

**Final
Proposed Plan for
RVAAP-060-R-01 Block D Igloo Munitions Response Site
Version 1.0**

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

**Contract No. W912DR-15-D-0016
Delivery Order No. 0001**

Prepared for:



**US Army Corps
of Engineers®**

**U.S. Army Corps of Engineers
Baltimore District
2 Hopkins Plaza
Baltimore, Maryland 21201**

Prepared by:

**HydroGeoLogic, Inc. (HGL)
11107 Sunset Hills Road
Suite 400
Reston, Virginia 20190**

December 19, 2018

This page was intentionally left blank.

REPORT DOCUMENTATION PAGE

*Form Approved
OMB No. 0704-0188*

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Executive Service Directorate (0704-0188). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ORGANIZATION.

| | | | | | |
|--|-----------------------------|--|--|---|--|
| 1. REPORT DATE (DD-MM-YYYY) 12-26-18 | | 2. REPORT TYPE Proposed Plan | | 3. DATES COVERED (From - To) August 2016 to December 2019 | |
| 4. TITLE AND SUBTITLE Final Proposed Plan for RVAAP-060-R-01 Block D Igloo Munitions Response Site | | | | 5a. CONTRACT NUMBER W912DR-15-D-0016, Delivery Order 0001 | |
| | | | | 5b. GRANT NUMBER NA | |
| | | | | 5c. PROGRAM ELEMENT NUMBER NA | |
| 6. AUTHOR(S) Kimberly Vaughn, PG, HydroGeoLogic, Inc. (HGL) Emily Justice | | | | 5d. PROJECT NUMBER NA | |
| | | | | 5e. TASK NUMBER NA | |
| | | | | 5f. WORK UNIT NUMBER NA | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) HGL 11107 Sunset Hills Rd, Suite 400 Reston, VA 20190 | | | | 8. PERFORMING ORGANIZATION REPORT NUMBER NA | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers, North Atlantic Division, Baltimore District 2 Hopkins Plaza Baltimore, MD 21201 | | | | 10. SPONSOR/MONITOR'S ACRONYM(S) USACE | |
| | | | | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) NA | |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT Reference distribution page | | | | | |
| 13. SUPPLEMENTARY NOTES None | | | | | |
| 14. ABSTRACT The U.S. Department of the Army (U.S. Army) is presenting this Final Proposed Plan to involve the public in the remedy selection process for the Block D Igloo Munitions Response Site RVAAP-060-R-01, within the former Ravenna Army Ammunition Plant located in Portage and Trumbull Counties, Ohio. This Proposed Plan presents the U.S. Army's preferred alternative of Surface and Subsurface Removal for addressing the munitions at the MRS. This alternative is presented for public consideration as the alternative that meets threshold criteria and provides protection to receptors. | | | | | |
| 15. SUBJECT TERMS | | | | | |
| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT SAR | 18. NUMBER OF PAGES 60 | 19a. NAME OF RESPONSIBLE PERSON Kimberly Vaughn |
| a. REPORT U | b. ABSTRACT U | c. THIS PAGE U | | | 19b. TELEPHONE NUMBER (Include area code) 512-658-6828 |

Reset

This page was intentionally left blank.



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

January 24, 2019

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

**Re: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Plans
Remedial Response
Portage County
267000859241**

Subject: Receipt and Review of the "Final Proposed Plan for RVAAP-060-R-01 Block D Igloo Munitions Response Site, Version 1.0" Dated December 19, 2018 (Work Activity No. 267000859241)

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the "Final Proposed Plan for RVAAP-060-R-01 Block D Igloo Munitions Response Site, Version 1.0" dated December 19, 2018. This document received by Ohio EPA's NEDO on January 11, 2019, was prepared by HydroGeoLogic, Inc. as a result of the investigation completed under the Army's munitions response program.

Based on the information contained in the Final Proposed Plan (PP) and other investigation documents/reports, Ohio EPA concurs with the preferred alternative of surface and subsurface removal for addressing the munitions at the RVAAP-060-R-01 Block D Igloo Munitions Response Site. As stated in the PP, the Army will offer a public comment period between March 1 and April 3, 2019, and hold an open house/public meeting on March 6, 2019. This is required prior to the submittal of the Record of Decision.

If you have any questions or concerns, please do not hesitate to contact Nicholas Roope at (330) 963-1235.

Sincerely,

A handwritten signature in blue ink that reads "James Sferra".

James Sferra
Chief
Division of Environmental Response and Revitalization

RECEIVED
JAN 24 2019

JS/NCR/nvp

ec: Nat Peters, USACE
Craig Coombs, USACE
Bob Princic, Ohio EPA, NEDO, DERR
Nicholas Roope, Ohio EPA, NEDO, DERR
Katie Tait/Kevin Sedlak, OHARNG RTLS
Rebecca Shreffler, Chenega
Mark Johnson Ohio EPA, NEDO, DERR
Tom Schneider, Ohio EPA, SWDO, DERR

This page was intentionally left blank.

CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

HydroGeoLogic, Inc., has completed the *Final Proposed Plan for RVAAP-060-R-01 Block D Igloo Munitions Response Site, Version 1.0*, at the former Ravenna Army Ammunition Plant in Portage and Trumbull Counties, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy, principles, and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets customer's needs consistent with law and existing United States Army Corps of Engineers policy.

Prepared/Approved by: 

Timothy Leahy
Project Manager
APTIM Federal Services LLC

Date: December 19, 2018

Reviewed/Approved
by: 

Kimberly Vaughn
Project Manager
HydroGeoLogic, Inc.

Date: December 19, 2018

This page was intentionally left blank.

DOCUMENT DISTRIBUTION

Final Proposed Plan for RVAAP-060-R-01 Block D Igloo Munitions Response Site, Version 1.0

| Name/Organization | Number of Printed Copies | Number of Electronic Copies |
|--|-----------------------------|--------------------------------|
| David Connolly, ARNG Restoration Program Manager | 0 | 1 |
| Kevin Sedlak, ARNG Restoration Project Manager, ARNG – IED | 0 | 1 |
| Katie Tait, Environmental Specialist, OHARNG | 0 | 1 |
| Craig Coombs, USACE Louisville District Project Manager | 0 | 1 |
| Travis McCoun, USACE Baltimore District COR | 0 | 1 |
| Nicholas Roope, Site Coordinator, Ohio Environmental Protection Agency | 1 | 1 |
| Mark Johnson, Project Manager, Ohio Environmental Protection Agency | 0 | Email/Transmittal Letter |
| Tom Schneider, Ohio Environmental Protection Agency, Federal Facilities | 0 | 1 |
| Gail Harris, RVAAP Administrative Records Manager | 2 | 2 |

ARNG – Army National Guard

COR – Contracting Officer's Representative

IED – Installation and Environmental Division

OHARNG – Ohio Army National Guard

RVAAP – Former Ravenna Army Ammunition Plant

USACE – United States Army Corps of Engineers

This page was intentionally left blank.

TABLE OF CONTENTS

SF-298 FORM

OHIO EPA CONCURRENCE LETTER

CONTRACTOR’S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

DOCUMENT DISTRIBUTION

TABLE OF CONTENTS i

ACRONYMS AND ABBREVIATIONS.....iii

1.0 INTRODUCTION..... 1

2.0 FACILITY AND MRS BACKGROUND .. 1

2.1 Facility History..... 1

2.2 MRS Background and History 3

2.2.1 Archives Search Report 3

2.2.2 Historical Records Review 4

2.2.3 Site Inspection 4

2.3 Remedial Investigation..... 5

2.4 Feasibility Study..... 5

3.0 MRS CHARACTERISTICS 6

3.1 Physical Characteristics and Land Use..... 6

3.2 Applicable or Relevant and Appropriate Requirements 6

3.3 Nature and Extent of Contamination..... 7

3.3.1 Munitions and Explosives of Concern..... 7

3.3.2 MC-Related Contamination..... 7

4.0 SCOPE AND ROLE OF RESPONSE ACTION..... 7

5.0 SUMMARY OF MRS RISKS 8

5.1 Receptors..... 8

5.2 MEC Exposure Pathways..... 9

5.3 MC-Related Contamination Exposure Pathways..... 9

6.0 REMEDIAL ACTION OBJECTIVES..... 9

7.0 SUMMARY OF REMEDIAL ALTERNATIVES 9

7.1 No Action..... 9

7.2 Land Use Controls..... 10

7.3 Surface Removal and LUCs 11

7.4 Surface and Subsurface Removal 13

8.0 EVALUATION OF ALTERNATIVES.... 14

8.1 Comparative Analysis of Alternatives..... 15

8.2 Overall Evaluation..... 17

9.0 PREFERRED ALTERNATIVE 18

9.1 Summary Statement 18

10.0 COMMUNITY PARTICIPATION 18

10.1 Public Comment Period 19

10.2 Public Meeting 19

10.3 Written Comments 19

10.4 Army Review of Public Comments..... 19

GLOSSARY OF TERMS 21

REFERENCES29

LIST OF TABLES

Table 1 Components of Remedial Alternatives .. 10

Table 2 CERCLA Evaluation Criteria 15

LIST OF FIGURES

Figure 1 Installation Location Map 33

Figure 2 MRS Location Map..... 35

Figure 3 SI MRS Boundaries Map 37

Figure 4 Post-SI MRS Boundaries Map 39

Figure 5 Post-RI MRS Boundaries Map..... 41

Figure 6 Chain-Link Fence Location..... 43

Figure 7 Siebert Stake and Sign Locations..... 45

This page was intentionally left blank.

ACRONYMS AND ABBREVIATIONS

| | | | |
|------------------|---|----------|--|
| AOC | Area of Concern | HGL | HydroGeoLogic, Inc. |
| ARAR | applicable or relevant and appropriate requirement | HRR | <i>Final Military Munitions Response Program Historical Records Review</i> |
| Army | U.S. Department of the Army | IED | Installation and Environmental Division |
| ARNG | Army National Guard | ISM | Incremental Sampling Methodology |
| ASR | <i>Archives Search Report for the Ravenna Army Ammunition Plant</i> | lb | pound |
| bgs | below ground surface | LUC | land-use control |
| BIP | blow in-place | MC | munitions constituents |
| CB&I | CB&I Federal Services LLC | MD | munitions debris |
| Camp Ravenna | Camp Ravenna Joint Military Training Center | MEC | munitions and explosives of concern |
| CERCLA | <i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i> | MEC HA | MEC Hazard Assessment |
| COR | Contracting Officer's Representative | MFD-H | maximum fragmentation distance-horizontal |
| CTT | Closed, Transferring, and Transferred | MMRP | Military Munitions Response Program |
| DA | U.S. Department of the Army | MRS | Munitions Response Site |
| DFFO | <i>Director's Final Findings and Orders for RVAAP</i> | NCP | <i>National Oil and Hazardous Substances Pollution Contingency Plan</i> |
| DoD | U.S. Department of Defense | OHARNG | Ohio Army National Guard |
| e ² M | engineering-environmental Management, Inc. | Ohio EPA | Ohio Environmental Protection Agency |
| Final FS | <i>Final Feasibility Study for RVAAP-060-R-01 Block D Igloo Munitions Response Site</i> | RAO | remedial action objective |
| Final RI Report | <i>Final Remedial Investigation Report for RVAAP-060-R-01 Block D Igloo Munitions Response Site</i> | RI | Remedial Investigation |
| Final SI Report | <i>Final Remedial Investigation Report for RVAAP-060-R-01 Block D Igloo Munitions Response Site</i> | ROD | Record of Decision |
| FS | Feasibility Study | RVAAP | Ravenna Army Ammunition Plant |
| | | SI | Site Inspection |
| | | TBC | To-Be Considered |
| | | TNT | 2,4,6-Trinitrotoluene |
| | | U.S. | United States |
| | | USACE | U.S. Army Corps of Engineers |

ACRONYMS AND ABBREVIATIONS

| | |
|--------|--|
| USP&FO | U.S. Property and Fiscal Officer for Ohio |
| UU/UE | unlimited use/unrestricted exposure |
| UXO | unexploded ordnance |

1.0 INTRODUCTION

The United States (U.S) Department of the Army (Army or DA) is presenting this **Proposed Plan*** to involve the public in the **alternative selection process** for the RVAAP-060-R-01 Block D Igloo **Munitions Response Site** (MRS) at the former Ravenna Army Ammunition Plant (RVAAP). The former RVAAP is located in Portage and Trumbull Counties, Ohio, as shown on **Figure 1**. The location of the MRS relative to the former RVAAP is shown on **Figure 2**.

The Army, in consultation with the Ohio Environmental Protection Agency (Ohio EPA), is the lead agency for investigating, reporting, making **remedial decisions**, and taking **remedial actions** at the former RVAAP. This Proposed Plan presents the Army's preliminary recommendations concerning how best to address **U.S. Department of Defense (DoD) military munitions** that are suspected to be present on the ground surface and in the subsurface at the Block D Igloo MRS. The various alternatives evaluated to address the potential for DoD military munitions and the Army's rationale for recommending the stated **Preferred Alternative** is included in this Proposed Plan.

The Army is issuing this Proposed Plan to address its public participation responsibilities under Section 117(a) of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980** (CERCLA), as amended by the **Superfund Amendments and Reauthorization Act of 1986** and Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan** (NCP) (40 Code of Federal Regulations 300). Implementation of the selected alternative at the MRS will comply with the requirements of the **Director's Final Findings and Orders (DFFO) for RVAAP** (Ohio EPA, 2004).

*Terminology used in this Proposed Plan is defined in the Glossary found at the back of this document.

This Proposed Plan summarizes information that can be found in the *Final Remedial Investigation Report for RVAAP-019-R-01 Landfill North of Winklepeck MRS and RVAAP-060-R-01 Block D Igloo MRS* (Final **Remedial Investigation** [RI] Report; CB&I Federal Services LLC [CB&I], 2015) and the *Final Feasibility Study for RVAAP-060-R-01 Block D Igloo Munitions Response Site, Version 1.0* (Final **Feasibility Study** [FS]) (HydroGeoLogic, Inc. [HGL], 2018). The Army encourages the public to review these documents to better understand the history of the MRS, activities that have been conducted there, and determinations that have been made for the MRS under the **Military Munitions Response Program** (MMRP).

The Army, in consultation with the Ohio EPA, will review and consider all comments on this Proposed Plan received during the 30-day public comment period. The public is encouraged to review and comment on all recommendations presented in this Proposed Plan.

2.0 FACILITY AND MRS BACKGROUND

This section summarizes the history of the Former RVAAP and the Block D Igloo MRS.

2.1 Facility History

The former RVAAP (Federal Facility ID No. OH213820736), now known as the Camp Ravenna Joint Military Training Center (Camp Ravenna), is located in northeastern Ohio within Portage and Trumbull Counties and is approximately 3 miles east-northeast of the city of Ravenna. The federally owned facility, approximately 11 miles long and 3.5 miles wide, is bounded by a Norfolk Southern railroad line to the north; State Route 5, the Michael J. Kirwan Reservoir, and a CSX railroad line to the south; State Route 534 to the east; and Garret, McCormick, and Berry Roads to the west. The facility is surrounded by the communities of Windham, Garrettsville, Newton Falls, Charlestown, and Wayland.

