "retained" technologies will be developed into two (2) remedial alternative in **Section 3**.

This Page Intentionally Blank

TABLE 2-6
GRAs AND POTENTIALLY APPLICABLE TECHNOLOGIES

Technologies			Retained
Purpose	**Technology**	**Process Option**	
Land Use Controls	Physical Mechanisms	Signs	No
		Fences	No
	Legal Mechanisms	Deed Restrictions (Limitations on Land Use)	No
		Negative Easements / Restrictive Covenants	No
		Land Use Plans / Ordinances / Permits	No
	Administrative Mechanisms	Public Awareness Programs / Notices	No
MC-contaminated Soil Removal and Disposal	Excavation	Manual Excavation	No
		Mechanized Excavation	**YES**
	On-Site Extraction	Soil Washing	No
		Acid Leaching	No
	Treatment	Phytoextraction	No
		In-situ Stabilization	**YES**
	Hazardous Waste Transport and Disposal	Transport and Offsite Disposal	**YES**
	Non-hazardous Waste Transport and Disposal	Transport and Offsite Disposal	**YES**

Notes:
GRA = general response action
MC = munitions consituents

This Page Intentionally Blank

3 Development of Alternatives for residual small arms waste

The retained technologies have been assembled into three (3) different remedial alternatives for Ridgway Training Range MRS:

- Alternative 1 – No Action
- Alternative 2 – Soil Excavation with Off-Site Disposal (as Hazardous Waste)
- Alternative 3 – Soil Stabilization and Excavation with Off-Site Disposal

Table 3-1 identifies the associated GRA, technologies, and process options for each of these alternatives.

3.1.1 Alternative 1 – No Action

The No Action alternative provides a comparative baseline against which other alternatives can be evaluated. Under this alternative, no remedial action will be taken to change the current existing condition at the MRS. The MRS will be left "as is," with no LUCs, containment, removal, treatment, or other mitigating actions, and assumes no action would be taken regarding residual small arms waste. This alternative is required by the NCP for baseline comparison purposes (40 CFR 300.430[e][6]). This alternative will have no capital, operations and maintenance (O&M), or periodic costs.

3.1.2 Alternative 2 – Soil Excavation with Off-Site Disposal (as Hazardous Waste)

Alternative 2 involves excavation and off-site disposal of the lead-contaminated soil with concentrations above established human health screening criteria (400 mg/kg) at PAE40-001-R-01 MRS. The excavation would eliminate the risk of encountering MC-contaminated soil and achieve unlimited use and unrestricted exposure (UU/UE) at the MRS. The parcel of land associated with the MRS is privately owned. Approval from the property owner would be needed to implement this remedy. All permanent items such as walls, backstop, pads, and shelters were not evaluated and will not be removed or disturbed. As such, removal of these items are not included in the alternative.

Based on the results of the RI, the extent of MC-contaminated soil was determined to cover 0.146 acres (approximately 45% of the MRS) to a depth of 2.5 feet (AECOM, 2019). The initial estimate of contaminated soil to be stabilized and removed is 707 bank cubic yards (BCY) or 1061 tons.

Prior to excavation, soil will undergo waste classification by sampling and analysis conducted per the requirements of the Resource Conservation and Recovery Act (RCRA) Part 261, which establishes standards for generators of solid and hazardous waste and Subtitle D and C solid waste disposal facilities, respectively.

Soil exceeding criteria areas will be disposed of at an approved RCRA Subtitle C disposal facility.

Lead concentrations will be evaluated in the field using XRF. If XRF results indicate lead concentrations are above the field delineation value of 400 mg/kg, an additional 0.5 feet of soil will be removed, and the area will be reevaluated by XRF. Once XRF results indicate the lead concentration is below 400 mg/kg, discrete confirmation samples will be collected and submitted

for laboratory analysis. Soil excavation and subsequent sampling and analysis will proceed until the results indicate the contaminant concentrations are below their established screening criteria.

Soil will be excavated with heavy equipment with enclosed cabs to minimize the potential for worker exposure to contaminated media. Erosion control and air and dust monitoring will be implemented to prevent any contamination to the surrounding soils, site workers, and any run-off into the drainage ditch. Excavated soil will be loaded directly into haul trucks waiting in the excavation areas and transported off-site to a Subtitle C disposal facility. During excavation, care will be taken to avoid damaging existing roads, fencing, or structures located outside the excavation subareas. Haul trucks will be properly labeled, licensed, and insured for the transportation of hazardous waste. When transporting contaminated soil, transport vehicles will be fitted with a tarp or other covering to prevent wind dispersal of material during transport. Before departing from the MRS, vehicles will be inspected to ensure the material is properly sealed in the vehicle and "dry" decontaminated to remove visible soil accumulation from the vehicle body, undercarriage, and tires, so no soil is tracked onto the roadways.

Backfill sources would be sampled and submitted for approval prior to use. Excavated areas would be backfilled, graded, and returned to pre-excavation conditions. Right-of-entry (ROE) would be obtained from the landowner, and its conditions followed. Closure documentation would be completed for the remedial action.

Based on the RI, the lead-contaminated removal action area is approximately 0.146 acres (**Figure 3-1),** to a depth of 2.5 ft. Lead concentrations appear to decrease with depth, however samples below 2.5 ft. could not be collected due to the gravel layer. Therefore, excavation will be conducted to a minimum depth of 3 ft. resulting in a minimum disposal volume of 707 BCY (1061 tons) of soil. The removal action is estimated to take approximately 11 days, which include one (1) day for characterization sampling, three (3) days for pre-, post-, and final-topographic surveys, five (5) days for excavation, XRF sampling, transport and disposal, one (1) day for confirmation sampling, and one (1) day for site restoration.

3.1.3 Alternative 3 – Soil Stabilization and Excavation with Off-Site Disposal

Alternative 3 involves stabilization, excavation and off-site disposal of the lead-contaminated soil with concentrations above established human health screening criteria (400 mg/kg) at PAE40-001-R-01 MRS. The excavation would eliminate the risk of encountering MC-contaminated soil and achieve unlimited use and unrestricted exposure (UU/UE) at the MRS. The parcel of land associated with the MRS is privately owned. Approval from the property owner would be needed to implement this remedy. All permanent items such as walls, backstop, pads, and shelters were not evaluated and will not be removed or disturbed. As such, removal of these items are not included in the alternative.

Based on the results of the RI, the extent of MC-contaminated soil was determined to cover 0.146 acres (approximately 45% of the MRS) to a depth of 2.5 feet (AECOM, 2019). The initial estimate of contaminated soil to be stabilized and removed is 707 BCY.

TABLE 3-1
REMEDIAL ALTERNATIVES FOR MC-CONTAMINATED SOIL
(PAE40-001-R-01 MRS)

Technologies / Process Options			GRA	Alternative 1	Alternative 2	Alternative 3
Purpose	**Technology**	**Process Option**		**No Action**	**Soil Excavation with Off-Site Disposal**	**Soil Stabilization and Excavation with Off-Site Disposal**
No Action	NA	NA	No Action	**X**	- -	- -
Land Use Controls	Administrative Mechanisms	Public Awareness Programs / Notices	LUCs	- -	- -	- -
MC-contaminated Soil Removal	Excavation	Mechanized Excavation	Removal and Disposal	- -	**X**	**X**
	Treatment	In-situ Stabilization		- -	- -	**X**
MC-contaminated Soil Disposal	Hazardous Waste Transport and Disposal	Transport and Offsite Disposal		- -	**X**	- -
	Non-Hazardous Waste Transport and Disposal	Transport and Offsite Disposal		- -	- -	**X**

Notes:
GRA = general response action
LUCs = Land Use Controls
MC = munitions constituents
NA = Not applicable
X = Selected Technology/Process

This Page Intentionally Blank

Prior to excavation, a waste analysis plan will be developed which will be maintained at the site. All stabilization, excavation, transport and disposal activities will be completed in accordance with the waste analysis plan. The soil will undergo waste classification by sampling and analysis conducted per the requirements of the RCRA Part 261, which establishes standards for generators of solid and hazardous waste and Subtitle D solid waste disposal facilities.

Application of the "20 times rule" to the maximum detected total lead concentration indicates that soil may need to be stabilized in-situ for the excavated soil to pass TCLP criteria and allow disposal as nonhazardous waste. Soil with lead concentrations above landfill disposal criteria will undergo in-situ soil stabilization consisting of the following:

- Mixing a reagent (e.g., Portland cement), ensuring adequate reagent contact and distribution in soil, to stabilize lead prior to excavation. The addition of Portland cement to render the soil non-hazardous is not intended to create a waste processing or treatment facility. A soil pH probe will be used to monitor pH levels during stabilization to ensure that the pH does not exceed 12.5.
- Post-treatment sampling and TCLP analysis of stabilized soil to evaluate stabilization effectiveness.
- If the soil is determined to be a hazardous waste, it will be determined if RCRA Land Disposal Restrictions apply (40 CFR Part 268).

Following soil stabilization, characterization samples will again be collected and analyzed for federal TCLP. If contaminant concentrations remain above the Environmental Protection Agency's (EPA) alternative land disposal restrictions (40 CFR Part 269.49) (additional treatment, sampling, and analysis will be completed. If, after multiple soil stabilization efforts, areas of soil remain above alternative land disposal restrictions, then soil exceeding criteria from these areas will be disposed of at an approved RCRA Subtitle C disposal facility and a permit-by-rule notification form will be submitted to PADEP. Soil that has undergone stabilization successfully will be excavated and disposed of at an appropriate disposal facility. For cost-estimation purposes, it is assumed that all excavated soil will be successfully stabilized.

Lead concentrations will be evaluated in the field using XRF. If XRF results indicate lead concentrations are above the field delineation value of 400 mg/kg, an additional 0.5 feet of soil

concentration is below 400 mg/kg, discrete confirmation samples will be collected and submitted for laboratory analysis. Soil excavation and subsequent sampling and analysis will proceed until the results indicate the contaminant concentrations are below their established screening criteria.

Soil stabilization is not appropriate at the Firing Point DU due to the presence of nitroglycerin and therefore, this technology will not be implemented at the Firing Point DU. The results of waste classification by sampling and analysis conducted per the requirements of the RCRA Part 261 will determine how the soil from the Firing Point DU is disposed. Soil exceeding non-hazardous waste disposal criteria from the Firing Point DU will be disposed of at an approved RCRA Subtitle C disposal facility.

Soil will be excavated with heavy equipment with enclosed cabs to minimize the potential for worker exposure to contaminated media. Erosion control and air and dust monitoring will be implemented to prevent any contamination to the surrounding soils, site workers, and any run-off

into the drainage ditch. Soil will be mixed with stabilizers using the excavation equipment. This will occur in three, 12-inch lifts. Excavated soil will be loaded directly into haul trucks waiting in the excavation areas and transported off-site to a licensed disposal facility. During excavation, care will be taken to avoid damaging existing roads, fencing, or structures located outside the excavation subareas. Haul trucks will be properly labeled, licensed, and insured for the transportation of soil. When transporting contaminated soil, transport vehicles will be fitted with a tarp or other covering to prevent wind dispersal of material during transport. Before departing from the MRS, vehicles will be inspected to ensure the material is properly sealed in the vehicle and "dry" decontaminated to remove visible soil accumulation from the vehicle body, undercarriage, and tires, so no soil is tracked onto the roadways.

Backfill sources would be sampled and submitted for approval prior to use. Excavated areas would be backfilled, graded, and returned to pre-excavation conditions. Right-of-entry (ROE) would be obtained from the landowner, and its conditions followed. Closure documentation would be completed for the remedial action.

Based on the RI, the lead-contaminated removal action area is approximately 0.146 acres (**Figure 3-1),** to a depth of 2.5 ft. Lead concentrations appear to decrease with depth, however samples below 2.5 ft. could not be collected due to the gravel layer. Therefore, excavation will be conducted to a minimum depth of 3 ft. resulting in a minimum disposal volume of 707 BCY of soil. The removal action is estimated to take approximately 12 days, which include one (1) day for characterization sampling, three (3) days for pre-, post-, and final-topographic surveys, six (6) days for stabilization, excavation, XRF sampling, transport and disposal, one (1) day for confirmation sampling, and one (1) day for site restoration.

CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	7/14/2020
SCALE	1:600	CHK BY	AS	7/14/2020
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	7/14/2020

N

Excavation Area for Alternatives 2 & 3 - Ridgway Training Site

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure 3-1

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_3-1_Ridgway_Alternative_3.mxd

This page intentionally blank

3.2 Screening of Individual Alternatives

Further screening of individual alternatives was not necessary. All alternatives discussed in **Section 3** are evaluated further in **Section 4**.

This page intentionally blank

4 Detailed Analysis of Alternatives

This section presents the analysis and assessment of each alternative with respect to the evaluation criteria specified by the NCP (CFR, Title 40, Part 300.430 [e][9]).

4.1 Introduction

The nine (9) criteria identified by the NCP are divided into three (3) functional categories:

- Threshold criteria
- Primary balancing criteria; and
- Modifying criteria

4.1.1 Threshold Criteria

Assessments against the following two (2) criteria relate directly to statutory findings that must ultimately be made in the ROD; therefore, these are categorized as "threshold" criteria, since an alternative may not be implemented without meeting them. These two (2) criteria are:

- Overall Protectiveness of Human Health and the Environment
- Compliance with ARARs

Overall Protectiveness of Human Health and the Environment

This criterion assesses whether the alternatives can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposure. Overall protection of human health and the environment draws on the attainment of RAOs and assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs

This criterion assesses whether the alternatives attain Federal or State ARARs (**Table 2-1**) or provide grounds for invoking a waiver. Final ARARs and compliance determinations will be made by the PAARNG in consultation with PADEP, and/or other appropriate Federal and State agencies in the ROD.

4.1.2 Balancing Criteria

The following five (5) balancing criteria are the primary criteria upon which the detailed analysis is based:

- Long-Term Effectiveness and Permanence
- Reduction of TMV through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Long-Term Effectiveness and Permanence

This criterion assesses the alternatives for the long-term effectiveness and permanence after remedial action has been implemented and the RAOs have been attained, along with the degree of certainty that the alternative will prove successful. Factors considered, as appropriate, include:

- Magnitude of residual risks
- Adequacy and reliability of controls

Magnitude of residual risks concerns risks remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals should be considered to the degree that they remain hazardous, taking into account their TMV and propensity to bioaccumulate.

Adequacy and reliability of controls concerns controls such as containment systems and institutional controls necessary to manage treatment residuals and untreated waste. This factor addresses, in particular, the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative; and the potential exposure pathways and risks posed should the remedial action need replacement.

For an MRS with MC-contaminated soil, the ability to maintain protection of human health and the environment over time will typically fall into categories associated with LUCs. The evaluation of long-term effectiveness and permanence of LUCs will take into account the administrative feasibility of maintaining the LUCs and the potential risk/hazard, should they fail, as well as mechanisms like the CERCLA Five (5)-Year Review process to evaluate on a periodic basis the long-term effectiveness and permanence, as well as protectiveness, of the alternative. If UU/UE is achieved, then the above are not required.

Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion assesses the degree to which alternatives employ recycling or treatment that reduce TMV, including how treatment is used to address the principal threats posed by the site. While no threat is posed by the MRS, residual small arms wastes are present, and active treatment is an option for addressing this waste. Factors that will be considered, as appropriate, include the following:

- Treatment or recycling processes the alternatives employ and the materials they will treat;
- Amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;
- Degree of expected reduction in TMV of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;
- Degree to which the treatment is irreversible;
- Type and quantity of residuals that will remain following treatment; and
- Degree to which treatment reduces the inherent hazards posed by the principal threats at the site.