Public Comment Period:

March 1 to April 3, 2019

Public Meeting:

The Army will hold an open house/public meeting to explain the Proposed Plan. Oral and written comments on the document will be accepted at the meeting. The open house/public meeting is scheduled for 6:00 p.m. on March 6, 2019, at the Charlestown Town Hall, 6368 Rock Spring Road, Ravenna, Ohio 44266.

Information Repositories:

Information used in selecting the Preferred Alternative is available online at www.rvaap.org and at the following locations:

Reed Memorial Library

167 East Main Street
Ravenna, Ohio 44266
(330) 296-2827

Hours of Operation:

9 a.m.–8 p.m., Monday–Thursday
9 a.m.–6 p.m., Friday
9 a.m.–5 p.m., Saturday
1 p.m.–5 p.m., Sunday

Newton Falls Public Library

204 South Canal Street
Newton Falls, Ohio 44444
(330) 872-1282

Hours of Operation:

9 a.m.–8 p.m., Monday–Thursday
9 a.m.–5 p.m., Friday and Saturday

The **Administrative Record** File, which includes the information used to select the Preferred Alternative, is available for review at the following location:

Camp Ravenna Joint Military Training Center

Environmental Office
1438 State Route 534
Newton Falls, Ohio 44444
(614) 336-6136

Note: Access to Camp Ravenna is restricted but an appointment to review the Administrative Record File can be scheduled.

Administrative control of the 21,683-acre facility has been transferred to the United States Property and Fiscal Officer for Ohio (USP&FO) and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a training site, Camp Ravenna. The restoration program for the facility involves the remediation of areas affected by past activities of the former RVAAP.

The former RVAAP was constructed in 1940 and 1941 for assembly/loading and **depot storage** of ammunition. While serving as an ammunition plant, the former RVAAP was a U.S. Government-owned and contractor-operated industrial facility. The ammunition plant consisted of 12 munitions assembly facilities, referred to as “load lines.” Load Lines 1 through 4 were used to melt and load **2,4,6-Trinitrotoluene** (TNT) and Composition B (a mixture of TNT and **Research Department Explosive** into **large-caliber shells** and bombs. Operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. After cleaning, the “pink water” wastewater, which contained TNT and Composition B, was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to **earthen settling ponds**. Load Lines 5 through 11 manufactured **fuzes, primers, and boosters**. From 1946 to 1949, Load Line 12 produced **ammonium nitrate** for explosives and fertilizers; subsequently it was used as a **weapons demilitarization facility**.

In 1950, the facility was placed in standby status, and operations were limited to **renovation, demilitarization,** and normal maintenance of equipment, along with storage of munitions. **Production** activities were resumed from July 1954 to October 1957 and again from May 1968 to August 1972. Demilitarization and production activities were conducted at Load Lines 1, 2, 3, and 12. Demilitarization activities included disassembling munitions and melting out and recovering explosives using hot water and

steam processes. These activities continued through 1992.

In addition to production and demilitarization activities at the load lines, other facilities at the former RVAAP included areas used for the burning, demolition, and testing of munitions. These burning and demolition grounds consisted of large, open areas and abandoned quarries. Other **Areas of Concern** (AOCs) at the former RVAAP include landfills, an aircraft fuel tank testing area, and various industrial support and maintenance facilities.

2.2 MRS Background and History

The "D" Block **storage bunkers** (igloos) are located in the north-central portion of Camp Ravenna within Portage County. On March 24, 1943, 2,516 clusters of M-41 20-pound (lb) **fragmentation bombs** exploded in Igloo 7-D-15 during loading into the bunker for storage. The explosion was reported to have been caused by rough handling and the faulty design of the M-110 fuze. At the time of the incident, Igloo 7-D-15 was 95 percent full.

The 60-foot-long igloo was constructed of reinforced concrete with a steel door. The bunker was primarily earthen covered with the exception of the front of it where the door was located. The igloo-shaped configuration of the bunker was designed to protect the personnel at the former RVAAP and the nearby residential communities from external force in the event of an internal explosion. The configuration of former Igloo 7-D-15 and the door location was designed to force any potential internal explosions toward the east.

The Block D Igloo MRS is 101.6 acres and extends from the location of former Igloo 7-D-15 to the east toward the "E" Block igloos, a distance of nearly 2,500 feet (presented on **Figure 5**). The distance was derived from a boundary evaluation that was conducted for the RI and conservatively represents the furthest distance (2,389 feet) that an M-41 20-lb fragmentation bomb, intact or in pieces, could have traveled as a result of the 1943 explosion. The MRS boundary includes a 100-foot buffer zone beyond the distance of the DoD military

munitions that were confirmed to be **munitions debris** (MD). As discussed in the following sections, the MRS boundary has been reduced to this size based on the investigations conducted.

The MRS is mostly heavily wooded with thick vegetation and ground cover. Roads, fields, and **wetlands** are also located within the boundaries of the MRS (CB&I, 2015).

The Army has completed various munitions response actions (investigations) at the Block D Igloo MRS under the MMRP. The timeline below shows the activities completed for the MRS:

- *Final Archives Search Report for Ravenna Army Ammunition Plant* (ASR; U.S. Army Corps of Engineers [USACE], 2004)
- *Final Military Munitions Response Program Historical Records Review* (HRR; environmental-engineering Management [e²M], 2007)
- *Final Site Inspection Report, Ravenna Army Ammunition Plant, Ohio* (Final Site Inspection [SI] Report; e²M, 2008)
- Final RI Report (CB&I, 2015)

A summary of the site-specific MMRP investigations conducted for the Block D Igloo MRS are presented in the following sections.

2.2.1 Archives Search Report

In 2004, the USACE conducted an archives search under the Defense Environmental Restoration Program for the presence of DoD military munitions that potentially presented explosives hazards at the former RVAAP. The search identified 12 MRSs as well as four additional locations with the potential for DoD military munitions. The four additional locations included former Igloo 7-D-15 that was referred to as "Block D Igloo". The ASR (USACE, 2004) indicated that the area surrounding former Igloo 7-D-15 potentially contained explosives ordnance and recommended further investigation under the MMRP.

2.2.2 Historical Records Review

In 2007, the Army completed an HRR under the MMRP at Camp Ravenna that included the Block D Igloo MRS. The HRR summarized the investigation following the accidental explosion of Igloo 7-D-15 (“D” Block) on March 24, 1943, and the development of the initial MRS boundary by the USACE, Huntsville District. According to the Army’s inventory of closed, transferring, and transferred military and defense sites (Army Closed, Transferring, and Transferred [CTT] Range/Site Inventory), the detonation of bombs in Igloo 7-D-15 caused multiple fatalities and was believed to have sent shrapnel and demolished material up to 2.9 miles away, off installation property. However, the majority of the demolished material was reported to have landed 1.3 to 2 miles to the northeast of the igloo, within installation boundaries. The material consisted of concrete fragments, parts of clothing, and an oil filter from a vehicle (e²M, 2007).

The USACE, Huntsville District utilized the information in the Army CTT Range/Site Inventory to establish the MRS boundary. The pre-SI MRS boundary captured the probable debris field resulting from the explosion and consisted of a 3,000-foot diameter circle (“for high explosive bombs”) centered on and surrounding Igloo 7-D-15. This resulted in a total MRS acreage of approximately 622.24 acres. A portion of the circle extended beyond the installation boundary and was considered separately as a transferred site, Block D Igloo-TD (e²M, 2007). The boundaries identified for the Block D Igloo MRS at the facility and off-post Block D Igloo-TD MRS in the HRR (e²M, 2007) prior to the SI are presented in **Figure 3**.

2.2.3 Site Inspection

In 2007, the Army conducted SI field work under the MMRP at Camp Ravenna that included the Block D Igloo MRS. Meandering path instrument-assisted **unexploded ordnance** (UXO) surveys were conducted during the SI field activities within and around the former

igloo footprint that was within the MRS and at four documented debris locations outside of the MRS. No DoD military munitions were observed on the ground surface within the interior of the former igloo or within a circumference of 100 feet surrounding the area. Several subsurface anomalies were recorded within the former igloo footprint but were considered to possibly be attributed to the remnants of the former reinforced concrete floor. No subsurface anomalies were detected within 100 feet surrounding the former igloo locations that were surveyed. No visual evidence of DoD military munitions was found and very few subsurface anomalies were detected at the four documented debris locations outside of the MRS. At locations where subsurface anomalies were recorded, the findings were attributed to debris associated with former rail lines and a roadway.

Sampling for **munitions constituents** (MC)-related contamination was conducted at one location as a **composite sample** within the former igloo footprint area during the SI field activities. **Lead** and **arsenic** were detected at concentrations that exceeded the Camp Ravenna **background values** and one-tenth the U.S. EPA Residential Soil **Preliminary Remediation Goals** and were considered as MC-related contamination. The SI sample location is shown in **Figure 3**.

The Final SI Report (e²M, 2008) recommended that the MRS boundary be revised to reduce the footprint from 622.24 acres to 340.2 acres. The proposed footprint consisted of the area immediately surrounding the former igloo and all remaining documented debris locations (and areas in between) that were documented in the Army CTT Range/Site Inventory but had not been investigated as part of the SI (e²M, 2008). Although the area of the MRS was reduced, inclusion of the documented debris locations, not previously investigated, increased the maximum distance of the MRS from the point of detonation at former Igloo 7-D-15 from 3,000 feet to nearly 10,000 feet. This resulted in non-continuous and irregular-shaped investigations areas that made up the new

MRS. The revised MRS area following the SI is presented in **Figure 4**.

2.3 Remedial Investigation

During planning for the RI, the Army prepared a boundary evaluation to verify the **maximum fragmentation distance-horizontal** (MFD-H) associated with the clusters of M-41 20-lb fragmentation bombs that exploded at the igloo. The results of the evaluation consequently further reduced the size of the RI area to 92.14 acres from the 340.2 acres recommended in the SI Report (e²M, 2008). Based on the revised MFD-H, the maximum distance to be investigated from the former igloo footprint was reduced from approximately 10,000 feet to 2,389 feet. The reduced area that was investigated for the RI is presented in **Figure 5**.

A total of 178 DoD military munitions were found on the ground surface during the RI. All of these items were documented as safe (i.e., MD) by the **UXO-qualified personnel** in the field. A total of 3,140 subsurface DoD military munitions were encountered during intrusive investigations at a maximum depth of 8 inches below ground surface (bgs). The UXO-qualified personnel determined that 3,135 of these items were safe (i.e., MD) and 5 of the items were **munitions and explosives of concern** (MEC). The maximum horizontal distance that DoD military munitions from the explosion were encountered was 1,800 feet to the east and supported the revised calculated distance of 2,389 feet (CB&I, 2015).

Sampling for MC-related contamination was conducted during the RI field work. Three samples were collected using the **Incremental Sampling Methodology** (ISM) where the MD was well distributed on the ground surface and was found in subsurface soils. Two **discrete soil samples** were collected beneath two of the individual MEC items found. The ISM samples were collected at depths between 0 to 0.5 feet (0 to 6 inches) bgs and the discrete soil samples were collected at 0.5-foot (6-inch) intervals below the individual MEC items. The depths of the discrete samples ranged from 0.25 feet

(3 inches) to 0.83 feet (10 inches) bgs. The RI sample locations are shown on **Figure 5**.

Nitroguanidine was detected at two of the three ISM sampling unit locations and at both discrete sample locations. The nitroguanidine concentrations were all very low and were not considered as MC associated with the 20-lb bombs that exploded at former Igloo 7-D-15. Nitroguanidine is used as an explosive propellant in triple-base propellant that was not used in the manufacture of the 20 lb bomb (CB&I, 2015). The concentration of nitroguanidine detected in ISM samples were below regulatory limits. Therefore, nitroguanidine was removed from further consideration as an MC-related contaminant at the MRS.

Concentrations of **antimony** and **iron** were detected in the ISM samples and were carried forward for evaluation in the **Human Health Risk Assessment** and the **Ecological Risk Assessment** in the RI. The risk assessments determined that antimony and iron did not pose risks to the human or environmental receptors at the MRS. The Final RI Report (CB&I, 2015) indicated MC-related contamination was unlikely at the MRS (CB&I, 2015).

The RI concluded the total area that was impacted by the explosion that occurred at Igloo 7-D-15 is approximately 101.6 acres, which is considered as the revised Block D Igloo MRS. The revised MRS area maintains the calculated MFD-H of 2,389 feet from the former igloo and includes a 100-foot buffer zone beyond the bound lateral extent of MD that represent the potential for MEC at those locations as well. The MRS was assigned a **Munitions Response Site Prioritization Protocol** priority of 3 (CB&I, 2015). A Priority 1 MRS contains the highest potential hazard, while a Priority 8 MRS contains the lowest potential hazard. The RI results and the MRS area following the RI is presented in **Figure 5**.

2.4 Feasibility Study

An FS was prepared for the Block D Igloo MRS by the Army in 2018. The FS evaluated possible alternatives in detail and provided a

comparative analysis of those alternatives based on criteria outlined in the NCP. The FS identified four possible alternatives to address potential explosives hazards associated with DoD military munitions at the Block D Igloo MRS. The alternatives consisted of 1) No Action, 2) **Land Use Controls** (LUCs), 3) Surface Removal and LUCs, and 4) Surface and Subsurface Removal. The FS also developed the **Remedial Action Objectives** (RAOs) based on the potential for DoD military munitions presenting explosive hazards at the Block D Igloo MRS (HGL, 2018).

3.0 MRS CHARACTERISTICS

The characteristics for the MRS that are discussed in this section are based on the munitions response actions that have been completed by the Army for the MRS.

3.1 *Physical Characteristics and Land Use*

The MRS is between the intersection of Smalley Road and Road 7D in the “D” Block storage bunkers (igloos) and Road 3E in the “E” Block igloos at Camp Ravenna. The MRS is located on federal property with administrative accountability assigned to the USP&FO for Ohio. The MRS is managed by the Army National Guard (ARNG) and the OHARNG.

The current land use activities at the MRS are **maintenance, natural resource management, environmental sampling, and military training**. Future activities at the MRS will be similar to currently conducted activities and land use is anticipated to remain the same.

The **native soil** types at the MRS consist primarily of the Mahoning silt loam and the undulating Mahoning Urban land complex. Depth to bedrock ranges from 5 feet bgs at the western portion of the MRS to 40 feet bgs at the eastern portion. The **frost line** for northeast Ohio extends to approximately 30 inches bgs.

The MRS is primarily thickly forested with large stands of trees. Two wetlands are present within the MRS. The wetlands present within the MRS are either forested wetlands or wet fields.

Topography across the MRS is relatively flat with low hillocks and “pit and mound” features typical of forested sites. The overall drainage direction for the MRS is east to southeast. The highest elevation at the MRS is approximately 1,110 feet above mean sea level near the location of the former igloo.

In general, surface water drainage for the MRS and surrounding area follows the topography toward the southeast. An unnamed tributary to Sand Creek begins approximately 1,000 feet southeast of the former igloo footprint and flows east to southeast (CB&I, 2015).

Biological inventories have occurred within the MRS and a **state-listed species of concern** consisting of the sharp-shinned hawk has been observed (CB&I, 2015). Additionally, there is the potential for other state-listed or **rare species** to be within the MRS. The Northern long-eared bat is a **federally threatened species** that was identified at Camp Ravenna and now must be considered during project and constructions activities.

3.2 *Applicable or Relevant and Appropriate Requirements*

Applicable or relevant and appropriate requirements (ARARs) are **promulgated, statutory, and regulatory** requirements that are substantive in nature, and must be met or waived during implementation of a remedial action, as required by the NCP. ARARs are identified based on MRS-specific factors such as contaminants present, location, physical features, and **remedial alternatives** being considered, and are subdivided into three categories (chemical-specific, action-specific, and location-specific). Remedial alternatives must either attain or formally waive each ARAR identified for the Block D Igloo MRS. As such, ARARs were considered in the development of the remedial alternatives. In addition to the promulgated statutory and regulatory requirements that comprise ARARs, non-promulgated advisories, guidance, or policies known as “**To Be Considered**” (TBCs) criteria were also evaluated for the MRS.

The potential ARARs that were considered for remedial action at the MRS are summarized below:

- Clean Water Act (Section 404) – This federal act governs the discharge of dredged and fill material into waters of the U.S., including adjacent wetlands.
- Erosion and Sediment Control Regulations (Ohio Administrative Code 1501.15-1-04) – This state rule requires that sediment and erosion controls be employed in areas of denudation and land disturbance, and describe management and conservation practices that will control wind or water erosion of the soil and minimize the degradation of water resources by soil and sediment.

A detailed discussion of the potential ARARs evaluated for the Block D Igloo MRS are presented in the FS (HGL, 2018).

3.3 Nature and Extent of Contamination

A summary of the nature and extent of contamination at the Block D Igloo MRS, that includes evaluation for DoD military munitions on the surface and in the subsurface, are presented in this section.

3.3.1 Munitions and Explosives of Concern

A total of 3,140 subsurface DoD military munitions were encountered during intrusive investigations at a maximum depth of 8 inches below ground surface (bgs). The UXO-qualified personnel determined that 3,135 of these items were MDAS (i.e., MD) and 5 of the items were MEC. The MEC items were corroded and weighed between 1 to 5 lbs. The MEC items were firmly entrenched in the ground at a maximum depth of 0.5 feet (6 inches) bgs and required hand tools (i.e., shovels) in order to be removed. The MEC consisted of parts and pieces of the M-41 20-lb fragmentation bomb with the exception of one MEC item that was a fuze from an unknown munitions type. The origin of this unknown type of fuze associated with fragmentation bombs (different than the fuze type used in the

20-lb bombs that exploded at Block D Igloo) is unknown.

The maximum distance of the subsurface MEC was approximately 1,800 feet due east of former Igloo 7-D-15. The locations of the subsurface MEC were encountered at investigation grid locations that were biased towards the areas where the DoD military munitions that were verified as safe (i.e., MD) were observed on the ground surface during the RI field work. Based on the five MEC items found during the RI, the average density is anticipated to be 3.723 MEC per acre and actual density at a 95-percent confidence level is calculated to be 6.512 MEC per acre. Therefore, it is statistically possible that between 350 and 600 MEC may be present at the MRS (CB&I, 2015). **Figure 5** presents locations of the buried MEC and the distribution of MD on the ground surface encountered during the RI field work.

3.3.2 MC-Related Contamination

Soil samples were collected for the evaluation of MC-related contamination during the RI at areas with concentrated surface and subsurface MD and beneath individual MEC items. The Final RI Report (CB&I, 2015) indicated that MC-related contamination was unlikely.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

The overall remedial strategy for the Block D Igloo MRS reflects the interests of both the Army and the Ohio EPA in mitigating risk and protecting potential human receptors where residual explosive hazards remain. In keeping with this strategy, a Preferred Alternative was developed for the MRS that addresses the remediation of source materials that consist of DoD military munitions confirmed as MEC. These materials constitute principle threat wastes at the MRS. Following completion of the response actions, the Army anticipates being able to conclude its investigation and remediation of the Block D Igloo MRS where the property can be used for the anticipated land use and is protective of the **Industrial Receptor**. Though there are no current plans

for the MRS to change from an industrial land use to a residential land use, there are no unacceptable risks to a potential future residential receptor from explosive hazards or MC-related contamination.

5.0 SUMMARY OF MRS RISKS

Risks at the MRS were evaluated in terms of an exposure model that consists of a **source** of contamination, a **receptor**, and **interaction** at the **exposure point**. Within this model, the source would consist of DoD military munitions associated with the 1943 explosion at former Igloo 7-D-15 and the representative receptor is the Industrial Receptor (a full-time employee or career military individual expected to work daily at Camp Ravenna). The **exposure pathway** would be a means of interaction between the source and the receptor, such as a person directly contacting DoD military munitions on the ground surface or encountering DoD military munitions during intrusive activities.

A qualitative **MEC Hazard Assessment (HA)** was completed in the Final RI Report (CB&I, 2015) and the FS (HGL, 2018) using information from investigations completed at the MRS. The MEC HA was completed for both phases of the CERCLA process since an explosive safety hazard was identified for the MRS. The MEC HAs considered the following factors:

- Presence and nature of DoD military munitions sources,
- Site characteristics that affect potential pathways between the DoD military munitions source and human receptors, and
- Types of activities that may result in exposure.

At the conclusion of the RI, the MEC HA supports the assessment of the explosive hazards that would remain if no action were taken. Based on current conditions and future land-use at the MRS, and assuming no response action occurs at the MRS, evaluation of the MEC HA resulted in a Hazard Level of 3

(moderate potential **explosive hazard** condition) (CB&I, 2015).

The MEC HA in the FS provides an assessment of the remedial alternatives with regard to the potential explosive hazards at the MRS. Evaluation of the LUCs alternative did not result in a change in the Hazard Level of 3 (moderate potential explosive hazard condition) when compared to the no response action evaluated in the RI. Evaluation of both the Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative, that involve different levels of removal of explosive hazards at the MRS, resulted in a Hazard Level of 4 (low potential explosive hazard condition) (HGL, 2018).

5.1 Receptors

A receptor is any human who comes into physical contact with a potential explosive hazard. The **human receptor** that has the greatest opportunity for exposure to an explosive hazard at the MRS is the Industrial Receptor. The Industrial Receptor represents a full-time occupational receptor at the MRS whose activities are consistent with full-time employees or military personnel who are expected to work daily at Camp Ravenna over their career. The maximum depth that the Industrial Receptor is expected to access as part of their planned activities is 4 feet bgs (ARNG, 2014).

Ecological receptors include terrestrial invertebrates (earthworms), voles, shrews, robins, foxes, hawks, and the Northern long-eared bat. No eligible cultural resource sites were identified during the cultural resource survey performed in the area between the “D” and “E” Block Igloos (HGL, 2018). In accordance with current guidance, humans are typically considered as the primary and often the only receptor to DoD military munitions; therefore, no ecological receptors are identified for the explosive hazards at the MRS (USACE, 2016).

5.2 MEC Exposure Pathways

Although no DoD military munitions confirmed as MEC was found on the ground surface, the presence of MEC in shallow subsurface soils strongly suggests that MEC most likely exists on the ground surface at uninvestigated locations. The exposure pathway for MEC on the ground surface at the Block D Igloo MRS is complete and would be to handle or tread underfoot for all receptors (CB&I, 2015).

DoD military munitions that were confirmed as MEC were encountered in subsurface soils during the RI at depths less than 1-foot bgs. Based on these results, the MEC exposure pathway for subsurface soil (greater than 0 inches bgs) is considered complete for all receptors that may engage in intrusive activities while using the MRS. Any buried MEC at the MRS may eventually become exposed due to **freeze/thaw cycling**.

The presence of DoD military munitions confirmed as MEC in the surface water and saturated areas was not verified during the RI; however, these areas are relatively shallow (i.e., less than 3 feet deep). If MEC is present in these areas, any receptors accessing these areas may come into contact with it by walking or handling if picked up. Therefore, the MEC exposure pathway for sediment in the saturated and surface water areas at the MRS is considered potentially complete.

5.3 MC-Related Contamination Exposure Pathways

The Final RI Report (CB&I, 2015) indicated that no known or suspected risks associated with MC-related contamination exists at the MRS, including evaluation for the **Unrestricted (Residential) Land Use**. Therefore, the MC-related contamination exposure pathway for receptors is **incomplete**

6.0 REMEDIAL ACTION OBJECTIVES

The RAOs were developed based on the hazards, receptors, and exposure pathways

identified at the Block D Igloo MRS and the analysis of ARARs. The RAOs are:

- Reduce the unacceptable potential hazard of DoD military munitions on the ground surface and in sediment at the saturated and surface water areas within the MRS to address the likelihood of exposure to the likely future receptors via direct contact such that the likelihood of encounter is negligible.
- Reduce the unacceptable potential hazard of DoD military munitions to a depth of 4 feet bgs within the MRS to address the likelihood of exposure to the likely future receptors via direct contact such that the likelihood of encounter is negligible.

7.0 SUMMARY OF REMEDIAL ALTERNATIVES

Remedial alternatives that were developed to address DoD military munitions at the Block D Igloo MRS were:

- No Action;
- LUCs;
- Surface Removal and LUCs;
- Surface and Subsurface Removal.

Following the preliminary evaluation of the developed remedial alternatives, all four remedial alternatives were retained for further consideration in the detailed analysis in the FS, and are described below. The individual components of the remedial alternatives that were developed are in **Table 1**.

7.1 No Action

The No Action alternative consists of continued use of the Block D Igloo MRS in its current condition with no action taken whatsoever, including administrative, remedial, or other action to location, remove, dispose, or prevent exposure to DoD military munitions at the MRS. Consideration of the No Action alternative is required by the NCP for **baseline** comparison with other alternatives. There are no costs associated with the No Action alternative.

Table 1 Components of Remedial Alternatives

| Remedial Alternative | Individual Components |
|---------------------------------------|---|
| No Action | <ul style="list-style-type: none"> • No components • Continued use of the MRS in its current condition with no removal action for DoD military munitions taken |
| LUCs | <ul style="list-style-type: none"> • No planned physical removal action for DoD military munitions taken • Engineering controls (i.e., fence and signs) • Educational awareness training program • Annual monitoring (i.e., inspections) • Five-Year Reviews |
| Surface Removal and LUCs | <ul style="list-style-type: none"> • Surface removal of DoD military munitions • Engineering controls (i.e., Siebert stakes and signs) • Educational awareness training program • Annual monitoring (i.e., inspections) • Five-Year Reviews |
| Surface and Subsurface Removal | <ul style="list-style-type: none"> • Surface and subsurface removal of DoD military munitions • Attains UU/UE that is also protective of the Industrial Receptor to its maximum exposure depth of 4 feet bgs • No LUCs required following the remedial action |

bgs denotes below ground surface
DoD denotes U.S. Department of Defense
LUC denotes land use control
MRS denotes Munitions Response Site.
UU/UE denotes unlimited use/unrestricted exposure

7.2 Land Use Controls

Capital Cost:..... \$626,025
Operation and Maintenance Cost: \$245,094
Periodic Cost:..... \$27,224
Present Worth Cost: \$898,343
Five-Year Reviews: \$94,505
Construction Time Frame: <1 year
Operation Time Frame:.....30 years

The LUCs alternative would not include any planned removal of DoD military munitions at the MRS. Rather; it would focus on restricting access and reducing human exposure to DoD military munitions through **engineering controls, educational controls, and annual monitoring** that were developed through the **Institutional Analysis** in the FS Report (HGL, 2018), and as described below.

The engineering controls would consist of an 8-foot high chain-link fence and warning signs around the perimeter of the MRS. The proposed fence would include gates at both ends of North D Road in “D” Block and Roads 1E, 2E, and 3E in “E” Block that traverse through the MRS. Fencing would be installed on both sides of Smalley Road in order to allow access through the MRS. The total length of fence would be approximately 12,500 feet. The signs warning unauthorized personnel from entering the MRS would be placed along the fence at approximate 50-foot spacing. The proposed locations for the installation of the engineering controls for this alternative are presented in **Figure 6**.

MEC avoidance would be implemented during fence installation activities to ensure that there

are no explosive hazards at the locations where the workers are traversing and securing the fence posts in the ground. The MEC avoidance procedures would consist of a UXO-qualified person conducting an **instrument-aided surface sweep** of the perimeter of the MRS where the workers would be walking, laying down materials, and installing the fence. If any DoD military munitions confirmed as MEC is encountered, the UXO-qualified person would immediately stop work, document the location, and evacuate the work area.

MEC considered acceptable to move would be transported off the MRS to temporary magazines at Open Demolition Area #2 for **consolidated detonation**. If a MEC item is not acceptable to move, then **blow in-place (BIP)** is unavoidable. Any destruction activities, whether it is consolidated detonation or BIP, would require notification to the Ohio EPA, OHARNG/Camp Ravenna, and local emergency facilities. Post-demolition activities would include pre- and post-environmental sampling to ensure no MC-related contamination is present. Any pits or holes created by the detonation would be backfilled and seeded with a Camp Ravenna-approved seed mix. All DoD military munitions verified as MD would be collected for off-site disposal at a licensed facility for **flashing and recycling**.

Educational controls to be implemented would include different levels of general **awareness training** that would be dependent on the personnel and activities to be conducted at the MRS. Full time-employees at Camp Ravenna would receive annual general awareness training to notify them of existing conditions, existing engineering controls, DoD military munitions hazards at Camp Ravenna, and reporting procedures (i.e., the Three R's of Safety – recognize, retreat, report). Training units, visitors, and contractors that may enter the MRS would receive a general munitions awareness brief that would emphasize the aforementioned reporting procedures to the Camp Ravenna Range Control. Those procedures are part of the briefings currently given to all employees, training units, visitors,

and contractors and include reporting any DoD military munitions found to Camp Ravenna Range Control.

Annual monitoring (i.e. inspections) would be conducted on an annual basis to ensure that the LUCs remain effective and protective of employees, training units, visitors, and contractors. **Five-Year Reviews** would be required to ensure the effectiveness of this alternative, because it does not achieve **unlimited use/unrestricted exposure (UU/UE)** at the MRS.

7.3 Surface Removal and LUCs

Capital Cost:..... \$1,642,116
Operation and Maintenance Cost:..... \$245,094
Periodic Cost:..... \$27,224
Present Worth Cost:..... \$1,914,434
Five-Year Reviews: \$94,505
Construction Time Frame:..... 1-2 years
Operation Time Frame:..... 30 years

The Surface Removal and LUCs alternative would use instrument-aided surface sweeps to identify and remove DoD military munitions exposed at/or just below the ground surface and the sediment in the saturated and surface water areas at the MRS. Extensive subsurface **excavation** in surface soil and sediments would not be conducted. Military training consisting of foot traffic would be allowed at the MRS following completion of the response action for this alternative; however, surface removal of DoD military munitions alone would not attain UU/UE and there would be digging restrictions to prevent authorized personnel who may enter the MRS from encountering subsurface DoD military munitions. LUCs consisting of engineering and educational controls and annual monitoring would be required to mitigate the potential for human exposure to remaining subsurface DoD military munitions.