Short-Term Effectiveness

This criterion assesses the short-term impacts of alternatives considering the following:

- Short-term risks that might be posed to the community during implementation of an alternative;
- Potential impacts on workers during remedial action and the effectiveness and reliability of mitigation measures during implementation;
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigation measures during implementation; and
- Time until remedial protection is achieved.

Implementability

This criterion assesses the ease or difficulty of implementing the alternatives by considering the following types of factors as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.

Cost

The types of costs that will be assessed include the following:

- Capital costs, including both direct and indirect costs;
- Annual O&M costs; and
- Net present value (PV) of capital and O&M costs.

PV cost is the total cost of an alternative over time in terms of today's dollar value. Estimates are expected to be accurate within a range of +50% to -30%. **Appendix A** presents the basis of the cost estimates. The costs developed for each alternative are based on vendor quotes, literature values, professional experience, and engineering judgment. The level of detail utilized in these elements is considered appropriate for choosing between alternatives, but the estimates are not intended for use in detailed budget planning.

Final costs will depend on actual labor and material costs, actual site conditions, market conditions, final project scope, final project schedule, productivity, and other variable factors. As a result, the final costs will vary from the estimates presented in this FS; however, these factors should not affect the relative cost differences between the alternatives.

4.1.3 Modifying Criteria

The final two (2) criteria, the "modifying factors," will be evaluated following receipt of comments on the FS and the Proposed Plan (PP). These criteria are:

- Regulatory Acceptance
- Community Acceptance

Regulatory Acceptance

This assessment reflects the State's (or support agency's) apparent preferences among or concerns about alternatives.

Community Acceptance

This assessment reflects the community's apparent preferences for or concerns about alternatives. Prior to remedy selection, the community is provided with an opportunity to review the subsequent PP during the public comment period. If requested by the public, a community meeting could be scheduled during the public comment period to provide the opportunity for the public to express concerns and ask questions.

4.2 Individual Analysis of Alternatives for Residual small arms waste

The detailed analyses of the two alternatives developed for PAE40-001-R-01 MRS are discussed below.

4.2.1 Alternative 1 – No Action

Alternative 1 leaves the MRS in its present condition with no LUCs or remedial actions.

Threshold Criteria

This section presents the Threshold Criteria for Alternative 1.

Overall Protection of Human Health and the Environment

Alternative 1 does not provide any means of mitigating MC-contaminated soil at the MRS. The waste would not be removed, reduced, or controlled through engineering or LUCs. The No Action alternative is not capable of achieving the RAO.

Compliance with ARARs

The identified ARARs (**Table 2-1**) would only applies to alternatives that include active remediation.

Balancing Criteria

This section presents the Balancing Criteria for Alternative 1.

Long-Term Effectiveness and Permanence

This alternative would not provide long-term effectiveness or permanence. The RAO would not be met because MC-contaminated soil would remain at the MRS, and controls would not be implemented to remove control exposures. Alternative 1 does not provide long-term effectiveness or permanence, and this criterion is not met.

Reduction of TMV through Treatment

No treatment would be provided; therefore, there would be no reduction of TMV, and as a result, Alternative 1 does not meet this criterion. However, should the property owner disturb the areas of MC-contaminated soil, they would risk exposure to MC-contamination.

Short-Term Effectiveness

No actions would be taken so there would be no short-term risks to the community or workers. Therefore, Alternative 1 meets this criterion.

Implementability

No activities are proposed; therefore, this alternative would be technically and administratively implementable. Therefore, this criterion is met.

Cost

There are no costs associated with Alternative 1.

4.2.2 Alternative 2 – Soil Excavation with Off-Site Disposal

Alternative 2 involves excavation at the MRS. Soil will be sampled and characterized to determine the waste classification, prior to excavation. It is assumed that all soil will have lead concentrations above Subtitle D landfill disposal criteria and will be disposed of at an approved RCRA Subtitle C disposal facility. This alternative is intended to achieve UU/UE.

Lead concentrations will be evaluated in the field using XRF. If XRF results indicate lead concentrations are above the field delineation value of 400 mg/kg, an additional 0.5 foot of soil will be removed, and the area will be re-evaluated by XRF. Once XRF results indicate the lead concentration is below 400 mg/kg, a discrete confirmation sample will be collected and submitted for laboratory analysis. It is expected that approximately four confirmation samples will be collected from distinct and separate areas within the Target Berm DU, and one confirmation sample will be collected from each half of the Firing Point DU, and Soil Pile DU (i.e. 2 samples per DU). Soil excavation and subsequent sampling and analysis will proceed until the results indicate the contaminant concentrations are below their established screening criteria. The parcel of land associated with the MRS footprint is privately owned. Approval from the property owner will be needed to implement of this remedy.

Threshold Criteria

This section presents the Threshold Criteria for Alternative 2.

Overall Protection of Human Health and the Environment

Alternative 2 reduces or eliminates potential human exposure to MC-contaminated soil by direct removal and disposal. The removal of MC-contaminated soil effectively eliminates the exposure hazard to the potential human and ecological receptor.

Compliance with ARARs

Planning would be required to comply with chemical-specific, location-specific, and action-specific ARARs. ARARs identified included regulations on the transportation, storage, treatment,

and disposal of lead contaminated soil. Soil will be excavated in accordance with applicable guidance documents.

Balancing Criteria

This section presents the Balancing Criteria for Alternative 2.

Long-Term Effectiveness and Permanence

Alternative 2 provides a high level of long-term effectiveness and permanence through the implementation and completion of soil excavation and disposal, and would immediately reduce the risks to acceptable levels for human receptors at the MRS.

Reduction of TMV through Treatment

Contaminated soil excavation and off-site disposal would immediately reduce the volume of contaminated soil at the site. Alternative 2 provides effective control and elimination in mobility and toxicity by removing the source of MC-contaminated soil from the MRS.

Short-Term Effectiveness

Soil excavation and off-site disposal could potentially have additive short-term impacts on the MRS. Potential short-term impacts may include increased traffic on public roads used by the haul trucks to transport excavated soil and backfill; however, these potential impacts are expected to be minimal and would not require extensive planning. MC-contaminated soil poses a low to moderate risk to the site workers during excavation activities. Appropriately trained personnel, safety procedures (i.e., air monitoring, dust control, erosion and sediment control), protective equipment, and approved planning documents would be used to reduce impacts on the workers, environment, and community. Time to complete this alternative may be dependent on characterization and confirmation sampling. The alternative duration is estimated to take approximately 11 days, the target excavation area is 0.146 acres, to a depth of 3 feet.

Implementability

Alternative 2 is considered relatively easy to implement technically, and moderately difficult to implement administratively. There is potential difficulty in finding a disposal facility that will accept the entire quantity of excavated material. Implementation of Alternative 2 requires approval and participation of the landowner. Therefore, ROE agreements would be required by PAARNG to access the property.

Cost

The cost estimates include the total cost for implementation of the residual small arms waste excavation and disposal. Detailed backup for the cost estimates is presented in **Appendix A**. The estimated cost for Alternative 2 is:

- Capital: $496,625
- O&M/Periodic: $0
- Total: **$496,625**
- Total PV: $496,625

4.2.3 Alternative 3 – Soil Stabilization and Excavation with Off-Site Disposal

Alternative 3 involves excavation at the MRS. Soil will be sampled and characterized to determine the waste classification, prior to excavation. Soil with lead concentrations above landfill disposal criteria will be stabilized by intermixing Portland cement and then re-characterized. If contaminant concentrations remain above landfill disposal criteria, additional treatment, sampling, and analysis will be completed. If, after multiple soil stabilization efforts, areas of soil remain above disposal criteria, then soil exceeding criteria from these areas will be disposed of at an approved RCRA Subtitle C disposal facility. This alternative is intended to achieve UU/UE.