Detection would be the first step in the surface removal of DoD military munitions, which would be accomplished by conducting an instrument-aided surface sweep. UXO-qualified personnel would systematically walk the MRS and mark, identify, and record the

locations of all DoD military munitions found on the surface for inspection, removal, or subsequent demolition. The search would be conducted with a **hand-held analog magnetometer** such as the Schonstedt GA52-CX, or similar instrument. The operator would systematically search sweep lanes within grids using the magnetometer to identify anomalies. If the instrument indicates a response but the **anomaly** is not found on or just below the ground surface or sediment in shallow surface water, the UXO-qualified personnel would move on without extensive digging into the subsurface.

An instrument-aided surface sweep using a hand-held analog magnetometer can be used in areas with thick vegetation and ground cover; however, vegetation clearing would still be required in areas with thick scrub brush and along the edges of the wetlands and unnamed stream. Vegetation clearing would allow for proper operation of the detection equipment and to provide visibility for the safety of UXO-qualified personnel.

Removal of DoD military munitions on the ground surface would be performed by UXO-qualified personnel intrusively investigating detected anomalies confirmed by the hand-held analog magnetometer instrument. Any DoD military munitions found would be evaluated to determine if was MEC or MD by the UXO-qualified personnel. If the DoD military munitions was partially exposed, or protruding above the surface, limited digging with hand tools would be conducted until the item could be verified as MEC or MD. It is not anticipated that the surface removal activities under this alternative would greatly disturb the environment, since only targets on or just below the ground surface would be investigated.

Disturbance of the fine sediments in the wetland areas would result in low visibility. As a result, the UXO-qualified personnel would conduct an **underwater tactile investigation** of any anomalies that are identified.

Any DoD military munitions that is encountered at either the terrestrial or underwater areas at the MRS would be evaluated by the UXO-qualified personnel to determine whether it is acceptable to move for consolidated detonation or if it would require BIP. Any destruction activities, whether it is consolidated detonation or BIP, would require notification to the Ohio EPA, OHARNG/Camp Ravenna, and local emergency facilities.

Any DoD military munitions requiring BIP may result in temporary road closures and nearby work locations depending on the location of the MEC item. Special precautions would be taken to avoid impacting the environment for any underwater DoD military munitions that required BIP. Engineering controls consisting of physical barriers (i.e., sand bags) would be considered to attenuate the blast wave. Following BIP at either the terrestrial or underwater areas, environmental testing and restoration would be required to ensure no MC-related contamination impacts to the environment.

LUCs are included in this alternative because DoD military munitions would remain in the subsurface after the surface removal. It is anticipated that the surface removal of DoD military munitions would permit the employees, training units, visitors, and contractors to access the MRS with no intrusive activities; however, engineering controls would be necessary to warn unauthorized personnel from entering the MRS. These engineering controls would consist of Siebert stakes and warning signs that would be placed along the perimeter of the MRS as well as along the sides of Smalley Road that traverses the MRS (**Figure 7**). The Siebert stakes and signs would be alternately placed and would be spaced approximately 50 feet apart. The path where the Siebert stakes would be installed is 12,500 feet and follows the same path as for the chain-link fence under the LUCs alternative. This equates to approximately 250 fence posts along the proposed path. The proposed locations for the installation of the engineering controls for this alternative are presented in **Figure 7**.

Educational controls would include the general awareness training discussed for the LUCs alternative in Section 7.2. Full time-employees at Camp Ravenna would receive annual general awareness training to notify them of existing conditions, existing engineering controls, DoD military munitions hazards at Camp Ravenna, and reporting procedures (i.e., the Three R's of Safety – recognize, retreat, report). Training units, visitors, and contractors that may enter the MRS would receive a general munitions awareness brief that would emphasize the aforementioned reporting procedures to the Camp Ravenna Range Control.

Annual monitoring (i.e., inspections) would be conducted to ensure the effectiveness of the LUCs. Five-Year Reviews would be required to ensure the effectiveness of this alternative, because it does not achieve UU/UE at the MRS.

MEC avoidance would be implemented during installation of the Siebert stakes and warning signs to ensure that there are no explosive hazards where the workers are traversing and securing the posts in the ground. The MEC avoidance procedures would consist of a UXO-qualified person conducting an instrument-aided surface sweep of the perimeter of the MRS where the workers will be walking, laying down materials, and installing the posts. If DoD military munitions confirmed as MEC is encountered, the UXO-qualified person would immediately stop work, document the location, and evacuate the work area. The aforementioned procedures for MEC demolition would be followed in the event that DoD military munitions confirmed as MEC was found.

7.4 Surface and Subsurface Removal

Capital Cost..... \$7,039,235
O&M Cost..... \$0
Periodic Cost..... \$0
Present Worth Cost: \$7,039,235
Construction Time Frame: 2-3 years

The Surface and Subsurface Removal alternative would use a combination of analog and **digital magnetometer instruments** and

manual digging to investigate, map, and remove all surface and subsurface DoD military munitions at the MRS to the maximum exposure depth of 4 feet bgs for the Industrial Receptor. Instrument-aided surface sweeps would be conducted for sediments in the saturated and surface water areas at the MRS and would target DoD military munitions at depths where it can be investigated and removed manually. Manual digging is the preferred method of DoD military munitions removal for this alternative since the maximum depth of DoD military munitions found during the RI was at 8 inches bgs. Successful completion of this alternative would attain UU/UE. Once anomalies are investigated and military munitions or metallic debris are removed, the digital magnetometer will be used to verify the anomaly has been removed.

Detection of DoD military munitions at the terrestrial areas of the MRS would be accomplished by 100-percent coverage using a portable Geometrics Model G-858G Cesium Gradiometer, or similar instrument, which is capable of detecting the items between ground surface and 4 feet bgs. Use of a digital magnetometer would allow for rapid data collection with minimal personnel, resulting in a digital, **georeferenced** map of the entire MRS. The data would be collected, processed, evaluated, and analyzed to select target anomalies likely to represent munitions of interest. Where an isolated target anomaly is present, the coordinates would be located again and the anomaly would be “**reacquired**” to precisely pinpoint its location with a pin flag for subsequent removal. A Schonstedt GA52-CX analog magnetometer, or similar instrument, would be used in conjunction with the digital magnetometer to investigate inaccessible areas that could not be mapped due to thick ground cover or overhead canopy that limits data collection.

The instrument-aided surface sweeps for the sediments would be conducted with a hand-held analog magnetometer, such as the Schonstedt GA52-CX, Mag 1 underwater magnetometer, or similar instrument. The

operator would systematically search sweep lanes within grids using the magnetometer to identify anomalies. Due to the saturated and flowing conditions of the sediments at the MRS, the maximum depth of the DoD military munitions in the sediment may be deeper than at the terrestrial portions of the MRS but is still anticipated to be relatively shallow (i.e., less than 2 feet deep) and detectable using the hand-held instruments.

Vegetation clearance would be required in areas with dense trees and brush where personnel would not be able to access with the man-portable gradiometer. The minimum amount of vegetation would be removed to achieve UU/UE. Areas of thick groundcover would be removed to provide visibility for the safety of the UXO-qualified personnel.

Any removal of DoD military munitions would be performed with shovels and other hand tools that minimize impact to the MRS landscape. The UXO-qualified personnel would establish 100 square foot area grids (10 feet by 10 feet) and investigate each anomaly and mark, identify, and record the locations of all DoD military munitions for investigation and removal or subsequent demolition. The conditions encountered during the RI indicated that the DoD military munitions associated with the explosion were well distributed at shallow depths (i.e., less than 1 foot bgs) and there were no concentrated areas of anomalies. No munitions were encountered at depths greater than 1 foot bgs. Each anomaly would be investigated to a maximum depth of 4 feet bgs, the maximum exposure depth for the Industrial Receptor. Munitions removed to this depth would achieve UU/UE. Any DoD military munitions items found would be inspected and ultimately determined to be MEC or MD by UXO-qualified personnel. It is not anticipated that manual excavation activities would greatly disturb the environment; however, each of the excavation areas would be re-graded and seeded with a Camp Ravenna-approved seed mix to ensure regrowth.

Disturbance of the fine sediments in the wetland areas would result in low visibility. As

a result, the UXO-qualified personnel would conduct an underwater tactile investigation of any anomalies that are identified.

Any terrestrial and/or underwater DoD military munitions that are identified as having potential explosive hazard at the MRS would be evaluated by UXO-qualified personnel to determine whether it is acceptable to move for consolidated detonation or if it requires BIP. The MEC demolition activities would be conducted for terrestrial and underwater MEC as discussed for the Surface Removal and LUCs alternative in Section 7.3.

8.0 EVALUATION OF ALTERNATIVES

The four remedial alternatives were evaluated with respect to the nine evaluation criteria outlined in the NCP [Section 300.430(f)] (**Table 2**). The nine criteria are categorized into three groups: Threshold Criteria, Primary Balancing Criteria, and Modifying Criteria. These criteria groups are as follows:

Threshold Criteria must be met for the alternative to be eligible for selection as a remedial option:

1. Overall protection of human health and the environment
2. Compliance with ARARs

Primary Balancing Criteria are used to weigh major trade-offs among alternatives:

1. Long-term effectiveness and permanence.
2. Reduction of **toxicity**, **mobility**, or **volume** through treatment
3. Short-term effectiveness
4. Implementability
5. Cost

Modifying Criteria may be considered to the extent that information is available during development of the FS, but can be fully considered only after public comment on this Proposed Plan.

1. State acceptance
2. Community acceptance

The comparative analysis evaluates the relative performance of the alternatives with respect to each of the nine criteria. Identifying the advantages and disadvantages of each alternative with respect to each other helps to identify the relative strengths of the preferred alternative. These strengths, combined with risk management decisions made by the Army and Ohio EPA, as well as input from the community, will serve as the basis for selecting the Preferred Alternative.

8.1 Comparative Analysis of Alternatives

Threshold Criteria

Overall Protection of Human Health and the Environment - The No Action alternative would not involve any measures to limit the hazards of any DoD military munitions and would not be protective of human health. Thus, the No Action alternative does not meet this criterion. The other action alternatives are protective of human health to differing degrees and meet this criterion. The Surface and Subsurface Removal alternative provides the greatest level of overall protection to human health by removing any DoD military munitions identified to the maximum exposure depth of 4 feet bgs. The Surface Removal and LUCs alternative provides the next greatest level of overall protection to human health since DoD military munitions on or just below the ground surface and sediment would be removed; however, subsurface DoD military munitions would remain. The LUCs alternative would be protective of human health by restricting direct contact to DoD military munitions through engineering and educational controls and monitoring but both surface and subsurface DoD military munitions would remain making it the least protective among the action alternatives.

Compliance with ARARs - There are no ARARs associated with the No Action alternative that would restrict or modify implementation. No ARARs are triggered for the three action alternatives since no activities would occur that would require **dredging** or **filling** activities in

Table 2 CERCLA Evaluation Criteria

| Threshold Criteria |
|---|
| <p><i>Overall Protection of Human Health and the Environment</i> considers how well the alternative protects human health and the environment from the hazard at the MRS.</p> <p><i>Compliance with ARARs</i> considers if the alternative can be implemented in compliance with the ARARs and/or TBCs identified for the MRS.</p> |
| Balancing Criteria |
| <p><i>Long-term Effectiveness and Permanence</i> considers how effective and permanent the alternative will be over time.</p> <p><i>Reduction of Toxicity, Mobility, or Volume Through Treatment</i> considers how well the alternative reduces the harmful effects of the hazard at the MRS.</p> <p><i>Short-term Effectiveness</i> considers how long it will take to complete the cleanup and follow-on work and if the community, workers at the MRS, and the environment can be kept safe during cleanup operations.</p> <p><i>Implementability</i> considers if the alternative can be practically and successfully implemented considering any technical and administrative issues that may need to be addressed.</p> <p><i>Cost</i> considers capital costs, operation and maintenance costs, and periodic costs associated with the implementation of the alternative using current prices.</p> |
| Modifying Criteria |
| <p><i>State Acceptance</i> indicates whether the state regulator approves of the alternative.</p> <p><i>Community Acceptance</i> addresses whether the public approves of the alternative.</p> |

the wetlands or would result in large-scale excavation that may contribute to **erosion** and **sedimentation**.

Balancing Criteria

Long-Term Effectiveness and Permanence - The No Action alternative would not provide long-term effectiveness and permanence since no actions would be taken to address the

explosive hazards associated with residual surface and subsurface DoD military munitions on the MRS. There are different degrees of long-term effectiveness and permanence associated with the action alternatives. The LUCs alternative is effective in the long term and permanent; however, fewer DoD military munitions would be permanently removed in comparison to the other action alternatives. The Surface Removal and LUCs alternative would have greater effectiveness and permanence than the LUCs alternative since it would involve the removal of DoD military munitions on the ground surface and sediment in the shallow surface water areas. The Surface and Subsurface Removal alternative would have the greatest long-term effectiveness and permanence since it would include the removal of surface and subsurface DoD military munitions and DoD military munitions in sediment that would eliminate the potential for explosive hazards at the MRS and result in UU/UE.

Reduction of Toxicity, Mobility, and Volume Through Treatment - The No Action alternative, LUCs alternative and Surface Removal and LUCs alternative do not satisfy the statutory preference for employing treatment as a principle element. The No Action alternative does not provide any reduction of the toxicity, mobility, or volume of DoD military munitions whatsoever. The LUCs alternative provides no treatment or removal of DoD military munitions, other than MEC avoidance during the installation of the chain-link fence and the removal of any incidental DoD military munitions that is reported during future activities. The Surface Removal and LUCs alternative provides a reduction in the volume of DoD military munitions on or just below the ground surface and sediment; however, DoD military munitions would remain in the subsurface. The Surface and Subsurface Removal alternative includes the complete removal of surface/subsurface DoD military munitions and DoD military munitions in the sediment and satisfies the statutory preference for employing treatment as a principal element.

Short-Term Effectiveness - The No Action alternative presents no short-term environmental impacts or adverse risks to the UXO personnel, the nearby community, or land users such as workers or Camp Ravenna personnel in the area. The alternative requires no time commitment to implement.

The LUCs alternative poses short-term risks above the baseline conditions for workers installing the perimeter fence at the MRS and for UXO personnel conducting MEC avoidance and the incidental destruction of any DoD military munitions found during future activities. There would be minimal environmental impacts to the MRS since only vegetation clearance and soil disturbance would be required for installation of the perimeter fence. This alternative can be quickly implemented and would take less than 1 year to develop and implement the LUCs and install the perimeter fence.

The short-term effectiveness of the Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative would be affected by the handling, removal, and demolition operations of DoD military munitions by UXO-qualified personnel. UXO-qualified personnel are required to have specialized training that would mitigate the short-term explosive hazards for them and the onsite workers during the remedial action.

The vegetation clearing required at the MRS under the Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative would potentially adversely impact the environment in the short-term by disturbing wildlife habitat that is used by ground- and forest-nesting birds, including the sharp-shinned hawk, and by the Northern long-eared bat for roosting. Camp Ravenna vegetation removal restrictions that are protective of these habitats would be followed by not clearing vegetation during the April 1 to September 30 time-frame. Soil and sediment disturbance for both alternatives would be minimal, since removal of DoD military munitions confirmed as MEC would be conducted by manual excavation (i.e., hand

digging and underwater tactile investigations) only.

The short-term exposure under the Surface Removal and LUCs alternative would be less than the Surface and Subsurface Removal alternative due to a shorter time frame to complete the surface clearance, develop and implement LUCs, and install the perimeter Siebert stakes and signs. The duration to complete the Surface Removal and LUCs alternative is 1 to 2 years. The duration to complete the Surface and Subsurface Removal alternative is 2 to 3 years.

Implementability - Although easy to technically implement, the No Action alternative would be the least administratively feasible to implement because the stakeholders are not likely to accept it as the Preferred Alternative. The LUCs alternative would be technically feasible to implement since there is no specialized equipment that is required to install the perimeter fence and awareness training and monitoring is already being conducted at Camp Ravenna. The LUCs alternative is administratively feasible to implement; however, there are adverse administrative concerns that installation of a perimeter fence would interfere with Camp Ravenna's mission as a military training facility by blocking access to areas and roadways where military training activities are routinely conducted.

The Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative would be technically feasible to implement since the equipment and personnel required to conduct the response actions are readily available. The Surface Removal and LUCs alternative would be administratively feasible to implement since it is protective of both authorized and unauthorized personnel and allows use of the MRS for military training which supports Camp Ravenna's mission. The Surface and Subsurface Removal alternative would be administratively feasible to implement since it attains UU/UE.

Overall, the degree of implementability for the Surface Removal and LUCs alternative and the

Surface and Subsurface Removal alternatives that involve the actual removal of DoD military munitions would be more complex than the No Action alternative and the LUCs alternative that do not include any planned DoD military munitions removal actions. The Surface and Subsurface Removal alternative would be the most difficult alternative to implement since it would remove both surface and subsurface DoD military munitions.

Cost - There are no costs associated with the No Action alternative. The LUCs alternative has the lowest total **present worth** costs (\$898,343) in comparison to the Surface Removal and LUCs alternative (\$1,914,434) and the Surface and Subsurface Removal alternative (\$7,039,235). Additionally, Five-Year Reviews would be required for both the LUCs alternative and the Surface Removal and LUCs alternative since UU/UE is not attained. The present worth costs associated with the Five-Year Reviews over the 30-year performance period would be \$94,505 for each alternative. Present worth costs are dollar amounts estimated using current prices for goods and services.

Modifying Criteria

Although remedial alternatives cannot be evaluated against modifying criteria at this time, available information is provided below.

State Acceptance - The Ohio EPA has indicated they support the Preferred Alternative recommended in this Proposed Plan; however, final approval may be reserved until public comments are satisfactorily addressed in the **Record of Decision (ROD)**.

Community Acceptance - Community acceptance of the Preferred Alternative will be evaluated after the public comment period ends and will be described in the ROD for the MRS.

8.2 Overall Evaluation

Based on the results of the RI and the history of the MRS as the location where the accidental detonation of 2,516 clusters of the M-41 20 lb fragmentation bomb occurred, the potential remains for residual MEC to be present in

surface and subsurface soil and sediment on the MRS. The potential presence of MEC on the MRS presents a potential explosive hazard to the Industrial Receptor via direct contact to a maximum exposure depth of 4 feet bgs. The NCP statutory preference for reduction of toxicity, mobility, or volume through treatment is best achieved with Alternative 4 that would attain UU/UE and a negligible probability of exposure for the Industrial Receptor. Though there are no current plans for the MRS to change from an industrial land use to a residential land use, there are no unacceptable risks to a potential future residential receptor from explosive hazards or MC-related contamination. Based on the evaluation of the NCP criteria, Alternative 2 (LUCs), Alternative 3 (Surface Removal and LUCs), and Alternative 4 (Surface and Subsurface Removal) are effective and implementable. The deciding factor in selecting a remedy will be the lowest-cost alternative that meets the RAOs and is technically and administratively implementable (HGL, 2018).

The MEC HA categorizes Alternative 1 as a “moderate potential explosive hazard condition” (i.e. Hazard Level 3). The Hazard Level would not change for Alternative 2, since no planned mass removal of MEC would occur; however, Alternative 2 takes action to mitigate potentially remaining MEC risks at the MRS through engineering and educational controls to restrict direct contact of the Industrial Receptor with the MEC. Alternatives 3 and 4 involve the physical removal of MEC to differing degrees, which both result in a MEC HA Hazard Level of 4, “low potential explosive hazard condition”. Although Alternatives 3 and 4 have the same Hazard Level, the MEC HA score is lower for Alternative 4 (355) than for Alternative 3 (390). The lower score for Alternative 4 indicates there is less of an explosive hazard condition due to a more robust removal action that involves both surface and subsurface MEC; whereas, only surface removal of MEC is performed under Alternative 3 (HGL, 2018).

9.0 PREFERRED ALTERNATIVE

The Surface and Subsurface Removal alternative is the Preferred Alternative for the Block D Igloo MRS. The Preferred Alternative satisfies the RAOs for the Block D Igloo MRS by reducing the unacceptable hazards of DoD military munitions for the Industrial Receptor in surface and subsurface soils and in sediment at the saturated and surface water areas at the MRS. Alternative 4 is a CERCLA preference since it attains UU/UE, is protective of human health and the environment, is ARAR compliant, and provides the best combination of primary balancing attributes that allow for the anticipated future land use.

This recommendation is not a final decision. The Army, in coordination with Ohio EPA, will select the alternative for the Block D Igloo MRS after reviewing and considering all comments submitted during the 30-day public comment period.

9.1 Summary Statement

Based on the information currently available, the ARNG believes that the preferred Surface and Subsurface Removal alternative meets the threshold criteria and provides the best overall protection of the public. The ARNG expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs (or justify a waiver); (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principle element, or explain why the preference for treatment will not be met.

10.0 COMMUNITY PARTICIPATION

Public participation is an important component of the alternative selection process. The Army, in coordination with the Ohio EPA, is soliciting input from the community on the preferred alternative. The comment period extends from March 1 to April 3, 2019. This period includes

a public meeting at which the Army will present this Proposed Plan. The Army will accept oral and written comments on the Proposed Plan at this meeting.

10.1 Public Comment Period

The 30-day comment period extends from March 1 to April 3, 2019, and provides an opportunity for public involvement in the decision-making process for the proposed action. The public is encouraged to review and comment on this Proposed Plan. All public comments will be considered by the Army and Ohio EPA before selecting an alternative. During the comment period, the public is also encouraged to review documents pertinent to the Block D Igloo MRS. This information is available at the Information Repositories and online at www.rvaap.org. To obtain further information, contact the Camp Ravenna Environmental Office.

10.2 Public Meeting

The Army will hold an open house and public meeting on this Proposed Plan on March 6, 2019, at the Charlestown Town Hall, 6368 Rock Spring Road, Ravenna, Ohio 44266. This meeting will provide an opportunity for the public to comment on the proposed action. Comments made at the meeting will be transcribed.

10.3 Written Comments

If the public would like to provide comments, questions, or suggestions on this Proposed Plan or other relevant issues in writing, they should be delivered to the Army at the public meeting or mailed (postmarked no later than April 3, 2019). The public can also submit comments, questions, or suggestions via email before the end of the comment period to the Camp Ravenna Environmental Office at kathryn.s.tait.nfg@mail.mil.

POINT OF CONTACT FOR WRITTEN COMMENTS

Ms. Kathryn Tait
Camp Ravenna Environmental Office
1438 State Route 534 SW
Newton Falls, Ohio 44444

10.4 Army Review of Public Comments

The Army will review the public's comments as part of the process in reaching a final decision for the most appropriate action to be taken. A **Responsiveness Summary**, a document that summarizes the Army's responses to comments received during the public comment period, will be included in the ROD. The Army's final choice of action will be documented in the ROD. The ROD will be added to the RVAAP Administrative Record and Information Repositories.

This page intentionally left blank.

GLOSSARY OF TERMS

2,4,6-Trinitrotoluene (TNT): An explosive used in military shells, bombs, and grenades, in industrial uses, and in underwater blasting. TNT production in the U.S. occurs solely at military arsenals.

Administrative Control: Direction or exercise of authority over subordinate or other organizations in respect to administration and support, including organization of Service forces, control of resources and equipment, personnel management, unit logistics, individual and unit training, readiness, mobilization, demobilization, discipline, and other matters not included in the operational missions of the subordinate or other organizations.

Administrative Record: This is a collection of documents, typically reports and correspondence, generated during site investigation and remedial activities. Information in the Administrative Record is used to select the Preferred Alternative. It is available for public review at the Ravenna Army Ammunition Plant, Building 1037; call (330) 358-7311 for an appointment.

Alternative Selection Process: A part of the CERCLA process, typically from the Proposed Plan through the ROD that involves public participation in identifying the preferred alternative. The final selection of the preferred alternative is made in the ROD after taking into consideration the recommendations in the Proposed Plan and any comments received from the public during the 30-day comment period.

Ammonium Nitrate: A chemical compound that is predominantly used in agriculture as a high-nitrogen fertilizer. Its other major use is as a component of explosive mixtures used in mining, quarrying, and civil construction.

Analog Magnetometer: An instrument that measures magnetism associated with metal items that contain iron (i.e., ferrous). A compass is a simple example of a magnetometer, one that measures the direction of a magnetic field. An analog magnetometer is less complex than a digital magnetometer and produces a sound or signal when metal items are encountered.

Awareness Training Program: Training that is implemented as an educational control at Camp Ravenna to provide informational materials on DoD military munitions recognition, avoidance, and encounter protocols.

Annual monitoring: Inspections that are conducted on a yearly basis.

Anomaly: An item seen as a subsurface irregularity (i.e., deviates from expected subsurface items such as pipes, utility lines, etc.) after geophysical investigations.

Antimony: Antimony is naturally occurring in the earth's crust. Antimony is commonly alloyed with lead to increase lead's durability. Long-term exposure by inhalation, ingestion, and skin contact can cause serious health effects.

Applicable or Relevant and Appropriate Requirements (ARARs): The federal and state requirements that a selected alternative will attain. These requirements may vary among sites and alternatives.

Archives Search Report (ASR): An initial historical records search for the presence of ordnance and explosives at the MRS.

Area of Concern (AOC): A term used by regulatory bodies to refer to environmentally sensitive or damaged areas.

Arsenic: Inorganic arsenic compounds are found in soils, sediments, and groundwater. These compounds occur either naturally or as a result of mining, ore smelting, and industrial use of arsenic. Long-term exposure to high levels of inorganic arsenic in drinking water has been associated with skin disorders and increased risks for diabetes, high blood pressure, and several types of cancer.

Background Value: Concentrations of chemicals in environmental media in the immediate area of an environmentally impacted site. Background values can be naturally occurring (i.e., the concentration is not due to a release of chemicals from human activities), or anthropogenic (i.e., the presence of a chemical in the environment is due to human activities, but is not the result

GLOSSARY OF TERMS

of site-specific use or release of waste or products, or industrial activity).

Baseline: A minimum or starting point used for comparison.

Biological Inventory: An attempt to document and identify all biological species living in some defined area.

Blow-In-Place: When DoD military munitions cannot be moved, a donor explosive is attached to the item where it was found and is used to trigger a high-order detonation that results in complete destruction of the item.

Booster: A sensitive explosive charge that acts as a bridge between a (relatively weak) conventional detonator and a low-sensitivity (but typically high-energy) explosive such as TNT. By itself, the initiating detonator would not deliver sufficient energy to set off the low-sensitivity charge. However, it detonates the primary charge (the booster), which then delivers an explosive shockwave sufficient to detonate the secondary, main, high-energy charge.

Capital Cost: This includes costs associated with construction, treatment equipment, site preparation, services, transportation, disposal, health and safety, installation and startup, administration, legal support, engineering, and design associated with remedial alternatives.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): This federal law was passed in 1980 and is commonly referred to as the Superfund Program. It provides for liability, compensation, cleanup, and emergency response in connection with the cleanup of inactive hazardous waste release sites that endanger public health or the environment.

Composite Sample: A composite sample is made by combining several smaller samples from individual locations from the same area in a site and then sending a portion to the lab.

Consolidated Detonation: MEC that is considered acceptable to move and is transported off of the MRS to a designated location for controlled destruction. The MEC may be destroyed with other MEC that was

found at the facility and was transported to the same designated location.

Demilitarization: The reduction of one or more types of weapons or weapons systems.

Department of Defense (DoD) Military Munitions: A munition or explosive deposited by DoD activities that may pose an explosive safety risk because it either did not function as designed, was discharged and/or abandoned, or is an explosive constituent. The term includes UXO, discarded military munitions, and MC-related contamination.

Depot Storage: A designated location for the storage of military supplies.

Digital Magnetometer: An instrument that measures magnetism associated with metal items that are iron-containing (i.e., ferrous). A compass is a simple example of a magnetometer, one that measures the direction of a magnetic field. A digital magnetometer is more complex than an analog magnetometer and can map and produce outputs of data of the metal items that are encountered.

Discarded Military Munitions: Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include UXO, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Discrete Soil Sample: A single soil sample taken at a specific location.

Dredging: An underwater excavation activity in shallow water areas with the purpose of gathering up bottom sediments.

DoD Military Munitions: All ammunition products and components under the control of the U.S. Department of Defense that are produced for or used by the armed forces for national defense and security.

Earthen Settling Pond: An earthen structure that uses sedimentation to remove settleable matter and turbidity from wastewater.

GLOSSARY OF TERMS

Ecological Receptor: A suite of wildlife species chosen to characterize the exposure scenarios for a particular representative habitat.

Ecological Risk Assessment: The process for evaluating how likely it is that the environment may be impacted as a result of exposure to one or more environmental stressors such as chemicals, land change, disease, invasive species and climate change.

Educational Controls: Programs geared toward notification of existing conditions, existing engineering controls, and potential hazards to visitors, Camp Ravenna personnel, contractors, and utility workers.

Engineering Controls: Physical structures that warn of hazards or prevent access to a site.

Environmental Sampling: The isolation and careful gathering of specimens of interest in a given environmental study.

Erosion: The action of surface processes (such as water flow or wind) that remove soil, rock, or dissolved material from one location on the Earth's crust, then transport it away to another location.

Excavation: The act of digging to removal soil or other earthen material.

Explosive Hazard: Any hazard containing an explosive component. Explosive hazards include UXO (including land mines), booby traps, improvised explosive devices, and bulk explosives.