Lead concentrations will be evaluated in the field using XRF. If XRF results indicate lead concentrations are above the field delineation value of 400 mg/kg, an additional 0.5 foot of soil will be removed, and the area will be re-evaluated by XRF. Once XRF results indicate the lead concentration is below 400 mg/kg, a discrete confirmation sample will be collected and submitted for laboratory analysis. It is expected that approximately four confirmation samples will be collected from distinct and separate areas within the Target Berm DU, and one confirmation sample will be collected from each half of the Firing Point DU, and Soil Pile DU (i.e. 2 samples per DU). Soil excavation and subsequent sampling and analysis will proceed until the results indicate the contaminant concentrations are below their established screening criteria. The parcel of land associated with the MRS footprint is privately owned. Approval from the property owner will be needed to implement of this remedy.

Threshold Criteria

This section presents the Threshold Criteria for Alternative 3.

Overall Protection of Human Health and the Environment

Alternative 3 reduces or eliminates potential human exposure to MC-contaminated soil by direct removal and disposal. The removal MC-contaminated soil effectively eliminates the exposure hazard to the potential human and ecological receptor.

Compliance with ARARs

Planning would be required to comply with chemical-specific, location-specific, and action-specific ARARs. ARARs identified included regulations on the transportation, storage, treatment, and disposal of lead contaminated soil. Soil will be excavated in accordance with applicable guidance documents.

Balancing Criteria

This section presents the Balancing Criteria for Alternative 3.

Long-Term Effectiveness and Permanence

Alternative 3 provides a high level of long-term effectiveness and permanence through the implementation and completion of soil excavation and disposal, and would immediately reduce the risks to acceptable levels for human receptors at the MRS.

Reduction of TMV through Treatment

Contaminated soil excavation and off-site disposal would immediately reduce the volume of contaminated soil at the site. Alternative 3 provides effective control and elimination in mobility and toxicity by stabilizing MC in the soil and removing the source of MC-contaminated soil from the MRS.

Short-Term Effectiveness

Soil excavation and off-site disposal could potentially have additive short-term impacts on the MRS. Potential short-term impacts may include increased traffic on public roads used by the haul trucks to transport excavated soil and backfill; however, these potential impacts are expected to be minimal and would not require extensive planning. MC-contaminated soil poses a low to moderate risk to the site workers during excavation activities. Appropriately trained personnel, safety procedures (i.e., air monitoring, dust control, erosion and sediment control), protective equipment, and approved planning documents would be used to reduce impacts on the workers, environment, and community. Time to complete this alternative may be dependent on characterization and confirmation sampling. The alternative duration is estimated to take approximately 12 days, the target excavation area is 0.146 acres, to a depth of 3 feet.

Implementability

Alternative 3 is considered relatively easy to implement technically and administratively. Implementation of Alternative 3 requires approval and participation of the landowner. Therefore, ROE agreements would be required by PAARNG to access the property.

Cost

The cost estimates include the total cost for implementation of the residual small arms waste excavation and disposal. Detailed backup for the cost estimates is presented in **Appendix A**. The estimated cost for Alternative 3 is:

- Capital: $389,108
- O&M/Periodic: $0
- Total: **$389,108**
- Total PV: $389,108

4.3 Comparative Analysis of Alternatives for MC-contaminated soil

The purpose of the comparative analysis is to evaluate the relative performance of all alternatives using the specific evaluation criteria for which they were analyzed individually in previous subsections. The regulatory and community acceptance criteria are excluded from the comparative analysis until formal comments are received on the FS and Proposed Plan.

This analysis is performed so that the advantages and disadvantages of the alternatives may be examined relative to each other and so that key differences in the alternatives may be identified, thus providing a framework for selection of an appropriate remedy for the site. The strengths and weaknesses of the alternatives relative to one another with respect to each criterion are presented in the following subsections. A discussion of how reasonable variations of key uncertainties could change the expectations of their relative performance is also presented. **Table 4-1** presents a visual representation of the comparative analysis.

TABLE 4-1
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR MC-CONTAMINATED SOIL
(PAE40-001-R-01 MRS)

Screening Criteria		Alternative 1 No Action	Alternative 2 Soil Excavation with Off-Site Disposal	Alternative 3 Soil Stabiliztion and Excavation with Off-Site Disposal
Threshold	Overall Protection of Human Health and the Environment	○	●	●
	Compliance with ARARs	○	●	●
Balancing	Long-Term Effectiveness	○	●	●
	Reduction of TMV Through Treatment	○	●	●
	Short-Term Effectiveness	●	●	●
	Implementability	●	◘	●
	Cost (x1,000)	$0	$497	$389
Modifying (a)	State Acceptance	TBD	TBD	TBD
	Community Acceptance	TBD	TBD	TBD

Notes:

(a) The Modifying criteria of state and community acceptance are ‘To Be Determined’ following review and input from these parties.

● Favorable (‘YES’ for threshold criteria)
◘ Moderately Favorable
○ Not Favorable (‘NO’ for threshold criteria)

ARAR = Applicable or Relevant and Appropriate Requirement
LUC = Land Use Control
MC = munitions constituents
TBD = To Be Determined
TMV = toxicity, mobility, or volume

This Page Intentionally Blank

4.3.1 Threshold Criteria

A comparative analysis of the two Threshold Criteria is presented below.

Overall Protection of Human Health and the Environment

Alternative 1 does not provide protection of human health. Alternatives 2 and 3 are protective of human health and the environment by reducing or eliminating the MC-contaminated soil from the MRS.

Compliance with ARARs

There are no ARARs associated with Alternative 1. The USEPA Regional Screening Level (RSL) for lead is 400 mg/kg. The RSL value is based on complete exposure pathways and is considered by USEPA to be protective for human receptors over a lifetime. MC-contaminated soil will remain in-situ for Alternative 1. Removal of MC-contaminated soil under Alternatives 2 and 3 would be performed to comply with all ARARs.

4.3.2 Balancing Criteria

A comparative analysis of these five Balancing Criteria is presented below.

Long-Term Effectiveness and Permanence

Alternative 1 would not be effective or permanent. Alternatives 2 and 3 offer long-term effectiveness and permanence because MC-contaminated soil is being removed from the MRS.

Reduction of TMV through Treatment

Alternative 1 will not reduce the TMV of MC-contaminated soil. Alternatives 2 and 3 would reduce the TMV of MC-contaminated soil through excavation, treatment, and disposal.

Short-Term Effectiveness

For Alternative 1, no removal actions would be implemented so there would be no short-term risks to the community or workers. Alternatives 2 and 3 pose a temporary higher potential risk to site workers from the handling of MC-contaminated soil during excavation. The worker exposure duration during for Alternatives 2 and 3 is estimated to be approximately 11 and 12 days, respectively.

Implementability

Alternative 1 would be implementable as it requires no action. Alternatives 2 and 3 require approval and participation of the landowner since the property is not owned by the U.S. Army. ROE agreements would be required to allow access to the property. This factor could impact the implementability of Alternatives 2 and 3. Alternative 2 requires approval and acceptance of all excavated material by a disposal facility. This factor could impact the implementability of Alternative 2.

Cost

The net PV costs for each remedial alternative are presented in **Table 4-2**. As shown in this table, Alternative 1 incurs no cost to implement while Alternative 2 would be the costliest to implement. The detailed cost estimate is presented in **Appendix A**.

4.3.3 State Acceptance

State acceptance will be assessed based on regulatory review of this FS and forthcoming PP. Modifying criteria (State and Community Acceptance) are considered in the remedy selection process.

4.3.4 Community Acceptance

Community acceptance cannot be assessed until public comments on the Proposed Plan are received. Modifying criteria (State and Community Acceptance) are considered in the remedy selection process.