Exposure Pathway: The means by which a person can interact with a hazard, such as encountering MEC at the MRS. If a pathway is complete, then a person can encounter MEC. If a pathway is incomplete, then a person cannot encounter MEC. If a pathway is potentially complete, it is suspected that a person may be able to contact MEC but it is not confirmed.

Exposure Point: Exposure to something dangerous (i.e., explosive and/or chemical hazard) that causes harm to a receptor.

Feasibility Study (FS): This CERCLA document reviews and evaluates multiple remedial technologies under consideration at

the site. It also identifies the preferred remedial action alternative.

Federally-Threatened Species: Species for which a final rule has been published in the Federal Register to list the species as threatened. Species is legally protected by the Endangered Species Act.

Filling: Placing a material to seal a space or void.

Five-Year Review: Required by CERCLA or program policy when hazardous substances remain on site above levels that permit unrestricted use and unlimited exposure. Five-year reviews provide an opportunity to evaluate the implementation and performance of a remedy to determine whether it remains protective of human health and the environment. Reviews take place five years following the start of a CERCLA response action and are repeated every five years so long as future uses remain restricted.

Flashing: A brief and instantaneous exposure of DoD military munitions to an intense heat that burns off potential explosive residues and renders it as MD. The MD can then be recycled or disposed as scrap metal.

Fragmentation Bomb: An aerial antipersonnel bomb that scatters shrapnel over a wide area upon explosion.

Freeze-Thaw Cycling: The natural process of freezing of the subsurface soils during cold temperatures followed by thawing as the soils warm. This process may result in "heaves" that move soils and objects from the subsurface closer to or onto the surface.

Frost Line: The maximum depth to which the groundwater in soil is expected to freeze.

Fuze: A device that detonates a munition's explosive material under specified conditions. In addition, a fuze has safety and arming mechanisms that protect users from premature or accidental detonation.

Georeferenced: The internal coordinate system of a map or aerial photo image that can be related to a ground system of geographic coordinates.

GLOSSARY OF TERMS

Historical Records Review (HRR): An in-depth review of historical documentation that identifies the types of activities previously conducted, the types of munitions used/stored, and historical finds and incidents associated with the MRS.

Human Health Risk Assessment: The process used to estimate the nature and probability of adverse health effects in humans who may be exposed to hazards in contaminated environmental media, now or in the future.

Human Receptor: Any human individual or population that is presently or will potentially be exposed to, and adversely affected by, the release or migration of contaminants or exposure to potentially explosive hazards.

Incremental Sampling Methodology (ISM): A sample collection and processing approach having specific elements designed to control data that is variable due to non-continuous distribution of contaminants in environmental media. ISM samples consist of collecting a sufficient number of discrete “increments” (typically 30 to 100) in an unbiased manner throughout a specified area, combining and variously processing the increments into a single larger sample, and incrementally separating out smaller samples (i.e., sub-samples) from the processed larger sample to obtain a representative aliquot (i.e., smaller sized sample) for analysis. Properly executed, the method provides unbiased, representative and reproducible estimates of the mean concentration of analytes for that sample area.

Industrial Receptor: A full-time occupational receptor at the MRS whose activities are consistent with full-time employees or career military personnel who are expected to work daily at Camp Ravenna over their career.

Information Repository: A collection of documents relating to a facility with investigations and response actions under CERCLA and/or a site’s permitting activity or corrective action. It includes documents and information about site activities as well as general information about environmental regulations and CERCLA. The purpose of an Information Repository is to (1) ensure open and convenient public access to site-related

documents and (2) better inform the public of the restoration process.

Institutional Analysis: An evaluation of: the type(s) of use restrictions necessary at a site, potential LUCs that might be relied upon to implement the selected restrictions, potential parties who may be responsible for long-term LUC activities, criteria for terminating the LUCs, issues that might impact the effectiveness of the LUCs, estimated costs, and funding sources.

Instrument-Aided Surface Sweep: An MMRP inspection and removal process whereby UXO-qualified personnel determine for the presence of DoD military munitions on or just below the ground surface using a hand-held analog instrument such as a Schonstedt.

Interaction: Mutual or reciprocal action or influence.

Iron: Iron by mass is the most common element on Earth, forming much of Earth's outer and inner core. Iron chemical compounds have many uses. Iron oxide mixed with aluminum powder can be ignited to create a thermite reaction. Iron is essential to almost all living things; however, exposure too much iron may cause conjunctivitis, choroiditis, and retinitis if it contacts and remains in the tissues. Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in impacts to the lungs.

Land Use Controls (LUCs): Used in CERCLA remedies to prevent or control exposures of potential receptors to contamination remaining in place at the site and to assure continued effectiveness of the response action. LUCs include access controls and monitoring.

Large-Caliber Shell: A projectile or shell is a missile fired from the muzzle of a gun or cannon. Projectiles above 7 inches in caliber are considered large-caliber.

Lead: Lead is ubiquitous in the environment, and human exposure arises from both natural and anthropogenic activities. Exposure from lead at high enough concentrations to receptors is typically through ingestion or inhalation. Long-term exposure

GLOSSARY OF TERMS

predominantly impacts the central nervous system.

Maintenance: Actions necessary for retaining or restoring an area to the specified operable condition to achieve its maximum useful life.

Manual Digging: Excavation by individual persons using hand tools.

Maximum Fragmentation Distance: The furthest distance that fragments associated with a particular munitions type is anticipated to travel once detonated or discharged in accordance with the DoD Explosives Safety Board Technical Paper 16, Methodologies for Calculating Primary Fragments.

Munitions and Explosives of Concern (MEC): A munitions or explosive that may pose an explosive safety risk because it either did not function as designed, was discharged and/or abandoned, or is an explosive constituent. MEC includes UXO, discarded military munitions, and explosive constituents of munitions present in high enough concentrations to pose an explosive hazard.

MEC Avoidance: A process where UXO-qualified personnel provide construction support for munitions response actions by evaluating and determining for potential DoD military munitions confirmed as MEC in order to mitigate the potential explosive hazards for onsite workers.

MEC Hazard Assessment (MEC HA): A methodology for assessing potential explosive hazards to human receptors at munitions response sites. The MEC HA allows a project team to evaluate the potential explosive hazard associated with an MRS, given current conditions and under various cleanup, land use activities, and LUC alternatives.

Military Munitions Response Program: A U.S. Department of Defense program consisting of actions necessary to ensure protection of human health, welfare, and the environment from the hazards associated with DoD military munitions and MC-related contamination at locations impacted by historical military activities.

Military Training: The instruction of personnel to enhance their capacity to perform specific military functions and tasks.

Mobility: The ability to move or to be moved freely and easily.

Munitions Constituents (MC): Any material originating from UXO, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Munitions Debris (MD): Remnants of military munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

Munitions Response Site (MRS): Any area on a defense site that is known or suspected to contain DoD military munitions or MC-related contamination.

Munitions Response Site Prioritization Protocol: The methodology developed by the Army for prioritizing MRSs for response actions under the MMRP.

Muzzle Velocity Measurement: The measurement of the speed of a projectile by a chronograph as it leaves the muzzle of the firing mechanism.

National Contingency Plan (NCP): The *National Oil and Hazardous Substances Pollution Contingency Plan*. These CERCLA regulations provide the federal government the authority to respond to the problems of abandoned or uncontrolled hazardous waste disposal sites as well as to certain incidents involving hazardous wastes (e.g., spills).

Native Soil: The primary location where a soil type can be expected to be found.

Natural Resource Management: Management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations.

Nitroguanidine: An organic compound that is colorless and is in crystalline solid form. It is not flammable and is a low-sensitivity

GLOSSARY OF TERMS

explosive; however, its detonation velocity is high. It is used as a propellant, fertilizer, and for other purposes

Operation and Maintenance Cost: Annual post-construction cost necessary to ensure the continued effectiveness of a remedial action.

Periodic Cost: Post-construction cost that occur on an infrequent basis (i.e., not annually) and are necessary to ensure the continued effectiveness of a remedial action

Planning-Level Survey: Installation-wide inventories that are conducted to characterize essential components of the installation natural resources - landform, soil, water, and biota. The kinds, locations, and sensitivity of the resources serve as the foundation for environmental planning, including preparation of the *Integrated Natural Resource Management Plan*.

Preferred Alternative: The best remedial response presented in the FS that meets the RAOs as identified in coordination by the U.S. Department of the Army and the Ohio EPA. The determination to make this alternative “final” is made after reviewing and considering all comments submitted during the 30-day public comment period.

Preliminary Remediation Goals: The Preliminary Remediation Goals (currently the Regional Screening Levels) are developed by Environmental Protection Agency Region 9 and provide a source of comparison values for residential and commercial/industrial exposures to soil, air, and drinking water. These standards are often used in the absence of established screening or cleanup goals for a site or facility.

Present Worth: Used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year. This allows the cost of the remedial alternatives to be compared on the basis of a single figure representing the amount of money that would be sufficient to cover capital and operation and maintenance costs associated with each remedial alternative over its life.

Primer: A primer, also known as a blasting cap, is a small, sensitive, primary explosive

device generally used to detonate a larger, more powerful and less-sensitive secondary explosive such as TNT, dynamite, or plastic explosive. Primers come in a variety of types, including nonelectric caps, electric caps, and fuse caps.

Production: The action of making or manufacturing from components or raw materials.

Promulgated: Promoted or made widely known.

Proposed Plan: This CERCLA document provides the public with information necessary to participate in the selection of an alternative. It is designed to solicit public comment on a preferred alternative before a ROD is established.

Rare Species: A group of organisms that is uncommon or scarce. The designation may be applied to either plant or animal taxon, and may be distinct from the term endangered or threatened species. Designation of a rare species may be made by an official body such as the federal government, state, or province.

Reacquire: To come into possession of find again.

Receptor: See human receptor.

Record of Decision (ROD): A legal record signed by the U.S. Department of the Army and Ohio EPA. It describes the cleanup action or alternative selected for a site, the basis for selecting those alternative, public comments, responses to comments, and the estimated cost of the alternative.

Regulatory: Serving or intended to control or maintain something.

Remedial Action: The actual construction or implementation phase of a CERCLA site cleanup that follows Remedial Design.

Remedial Alternative: A response action scenario that is identified and screened in the Feasibility Study. The alternatives identified may range from No Action to a response action that attains UU/UE.

Remedial Decision: A formal, written communication from the regulating authority that approves a site investigation, identifies

GLOSSARY OF TERMS

the preferred alternative, and approves the remedial action, if any, at a site.

Remedial Action Objective (RAO): The phase of the CERCLA process when the selected remedy is in place and is operating, leading to the cleanup objective. The RAO may include active remediation, monitoring, operation, and optimization for extended periods of time to reduce contaminants to site cleanup standards; along with implementation and management/maintenance of LUCs.

Remedial Investigation (RI): A CERCLA investigation that involves sampling environmental media, such as air, soil, and water, to determine the nature and extent of contamination and to calculate human health and environmental risks that result from the contamination.

Renovation: The process of improving a broken, damaged, or outdated structure or piece of equipment.

Research Department Explosives: A hard, white crystalline solid, insoluble in water and only slightly soluble in some other solvents. Sensitive to percussion, its principal nonmilitary use is in blasting caps. It is often mixed with other substances to decrease its sensitivity.

Responsiveness Summary: A section of the ROD where the U.S. Department of the Army documents and responds to written and oral comments received from the public about the Proposed Plan.

Sedimentation: The tendency for particles in suspension to settle out of the fluid (i.e., storm water or standing water) in which they are entrained and come to rest against a barrier.

Site Inspection (SI): Part of the CERCLA evaluation process that is conducted following a Preliminary Assessment to further evaluate the extent to which a site presents a threat to human health or the environment.

Source: The location at the MRS where DoD military munitions and/or MC-related contamination is situated in the environment,

or are expected to be found, and can come into contact with a receptor.

State-Listed Species of Concern: A species or subspecies that falls under the jurisdiction of the Ohio Department of Natural Resources and which might become threatened in Ohio under continued or increased stress.

Statutory: A written law that is regulated, permitted, or enacted by a legislative body.

Storage Bunkers: A reinforced concrete military structure that is mostly below ground and is designed to provide safe storage and handling of munitions.

To-Be Considered (TBC) Guidance: Federal and state environmental public health programs that develop criteria, advisories, guidance, and proposed standards that are not legally binding but may provide useful information or recommended procedures.

Toxicity: The degree to which a substance can damage an organism.

Underwater Tactile Investigation: Exploration for submerged DoD military munitions in sediments by former Navy Explosive Ordnance Disposal divers that requires determination of anomalies as an explosive hazard by sense of touch only.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

GLOSSARY OF TERMS

UXO Qualified Personnel: Workers, typically with former Army or Navy explosive ordnance and disposal backgrounds, that are specially trained to handle conventional and unconventional weapons for secured disposal.

Unlimited Use/Unrestricted Exposure (UU/UE): There are no restrictions placed on the potential future use of land or other natural resources.

Unrestricted (Residential) Land Use: Contaminated land that has been cleaned up to a standard that allows for residential housing, the most conservative land use as opposed to commercial or industrial, without any limitations.

Volume: The amount of space that a substance or object occupies.

Weapons Demilitarization Facility: A facility or installation involved in the reduction of a nation's army, weapons, weapons systems, or military vehicles to an agreed upon minimum.

Wetland: A land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydric soil.

REFERENCES

Army National Guard (ARNG), 2014. *Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the Ravenna Army Ammunition Plant (RVAAP) Installation Restoration Program*, Portage/Trumbull Counties, Ohio, February.

CB&I Federal Services LLC (CB&I), 2015. *Final Remedial Investigation Report for RVAAP-019-R-01 Landfill North of Winklepeck MRS and RVAAP-060-R-01 Block D Igloo MRS*, Version 1.0, prepared for the U.S. Army Corps of Engineers, Baltimore District, March.

engineering-environmental Management, Inc. (e²M), 2007. *Final Military Munitions Response Program Historical Records Review*, Ravenna Army Ammunition Plant, Ohio, January.

e²M, 2008. *Final Site Inspection Report*, Ravenna Army Ammunition Plant, Ohio, Military Munitions Response Sites, Ravenna Army Ammunition Plant, Ohio, May.

HydroGeoLogic, Inc. (HGL), 2018. *Final Feasibility Study for RVAAP-060-R-01 Block D Igloo Munitions Response Site*, Version 1.0, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio, April.

Ohio Environmental Protection Agency (Ohio EPA), 2004. *Director's Final Findings and Orders*, June 10.