TABLE 4-2
COST COMPARISON OF REMEDIAL ACTION ALTERNATIVES FOR MC-CONTAMINATED SOIL
(PAE40-001-R-01 MRS)

Cost	Alternative 1 No Action	Alternative 2 Soil Excavation with Off-Site Disposal	Alternative 3 Soil Stabilization and Excavation with Off Site Disposal
Capital	$0	$496,625	$389,108
O&M / Periodic	$0	$0	$0
Total	**$0**	**$496,625**	**$389,108**
Total Present Value	$0	$496,625	$389,108

Notes:
LUCs = Land Use Controls
MC = munitions constituents
O&M = operations and maintenance

This Page Intentionally Blank

5 References

AECOM 2019, *Final Remedial Investigation Report.* June 2019

AECOM, 2017. *Final Remedial Investigation Work Plan and UFP-QAPP, Ridgway Training Range, Pennsylvania*. June.

DoD. 2007. *Munitions Response Site Prioritization Protocol (MRSPP) Primer.* June 2007.

Earth Resources Technology, Inc., 2008. Draft Final Operational Range Assessment Program, Phase I Qualitative Assessment Report, Ridgway Training Site, March.

Pennsylvania Department of Military and Veterans Affairs (PADMVA), 2011. Ridgway Weekend Training Site (WETS) & Range, Environmental Baseline Survey Report (EBS). August.

Parsons Infrastructure and Technology (Parsons), 2012. *Final Pennsylvania Site Inspection Report,* Army National Guard Military Munitions Response Program, September.

U.S. Environmental Protection Agency (USEPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Office of Solid Waste and Emergency and Remedial Response, OSWER Directive 9234.1-01. August.

USEPA. 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. July.

This Page Intentionally Blank

Appendix A: Cost Estimates for Remedial Action Alternatives

This Page Intentionally Blank

TABLE A-1
COST COMPARISON OF REMEDIAL ACTION ALTERNATIVES FOR MC

Site:	**Ridgway Training Range (PAE-40-001-R-01)**	**2020**
Installation:	**NDNODS, Pennsylvania**	**06/23/2020**
Phase:	**Feasibility Study (-30% to +50%)**	

Description	**Alternative 1 No Action**	**Alternative 2 Soil Excavation with Off-Site Disposal**	**Alternative 3 Soil Stabilization and Excavation with Off-Site Disposal**
Total Project Duration (Years)	0	1	1
Capital Cost	$0	$496,625	$389,108
Total O&M/Periodic Cost	$0	$0	$0
Total Cost of Alternative[1]	**$0**	**$496,625**	**$389,108**
Total Present Value of Alternative	$0	$496,625	$389,108

Notes

[1]Cost estimates are developed in the FS primarily for the purpose of comparing remedial action alternatives, not for establishing project budgets.

TABLE A-2
ALTERNATIVE 2 - SOIL STABILIZATION AND EXCAVATION WITH OFF-SITE DISPOSAL

Alternative 2 - Soil Excavation with Off-Site Disposal

Site: Ridgway Training Range (PAE-40-001-R-01)
Installation: NDNODS, Pennsylvania
Phase: Feasibility Study (-30% to +50%)
Base Year 2020

Description: Includes completion of a Soil Removal Work Plan and Site Specific Final Report for PAE4-001-R-01. Includes excavation, transportation, and disposal of an estimated 707 BCY (1061 tons) of lead contaminated soil based on excavation over a 0.146 acre area to a depth of 3 feet. Includes the required field quality and safety equipment, including personal and area air monitors and an XRF for field screening. Includes transportation and disposal of the hazardous soil at a RCRA Subtitle C permitted landfill. Includes subcontractor oversight. Capital costs occur in Year 0 and there are no annual or periodic costs.

CAPITAL COSTS

Description	QTY	U/M	Unit Cost	Cost	Notes
Field Activities					
Hazardous Soil Transportation	1,061	Ton	$68	$72,148	Recent Sub Pricing
Hazardous Soil Disposal	1,061	Ton	$116	$123,076	Recent Sub Pricing
Hazardous Soil Removal	1	LS	$97,614	$97,614	See Table UCW-1
Pre and Post Topographic Surveys	2	Each	$2,585	$5,170	Recent Sub Pricing
Reporting					
Site-Specific Final Report	1	LS	$25,000	$25,000	
SUBTOTAL 1				$323,008	
Contingency	25%			$80,752	15% scope + 10% bid
SUBTOTAL 2				$403,760	
Project Management	8%			$32,301	
Remedial Design	15%			$60,564	
SUBTOTAL 3				$496,625	
TOTAL CAPITAL COST				**$496,625**	

PERIODIC COSTS	Unit Cost	Cost
TOTAL PERIODIC COST		**$0**

PRESENT VALUE ANALYSIS

Description	Year	Cost	Cost/Year	DF (1.5%)	Present Value	Notes
Capital Cost	0	$496,625	$496,625	1.000	$496,625.00	
		$496,625			$496,625.00	

TOTAL COST OF ALTERNATIVE **$496,625**

TOTAL PRESENT VALUE OF ALTERNATIVE **$496,625**

TABLE A-3
ALTERNATIVE 3 - SOIL STABILIZATION AND EXCAVATION WITH OFF-SITE DISPOSAL

Alternative 3 - Soil Stabilization and Excavation with Off-Site Disposal

Site: Ridgway Training Range (PAE-40-001-R-01)
Installation: NDNODS, Pennsylvania
Phase: Feasibility Study (-30% to +50%)
Base Year 2020

Description: Includes completion of a Soil Removal Work Plan and Site Specific Final Report for PAE4-001-R-01. Includes excavation, transportation, and disposal of an estimated 707 BCY of lead contaminated soil based on excavation over a 0.146 acres area to a depth of 3 feet. Includes stabilization of an estimated 688 BCY of lead contaminated soil based on excavation over a 0.142 acres area to a depth of 3 feet We assume that the excavated soil will require stabilization and will be done in three 12 inch deep passes. Includes the required field quality and safety equipment, including personal and area air monitors and an XRF for field screening. Includes transportation and disposal of the stabilized soil at a RCRA Subtitle D permitted landfill. Includes subcontractor oversight. Capital costs occur in Year 0 and there are no annual or periodic costs.

CAPITAL COSTS

Description	QTY	U/M	Unit Cost	Cost	Notes
Field Activities					
Soil Stabilization (Three 12" deep passes)	688	Sq Yd	$54.57	$37,544	RS Means
Soil Removal including T&D	1	LS	$185,364	$185,364	See Table UCW-2
Pre and Post Topographic Surveys	2	Each	$2,585	$5,170	Recent Sub Pricing
Reporting					
Site-Specific Final Report	1	LS	$25,000	$25,000	
SUBTOTAL 1				$253,078	
Contingency	25%			$63,270	15% scope + 10% bid
SUBTOTAL 2				$316,348	
Project Management	8%			$25,308	
Remedial Design	15%			$47,452	
SUBTOTAL 3				$389,108	
TOTAL CAPITAL COST				**$389,108**	

PERIODIC COSTS	Unit Cost	Cost
TOTAL PERIODIC COST		**$0**

PRESENT VALUE ANALYSIS

Description	Year	Cost	Cost/Year	DF (1.5%)	Present Value	Notes
Capital Cost	0	$389,108	$389,108	1.000	$389,108.16	
		$389,108			$389,108.16	

TOTAL COST OF ALTERNATIVE **$389,108**

TOTAL PRESENT VALUE OF ALTERNATIVE **$389,108**

TABLE UCW-1
SOIL REMOVAL, TRANSPORTATION, AND DISPOSAL

Capital Cost Sub-Element
Soil Removal, Transportation, and Disposal

UNIT COST WORKSHEET

Site: Ridgway Training Range (PAE-40-001-R-01)
Installation: NDNODS, Pennsylvania

Work Statement:

Unit cost is for soil removal of an estimated 1061 tons (0.146 acres x 3 feet deep) of contaminated soil. Assumes soil removal involves a subcontractor, a Geologist, and an Environmental Scientist for oversight/support. The soil will be transported and disposed of at a Subtitle C Landfill. Includes an estimated 375 tons per day for excavation and stockpile and 375 tons per day for backfill and compaction. Assumes three days awaiting results of the quick turn confirmation sampling.