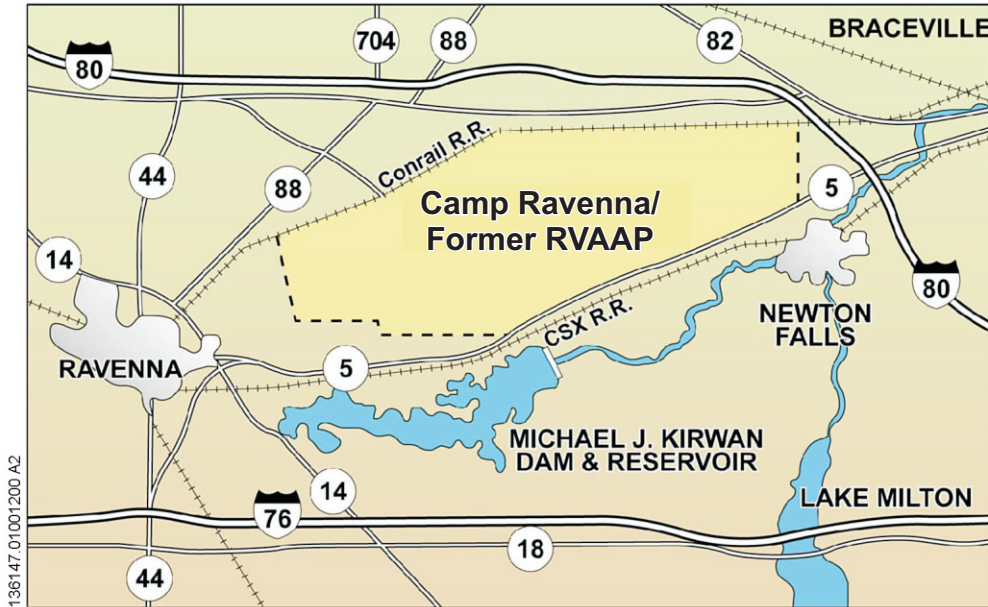
U.S. Army Corps of Engineers (USACE), 2004. *Defense Environmental Restoration Program, Ordnance and Explosives, Archives Search Report for the Ravenna Army Ammunition Plant*, Ravenna, Ohio, June.

USACE, 2016. *Technical Project Planning Process*, Engineering Manual (EM) 200-1-2, February 29.

This page intentionally left blank.

FIGURES

This page intentionally left blank.




136147_01001200_A2



\\Gst-srv-01\HGLGIS\Ravenna_AAP\FBQ\FS\
 (01)Location_Map.cdr
 2/5/2018 JAR
 Source: CB&I



Legend
 Camp Ravenna/Former RVAAP





Note:
 RVAAP=Ravenna Army Ammunition Plant

Figure 1
Location Map
Camp Ravenna/
Former RVAAP
Portage and Trumbull
Counties, Ohio

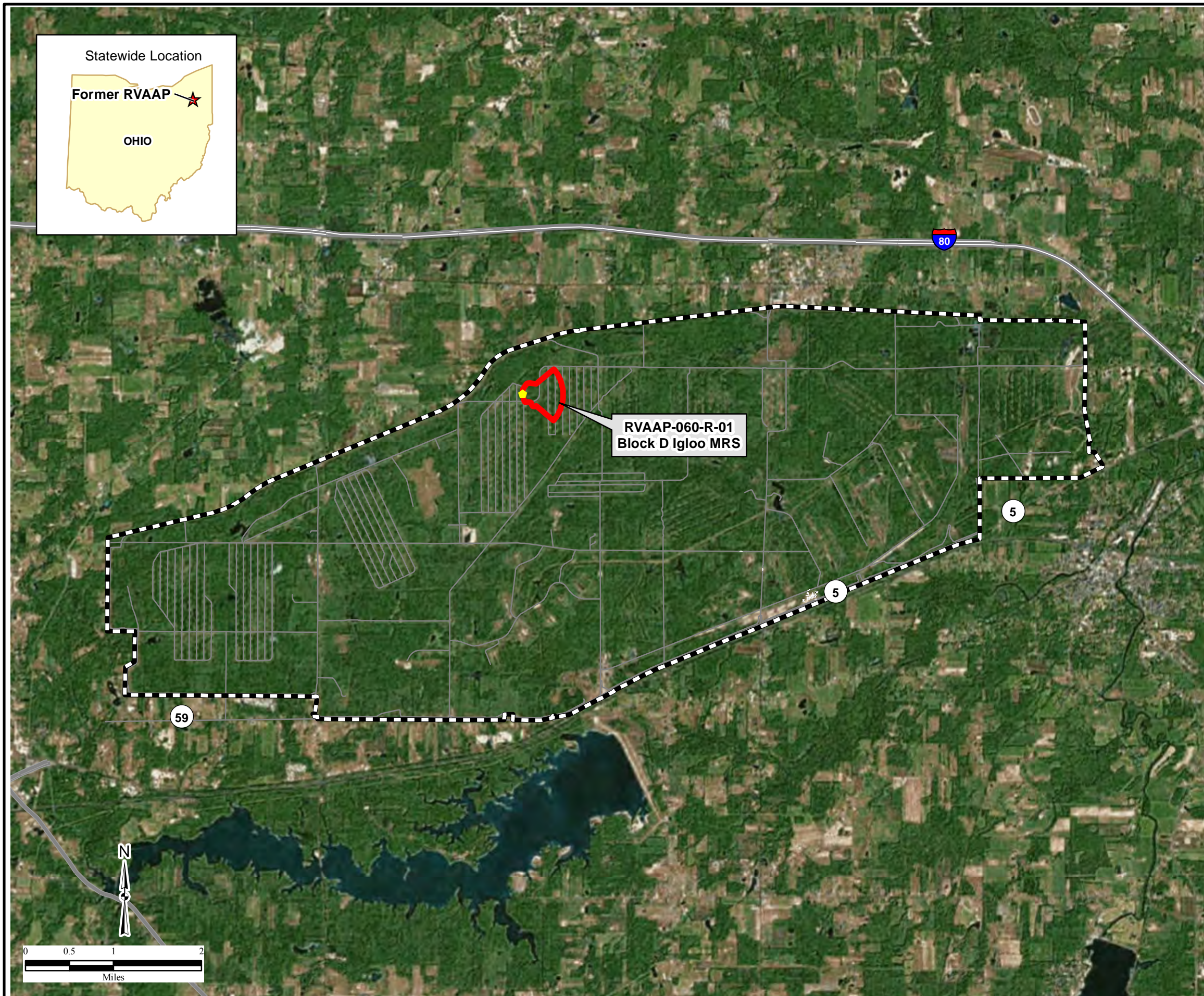
This page intentionally left blank.

Figure 2
MRS Location Map
Camp Ravenna/Former RVAAP
Portage/Trumbull Counties, Ohio

Legend

-  Location of Former Igloo 7-D-15
-  RVAAP-060-R-01 Block D Igloo MRS Boundary
-  Camp Ravenna Facility Boundary
-  Road

Notes:
MRS denotes Munitions Response Site
RVAAP denotes Ravenna Army Ammunition Plant

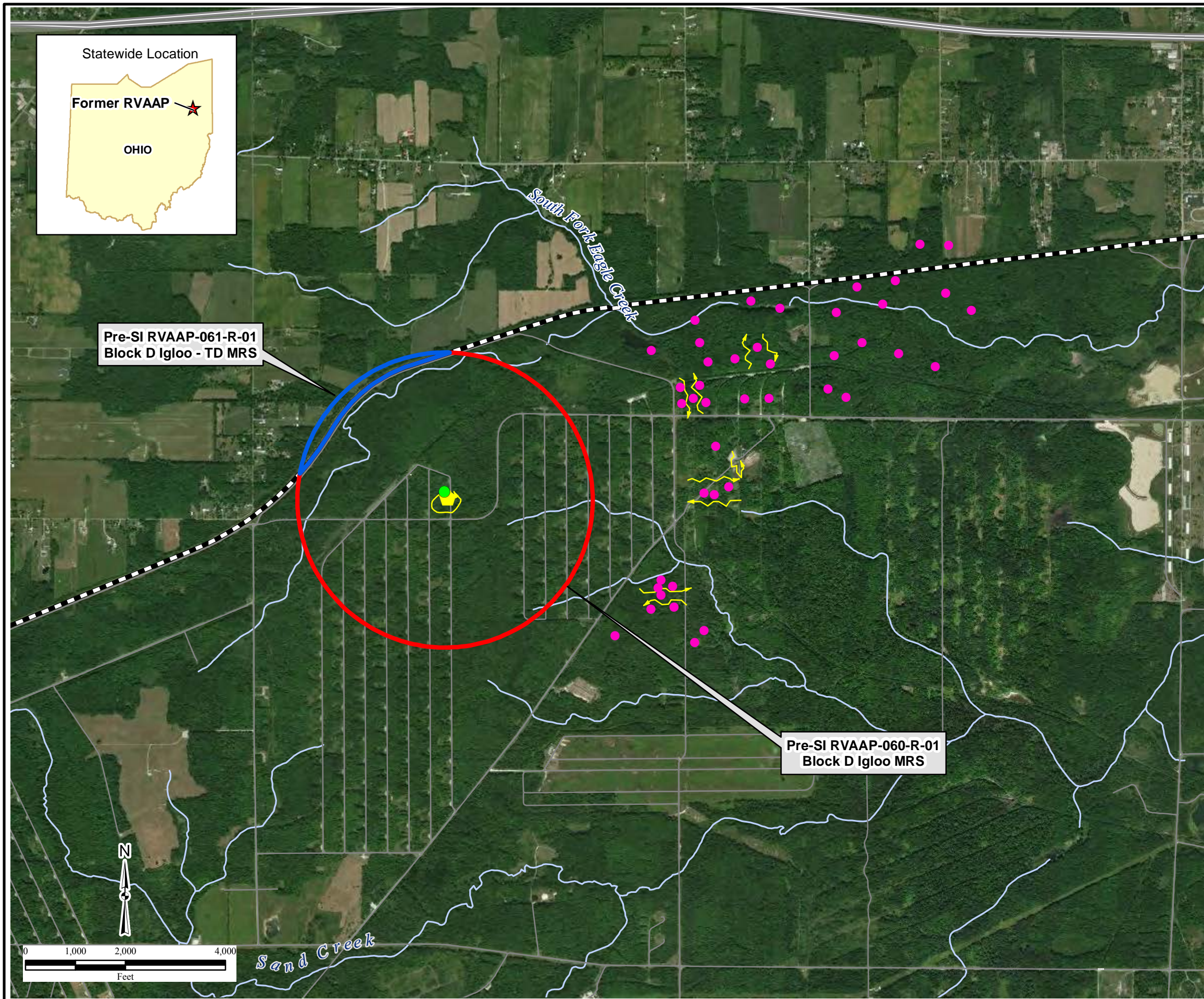


H:\MAMMS\Ravenna\GIS_Documents\Project_Maps
HGL\March2017\Block_D_Igloo_FS\HGL_RVAAP_BDI_001_Fig1_2_Site_Map.mxd
3/23/2017 JWR
Source CB&I












This page intentionally left blank.

Figure 3
SI MRS Boundaries Map
Block D Igloo MRS
Camp Ravenna/Former RVAAP
Portage/Trumbull Counties, Ohio



Legend

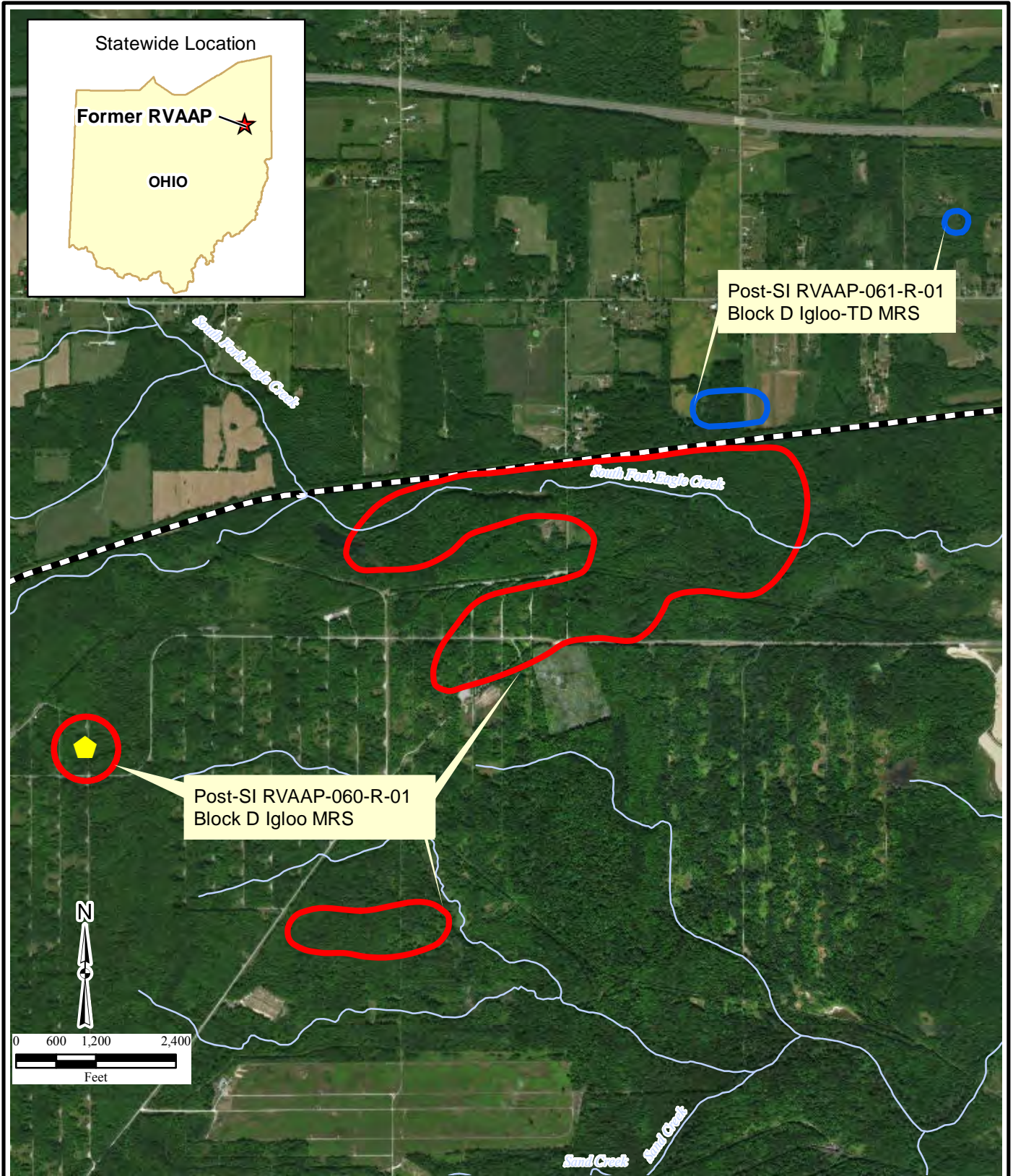
-  Location of Former Igloo 7-D-15
-  MC Soil Sample Location
-  Location of Non-munitions Debris From the 1943 Explosion of Igloo 7-D-15
-  Survey Transects
-  Pre-SI RVAAP-060-R-01 Block D Igloo-TD MRS
-  Pre-SI RVAAP-061-R-01 Block D Igloo MRS
-  Facility Boundary
-  Road
-  Stream

Notes:
MRS=munitions response site
RVAAP=Ravenna Army Ammunition Plant

H:\MAMMS\Ravenna\GIS_Documents\Project_Maps
HGL\May2018\Block_D_Igloo_PPI
HGL_RVAAP_BDI_003_Fig3_BlockDIgloo_SI_MRS_Bound.mxd
05/03/2018 JWR
Source Aptim



This page intentionally left blank.