Cost Analysis:

DESCRIPTION	QTY	U/M	UNIT COST	COST	NOTES
Labor					
Geologist	106	Hour	$117.05	$12,407	Nine 10-hr days, +2 travel days
Environmental Scientist	106	Hour	$94.38	$10,004	Nine 10-hr days, +2 travel days
Subtotal Labor Cost				**$22,411**	
ODCs/Subs					
XRF Confirmation Sampling	4	Week	$1,575.00	$6,300	Recent Sub Pricing
Air Monitoring / Dust Control	2	Week	$2,925.00	$5,850	Recent Sub Pricing
Rental Pickup	2	Week	$335.00	$670	
Mobilization	1	LS	$20,000.00	$20,000	Recent Sub Pricing
Erosion Controls	0.25	Acre	$3,500.00	$875	Recent Sub Pricing
Excavate and Load Soil	707	BCY	$10.45	$7,388	Recent Sub Pricing
Backfill, Compaction, and Grading	707	BCY	$20.00	$14,140	Recent Sub Pricing
Analytical Laboratory Sampling	1	LS	$5,000.00	$5,000	Recent Sub Pricing
Level D PPE	18	Day	$5.00	$90	
Subtotal ODC/Subs Costs				**$60,313**	
Prime Contractor Overhead and Profit	18%			**$14,890**	10% overhead + 8% profit
Lump Sum Price				**$97,614**	

Source of Cost Data:

Costs based on previous experience.

Cost Adjustment Checklist:

	FACTOR:	**NOTES:** The break down of the hourly rate is included on the Hourly Rate Derivation sheet.
✓	H&S Productivity (labor & equip only)	
✓	Escalation to Base Year	2019 is base year.
✓	Area Cost Factor	Costs are based on local quotes, historical data, and RS Means.
✓	Subcontractor Overhead and Profit	Included in cost.
✓	Prime Contractor Overhead and Profit	Included in cost.

TABLE UCW-2
SOIL REMOVAL, STABILIZATION, TRANSPORTATION, AND DISPOSAL

Capital Cost Sub-Element
Soil Removal, Stabilization, Transportation, and Disposal

UNIT COST WORKSHEET

Site: Ridgway Training Range (PAE-40-001-R-01)
Installation: NDNODS, Pennsylvania

Work Statement:

Unit cost is for soil removal of an estimated 707 BCY (0.146 acres x 3 feet deep) of contaminated soil. Assumes soil removal involves a subcontractor, a Geologist, and an Environmental Scientist for oversight/support. The soil will be transported and disposed of at a Subtitle D Landfill. Includes an estimated 250 BCY per day for excavation and stockpile and 250 BCY per day for backfill and compaction. Assumes 50% increase in weight from soil stabilization process. Assumes three days awaiting results of the quick turn confirmation sampling.

Cost Analysis:

DESCRIPTION	QTY	U/M	UNIT COST	COST	NOTES
Labor					
Geologist	116	Hour	$117.05	$13,577	Ten 10-hr days, +2 travel days
Environmental Scientist	116	Hour	$94.38	$10,948	Ten 10-hr days, +2 travel days
Subtotal Labor Cost				**$24,525**	
ODCs/Subs					
XRF Confirmation Sampling	4	Week	$1,575.00	$6,300	Recent Sub Pricing
Air Monitoring / Dust Control	2	Week	$2,925.00	$5,850	Recent Sub Pricing
Rental Pickup	2	Week	$335.00	$670	
Mobilization	1	LS	$20,000.00	$20,000	Recent Sub Pricing
Erosion Controls	0.25	Acre	$3,500.00	$875	Recent Sub Pricing
Excavate and Load Soil	707	BCY	$10.45	$7,388	Recent Sub Pricing
Backfill, Compaction, and Grading	707	BCY	$20.00	$14,140	Recent Sub Pricing
Transport and Dispose Soil	1,700	Ton	$42.50	$72,250	Recent Sub Pricing
Analytical Laboratory Sampling	1	LS	$5,000.00	$5,000	Recent Sub Pricing
Level D PPE	18	Day	$5.00	$90	
Subtotal ODC/Subs Costs				**$132,563**	
Prime Contractor Overhead and Profit	18%			**$28,276**	10% overhead + 8% profit
Lump Sum Price				**$185,364**	

Source of Cost Data:

Costs based on previous experience.

Cost Adjustment Checklist:

	FACTOR:	**NOTES:** The break down of the hourly rate is included on the Hourly Rate Derivation sheet.
✓	H&S Productivity (labor & equip only)	
✓	Escalation to Base Year	2020 is base year.
✓	Area Cost Factor	Costs are based on local quotes, historical data, and RS Means.
✓	Subcontractor Overhead and Profit	Included in cost.
✓	Prime Contractor Overhead and Profit	Included in cost.

HOURLY RATES DERIVATION

FIELD CREW HOURLY RATES — COST BACKUP SHEET 1

Geologist			Environmental Scientist		
Hourly Rate	$	90.97	Hourly Rate	$	68.30
Elk Co. Per Diem Per Day	$	149.00	Elk Co. Per Diem Per Day	$	149.00
40 HR Week	$	3,638.80	40 HR Week	$	2,732.00
Per Diem 7 Days	$	1,043.00	Per Diem 7 Days	$	1,043.00
Weekly Total	$	4,681.80	Weekly Total	$	3,775.00
Hourly rate (including Per Diem)	$	117.05	Hourly rate (including Per Diem)	$	94.38

Appendix B: Munitions Response Site Prioritization Protocol

This Page Intentionally Blank

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: Ridgway Training Range (PAE40-001-R-01)

Component: Army National Guard Directorate

Installation/Property Name: JFHQ Pennsylvania

Location (City, County, State): Ridgway Township, Elk County, Pennsylvania

Site Name/Project Name (Project No.): Ridgway Training Range Remedial Investigation

Date Information Entered/Updated: 11 October 2018

Point of Contact (Name/Phone): Dave Connolly (ARNG), (703)607-7589

Project Phase (check only one):

❑ PA	❑ SI	☑ RI	❑ FS	❑ RD
❑ RA-C	❑ RIP	❑ RA-O	❑ RC	❑ LTM

Media Evaluated (check all that apply):

❑ Groundwater	☑ Sediment (human receptor)
☑ Surface soil	❑ Surface Water (ecological receptor)
☑ Sediment (ecological receptor)	❑ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:

The NDNODS Ridgway Training Range MRS is a 0.22-acre site used by the PAARNG for live-fire weapons training from 1987 to 2005. Weapons training was conducted within the enclosed 25 Meter Outdoor Baffle M-16 Rifle Range. Support structures on the range included a block target storage building, a downrange backstop, and a shelter building over the 12 firing positions protecting the soldiers from the weather. The firing points were recessed into the ground surface via culvert type material. Wooden covers enclosed the firing positions. The range configuration consisted of 12-foot high concrete side and impact walls (original construction). Documentation specifying the exact munitions used was not found; however, based on range type, timeframe of range use, and location, AECOM surmised that the following munitions were fired: .22 caliber, .38 caliber, .45 caliber, .50 caliber, 9 millimeter (mm), 5.56mm, and 7.62mm. (continued next page)

Transfer of the property to a private owner was completed in 2015. To improve drainage in front of the target berm at the MRS, the landowner installed a French drain parallel to the berm. Soil excavated during construction of the berm is stored in a pile within the MRS walls.

Description of Pathways for Human and Ecological Receptors:

MC within soil at the MRS is anticipated to remain at the Target Berm, Firing Point, Soil Pile, and French Drain Outfall and not be transported off site. Exposure pathways between MC and receptors are restricted to source areas, which is potentially the soil at the Target Berm, the Firing Point, and the Soil Pile, and sediment at the French Drain Outfall. Particulates from the berm are being transported, via the French drain, to the ponded area (French Drain Outfall) to the north of the MRS. Since the drain discharges to a ponded area, it is expected that particulates settle in the small detention pond and receptors are only potentially exposed to sediment in this area. A drainage ditch south of the MRS abuts the southern end of the Target Berm which extends beyond the southern MRS wall, and there is potential for runoff to enter the drainage ditch; however, sample data indicates that MC are not being transported throughout the drainage ditch. The drainage ditch is intermittently inundated, but potentially confluences with a wetland in the southeast portion of the MRS when flowing. The MRS walls prevent soil particles from the Target berm within the MRS walls from being transported off-site to the east. Evidence of erosion is present on the center of the Target Berm, but the MRS walls prevent soil particles from the center of the Target Berm from being transported off-site to the east. MC deposited in the Soil Pile have limited potential to migrate due to the pile's location within the MRS walls.

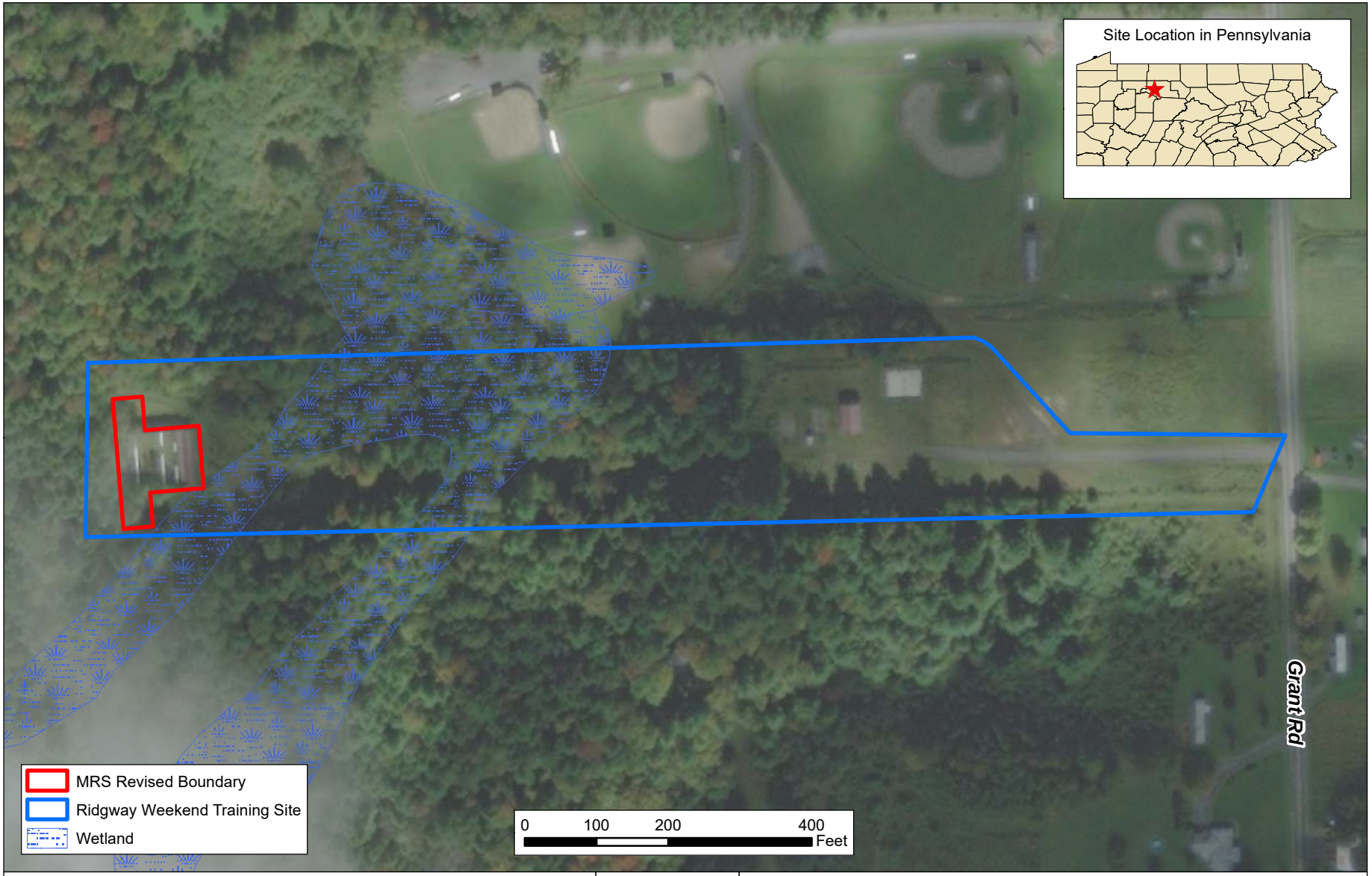
Antimony, copper, lead, and zinc have a strong affinity to sorb to soil particles, particularly soils that are rich in organic matter, and usually only migrate via physical transport pathways. Because of these chemical properties, they typically do not leach to groundwater except where shallow groundwater exists less than 5 feet below ground surface (bgs). According to the 2011 Environmental Baseline Survey, existing boring logs from wells in the area show depths to bedrock varying from 10 to 33 feet (see Cross Section A-A' of ***Figure 10-1*** *of the UFP-QAPP [AECOM, 2017]). Therefore, groundwater pathways are incomplete for the Ridgway Training Range MRS. Because explosives (e.g. nitroglycerin) are organic compounds, they also are subject to biological or chemical degradation over time, which results in these compounds being less persistent in the environment than MC metals.*

MC may be transported to the ponded area where the French drain daylights and the drainage ditch south of the MRS. Exposure pathways between MC and receptors are restricted to source areas, which are the Target Berm, Firing Point, and Soil Pile, as well as the French Drain Outfall and the drainage ditch south of the MRS.

Description of Receptors (Human and Ecological):

*The area surrounding the MRS is predominantly rural; the properties surrounding the MRS include agricultural, mining, residential, and recreational land (****Figure 2-1*** *of the RI Report). A community baseball/athletic is north of the property. The property is privately owned, and the property is used as a staging area by a landscaping company. Future use is planned to be the same. Access to the MRS is mostly restricted via a locked gate, so the public does not have access to the site. Potential human receptors include the landowner and visitors or workers (e.g., construction, commercial/industrial) that the landowner allows on site. As there is no restriction on the land, there is potential that the site could be used for residential purposes in the future.*

There is no federally designated critical habitat located within the site; however, habitat supporting ecological receptors is present within the MRS. A portion of a wetland is present within the MRS that could provide habitat for aquatic species, and some preferential habitat quality exists in the areas surrounding the MRS. Although no federally designated critical habitat is located within the MRS, Pennsylvania State-endangered species have the potential to exist at or in the vicinity of the MRS. Many of these species will not be found on or near the MRS; a list of species and their preferred habitat is listed in Table 2-1 of the RI report to help determine the likelihood of each species being present.