H:\MAMMS\Ravenna\GIS_Documents\Project_Maps
 HGL\May2018\Block_D_Igloo_PP
 HGL_RVAAP_BDI_004_Fig4_BlockDIgloo_Post_
 SI_SiteFeatures.mxd
 05/03/2018 JWR
 Source Aptim






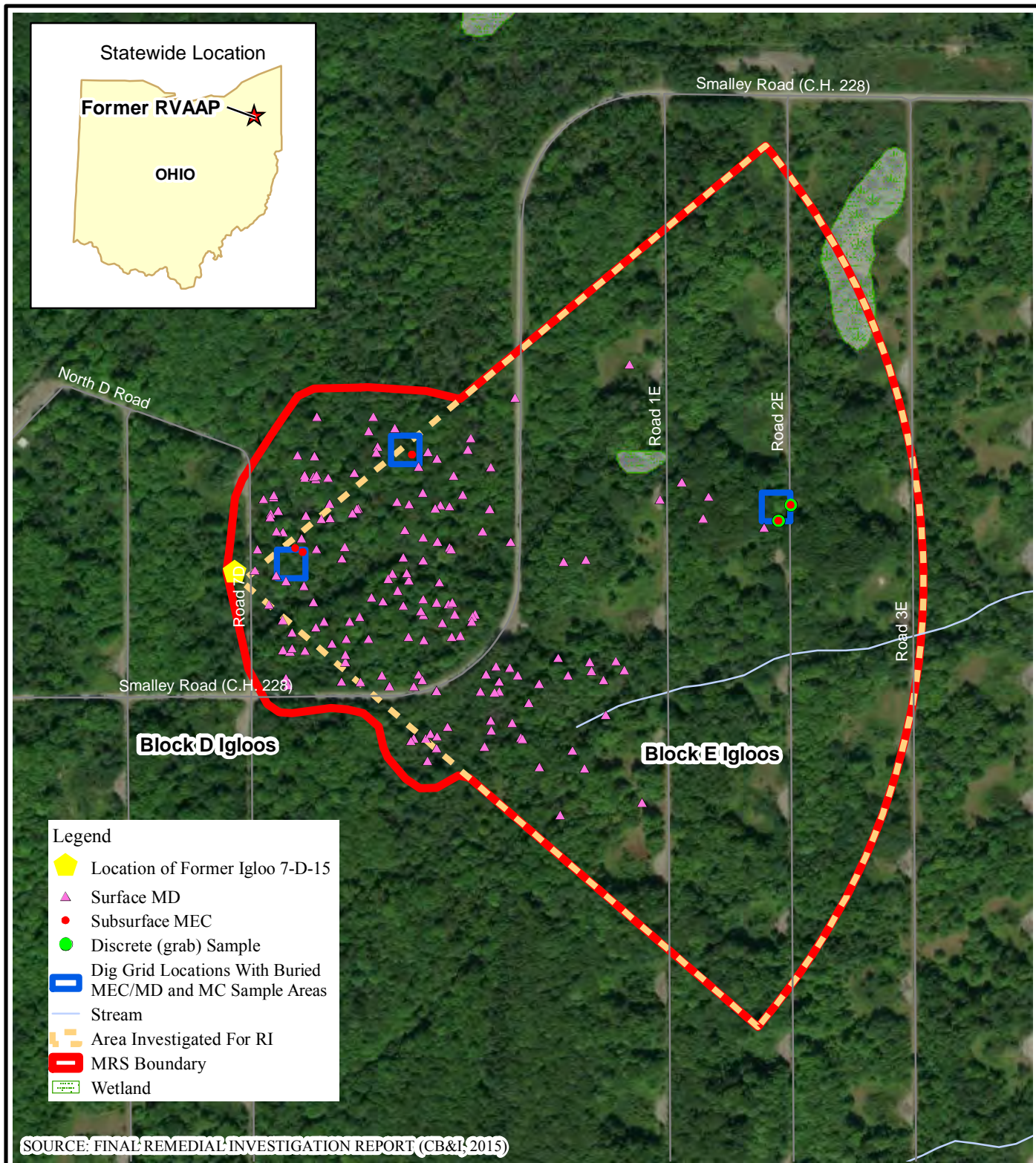
-  Location of Former Igloo 7-D-15
-  Stream
-  Post-SI Block D Igloo MRS
-  Post-SI Block D Igloo-TD MRS
-  Facility Boundary

Figure 4
Post-SI MRS Boundaries Map
Block D Igloo MRS
Camp Ravenna/Former RVAAP
Portage/Trumbull Counties, Ohio



This page intentionally left blank.



H:\MAMMS\Ravenna\GIS_Documents\Project_Maps
 HGL\May2018\Block_D_Igloo_PP
 HGL_RVAAP_BDL_005_Fig5_BlockDigloo_Post_
 RI_Bounds_Map.mxd
 07/10/2018 JWR
 Source APTIM

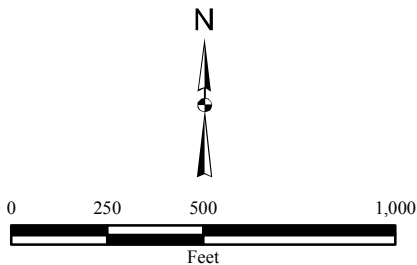
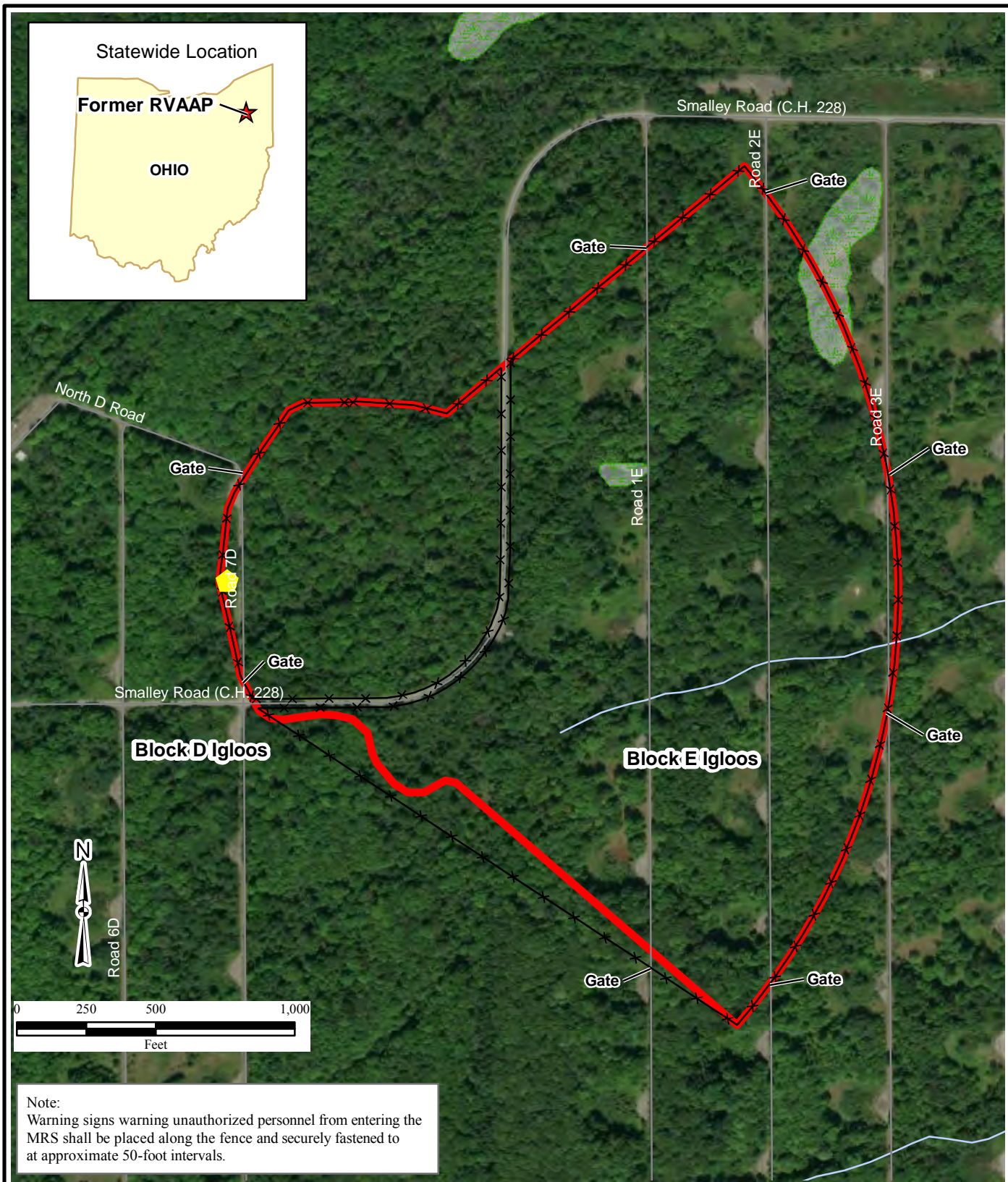


Figure 5
 Post RI MRS Boundaries Map
 Block D Igloo MRS
 Camp Ravenna/Former RVAAP
 Portage/Trumbull Counties, Ohio



This page intentionally left blank.



Note:
Warning signs warning unauthorized personnel from entering the MRS shall be placed along the fence and securely fastened to at approximate 50-foot intervals.

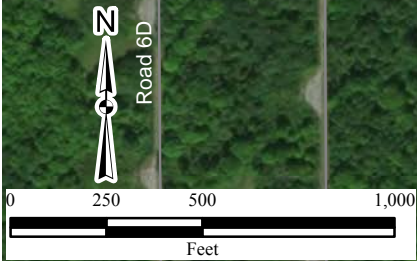
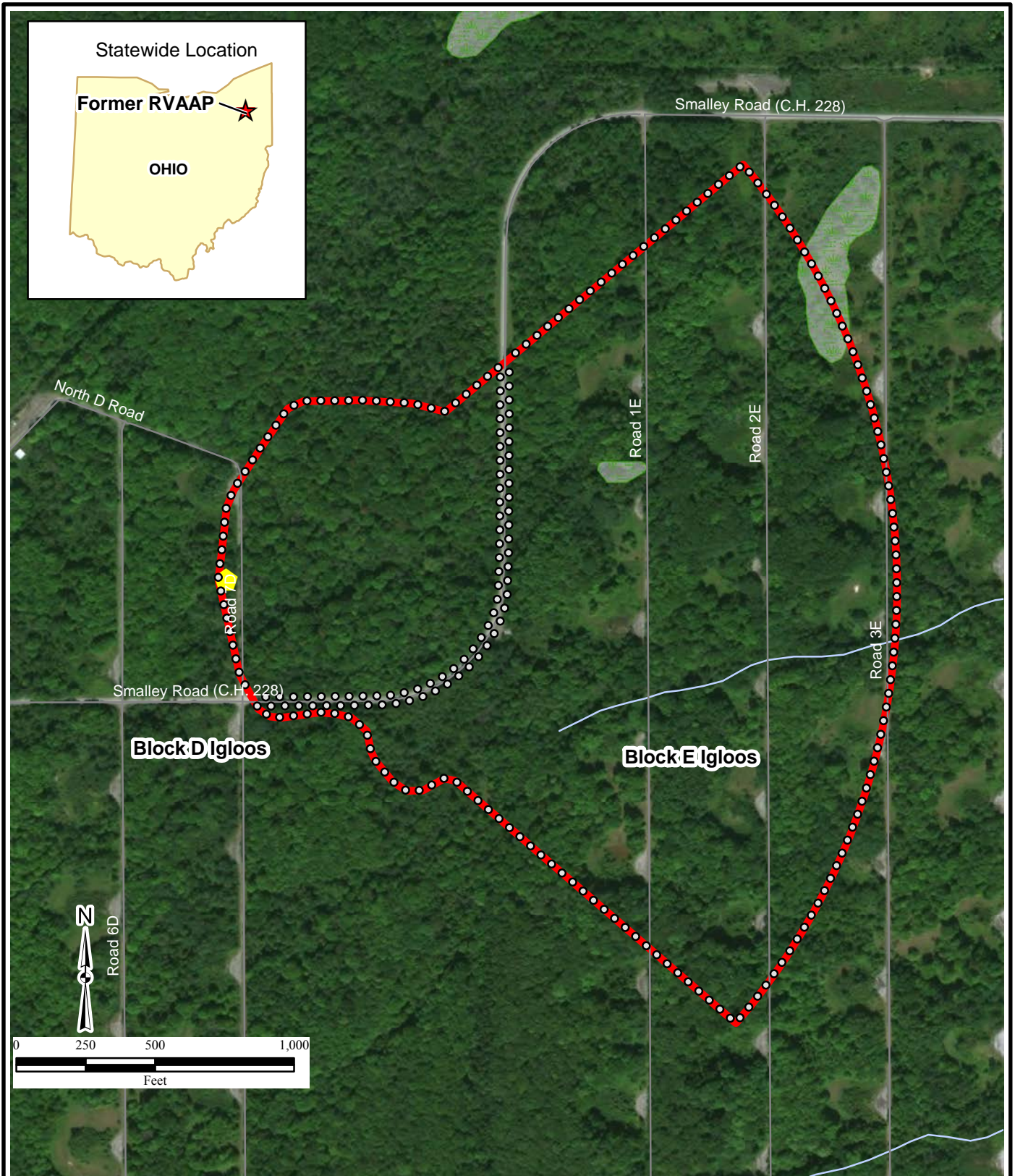
H:\MAMMS\Ravenna\GIS_Documents\Project_Maps
 VGL\July2018\Block_D_Igloo_PP
 VGL_RVAAP_BDI_006_Fig6_BlockDIgloo_CLF_Map.mxd
 07/19/2018 JWR
 Source Aptim

Legend

- Location of Former Igloo 7-D-15
- Stream
- Munitions Response Site Boundary
- Wetland
- Proposed 8' High Chain-Link Fence

Figure 6
Chain Link Fence Location
Block D Igloo MRS
Camp Ravenna/Former RVAAP
Portage/Trumbull Counties, Ohio

This page intentionally left blank.



H:\MAMMS\Ravenna\GIS_Documents\Project_Maps
 VHGL\May2018\Block_D_Igloo_PP
 VHGL_RVAAP_BDI_007_Fig_7_BlockDIgloo_Siebert_Map.mxd
 05/30/2018 JWR
 Source Aptim

Legend






-  Location of Former Igloo 7-D-15
-  Stream
-  Munitions Response Site Boundary
-  Wetland
-  Siebert Stake/Sign Post (50 foot spacing)

Figure 7
Siebert Stake and Sign Locations
Block D Igloo MRS
Camp Ravenna/Former RVAAP
Portage/Trumbull Counties, Ohio



This page intentionally left blank.