CLIENT	Army National Guard			
PROJECT	Feasibility Study through DD for Ridgway Traning Site, PA MRS			
REVISION NO	0	GIS BY	MS	10/16/2019
SCALE	1:2,400	CHK BY	AS	10/16/2019
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community		PM	RG	10/16/2019

TITLE

Ridgway Training Range Site Layout

AECOM
12420 Milestone Center Drive
Germantown, MD 20876

Figure C-1

\\USGRM2PFPSW001.services.egginc.com\60519685-GRM2\900-Work\GIS\Ridgway\1_MXD\FS\Fig_1-2_Ridgway_SiteLayout.mxd

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	• UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). • Hand grenades containing energetic filler. • Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30

High explosive (used or damaged)	• UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive."
	• DMM containing a high-explosive filler that have:
	  • Been damaged by burning or detonation
	  • Deteriorated to the point of instability.
		25

Pyrotechnic (used or damaged)	• UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades).
	• DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have:
	  • Been damaged by burning or detonation
	  • Deteriorated to the point of instability.
		20

High explosive (unused)	• DMM containing a high-explosive filler that:
	  • Have not been damaged by burning or detonation
	  • Are not deteriorated to the point of instability.
		15

Propellant	• UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor).
	• DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are:
	  • Damaged by burning or detonation
	  • Deteriorated to the point of instability.
		15

Bulk secondary high explosives, pyrotechnics, or propellant	• DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). • DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10

Pyrotechnic (not used or damaged)	• DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that:
	  • Have not been damaged by burning or detonation
	  • Are not deteriorated to the point of instability.
		10

Practice	• UXO that are practice munitions that are not associated with a sensitive fuze.
	• DMM that are practice munitions that are not associated with a sensitive fuze and that have not:
	  • Been damaged by burning or detonation
	  • Deteriorated to the point of instability.
		5

Riot control	• UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	• Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	**2**
Evidence of no munitions	• Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	2

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

The 2012 SI report reported there was no evidence of MEC at this MRS (RI report, Section 2.2.2). During the RI, no evidence of MEC was observed at this site; a 5.56mm caliber bullet was observed during RI field work on the ground surface at the Firing Point; no evidence of munitions was observed at the Target Berm, Soil Pile, or French drain area.

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	• The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	10
Former munitions treatment (i.e., OB/OD) unit	• The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	• The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	• The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	• The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	5
Former industrial operating facilities	• The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	• The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	• The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	• The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	• The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	**1**
Evidence of no munitions	• Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

During the RI, no evidence of MEC was observed at this MRS a 5.56mm caliber bullet was observed during RI field work on the ground surface at the Firing Point; no evidence of munitions was observed at the Target Berm, Soil Pile, or French drain area.

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	• Physical evidence indicates that there are UXO or DMM on the surface of the MRS. • Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	• Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. • Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	• Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. • Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	• There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	• There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	• There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	• The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	**1**
Evidence of no munitions	• Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

During the RI, no evidence of MEC was observed at this site; a 5.56mm caliber bullet was observed during RI field work on the ground surface at the Firing Point (RI report, Section 5.3); no evidence of munitions was observed at the Target Berm, Soil Pile, or French drain area. Analytical results from the RI showed elevated levels of small arms metals MC in the Target Berm, Soil Pile, and French Drain soil and sediment compared to background and elevated levels of nitroglycerin in the Firing Point soil compared to background (RI report, Section 5).

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	• There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	• There is a barrier preventing access to parts of the MRS, but not the entire MRS.	8
Barrier to MRS access is complete but not monitored	• There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	**5**
Barrier to MRS access is complete and monitored	• There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

Access to the MRS is restricted via a locked gate (RI report, Section 2.3).

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	• The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. • The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	**5**
Scheduled for transfer from DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The MRS is a NDNODS Site that contains one parcel of land. The MRS is entirely privately owned by Steve Lawrie (RI report, Section 2.2).

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	• There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	• There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	• There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	**1**
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	1

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

The MRS is a small 0.22-acre tract of land that is surrounded by predominantly rural areas. According to the 2010 US Census for Pennsylvania, the Ridgway Township has a population density of 29.0 per square mile.

Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	• There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	**5**
16 to 25 inhabited structures	• There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	• There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	• There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	• There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	• There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

The MRS is a small 0.22-acre tract of uninhabited land that is comprised of that does not contain any habitable structures. More than 26 inhabited structures are located within a two-mile radius of the MRS.

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	**5**
Parks and recreational areas	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	• There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

The MRS is currently used for the staging of landscaping equipment. Land uses of properties surrounding the site include recreational, agricultural, residential, and mining. Located on the site's northern boundary is a community baseball/athletic field (RI Report, Section 2.1).

Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	• There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	• There are ecological resources present on the MRS.	3
Cultural resources present	• There are cultural resources present on the MRS.	**3**
No ecological or cultural resources present	• There are no ecological resources or cultural resources present on the MRS.	0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

*There are no known cultural resources located within the MRS. There are no documented occurrences of federally listed threatened and endangered species or federally-designated critical habitat on the MRS. A portion of a wetland is located within the MRS, providing habitat for aquatic species (RI Report, Section 2.1; RI Report **Figure 2-1**).*

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	2	3
Source of Hazard	Table 2	1	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	1	11
Ease of Access	Table 4	5	
Status of Property	Table 5	5	
Receptor Factor Data Elements			
Population Density	Table 6	1	14
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	3	
EHE MODULE TOTAL			28

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	**G**
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	**No Known or Suspected Explosive Hazard**

As small arms are the only munitions known to have been used on the MRS, small arms do not present a unique explosive hazard [Army Guidance SAIE (ESOH) Memorandum February 2009], therefore the MRS does not present a unique explosive hazard. Accordingly, the EHE module has been rated “No Known or Suspected Explosive Hazard”.

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: • CWM that are UXO (i.e., CWM/UXO) • Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	• The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	• The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: • Non-explosively configured CWM/DMM either damaged or undamaged • Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	• The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	• CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	• Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	**0**
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

The 2012 SI and Historical Records Review determined that there was no evidence of MEC or CWM at the MRS (RI report, Section 2.4).

Tables 12 through 19 are Intentionally Omitted According to Army Guidance

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	0	
Accessibility Factor Data Elements			
Location of CWM	Table 13	0	0
Ease of Access	Table 14	0	
Status of Property	Table 15	0	
Receptor Factor Data Elements			
Population Density	Table 16	0	0
Population Near Hazard	Table 17	0	
Types of Activities/Structures	Table 18	0	
Ecological and/or Cultural Resources	Table 19	0	
CHE MODULE TOTAL			0

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	**No Known or Suspected CWM Hazard**

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Media Not Evaluated			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	**H (High)**		
100 > CHF > 2	**M (Medium)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Groundwater MC Hazard ☑

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Media Not Evaluated			

CHF Scale	CHF Value	Sum The Ratios	
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ☑

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	0.966	880	0.00109
Copper	79.7	81000	0.00098
Lead	358	5000	0.0716
Zinc	74.9	660000	0.00011
CHF Scale	**CHF Value**	**Sum The Ratios**	0.0826
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **<u>the single highest value</u>** from above in the box to the right (maximum value = H).	M

No Known or Suspected Sediment (Human Endpoint) MC Hazard ☐

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Media Not Evaluated			
CHF Scale	**CHF Value**	**Sum the Ratios**	
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ☑

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Antimony	0.966	2	0.483
Copper	79.7	31.6	2.522
Lead	358	35.8	10
Zinc	74.9	121	0.619
CHF Scale	**CHF Value**	**Sum the Ratios**	13.624
CHF > 100	**H (High)**	$CHF = \sum$ [Maximum Concentration of Contaminant] / [Comparison Value for Contaminant]	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	H

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ☐

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Antimony	1080	3.1	348.38
Copper	2060	310	6.64
Lead	57200	400	143
Zinc	443	2,300	0.19
Nitroglycerin	4.4	0.63	6.98
CHF Scale	**CHF Value**	**Sum the Ratios**	505.19
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		H

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	**M**
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	**M**
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Surface Soil MC Hazard ❑

Tables 27 is Intentionally Omitted
According to Army Guidance

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)					
Surface Water/Human Endpoint (Table 22)					
Sediment/Human Endpoint (Table 23)	L	L	M	L-L-M	F
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)	M	H	M	M-H-M	C
Surface Soil (Table 26)	H	M	M	H-M-M	C

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	C

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	**C**
HMM	
HML	D
MMM	
HLL	E
MML	
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	**C**	**4**
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	**8**			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		**No Known or Suspected CWM Hazard**		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				**4**	