# Final
# Military Munitions Response Program
# Historical Records Review
# Ravenna Army Ammunition Plant, Ohio

***Submitted To:***

**US Army Corps of Engineers, Omaha District**
**CENWO-PM-HC**
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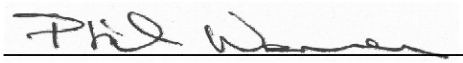
Prepared by: 
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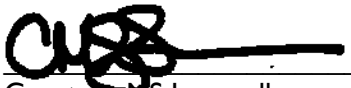
Reviewed by: 
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engineering-environmental Management, Inc (e²M) prepared this report at the direction of the US Army Corps of Engineers (USACE), Omaha District and, as such, this document should be used only with the approval of the USACE. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented therein.

## EXECUTIVE SUMMARY

Under contract with the United States Army Corps of Engineers (USACE), Omaha District; engineering-environmental Management, Inc. ($e^2M$) has prepared the following Historical Records Review (HRR) Report for the other than operational ranges and sites with known or suspected unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC) at Ravenna Army Ammunition Plant (RVAAP), located in Portage and Trumbull Counties, Ohio. These Munitions Response Sites (MRSs) at RVAAP are being evaluated under the United States (US) Army Military Munitions Response Program (MMRP).

The intent of the HRR is to perform a limited-scope records search to document historical and other known information on the MRSs identified at RVAAP to supplement the United States (US) Army inventory of closed, transferring and transferred (CTT) military ranges and defense sites with UXO, DMM or MC; and to support the Technical Project Planning (TPP) process designed to facilitate decisions on those areas where more information is needed to determine the next step(s) in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. Primary sources of information researched as part of the data collection effort for the HRR included an installation site visit; a review of existing historical documents, maps/drawings, photographs, and investigative reports comprising the Administrative Record (AR); interviews with installation personnel; and reviews of the US Army CTT Range/Site Inventory, Archive Search Report (ASR), and supporting documentation.

After reviewing the information collected during the HRR, the following conclusions have been made for the MRSs at RVAAP:

- Nineteen MMRP-eligible sites were identified during the US Army CTT Range/Site Inventory.
- Since the completion of that phase, Winklepeck Burning Grounds (WPG) (RVAAP-005-R-01)[1] has been addressed under Base Realignment and Closure (BRAC) and Installation Restoration Program (IRP) funding. Chemical contamination at the MRS was addressed under the IRP, whereas BRAC funding was used to address explosive safety. Further, the MRS is no longer eligible for the MMRP since the parcel is being developed as an operational range (Mark 19 Range) by the Ohio Army National Guard (OHARNG). Therefore, this MRS has been removed from the MMRP.

[1] Army Environmental Database-Restoration (AEDB-R) Number

- The remaining eighteen MRSs qualify due to the demolition and/or disposal activities that were conducted which resulted in the potential presence of munitions and explosives of concern (MEC) and/or MC, and where releases occurred prior to September 2002.

Furthermore, based on additional information collected during the HRR, the original site descriptions, acreage, and/or boundaries for six of the MRSs were modified. These modifications are summarized below:

- Ramsdell Quarry Landfill (RVAAP-001-R-01), realignment of the MRS boundary and increase in acreage from 3.79 acres to approximately 13.43 acres;
- Demolition Area #2 (RVAAP-004-R-01), realignment of the MRS boundary and increase in acreage from 14.91 acres to approximately 32.95 acres;
- Load Line #1 (RVAAP-008-R-01), realignment of the MRS boundary and decrease in acreage from 163.62 acres to approximately 4.63 acres;
- Load Line #12 (RVAAP-012-R-01), realignment of the MRS boundary and decrease in acreage from 77.58 acres to approximately 1.0 acre;
- Landfill North of Winklepeck (RVAAP-019-R-01), realignment of MRS boundary and increase in acreage from 7.55 acres to approximately 14.05 acres; and
- Firestone Test Facility (RVAAP-033-R-01), realignment of the MRS boundary and increase in acreage from 0.25 acres to approximately 0.91 acres.

*Ramsdell Quarry Landfill (RVAAP-001-R-01)*

Based on information provided by the Installation, the MRS boundary identified during the US Army CTT Range/Site Inventory may not capture the full extent of MEC, which may extend further to the north and south of the current MRS location. This was supported by information presented in the IRP reports which revealed the landfill is not situated in the bottom of the quarry where open burning/open detonation (OB/OD) operations took place, but rather along the southern and western rim of the excavation, which correlates to the location of the current MRS boundary. Based on this, it is understood the current MRS boundary does not completely encompass the OB/OD area formerly used to thermally treat explosives waste and munitions, thus the MRS boundary must be expanded. Further, under the MMRP any MEC that may be present in a capped and closed landfill is not eligible since this is considered a "Response Complete". Therefore, the MRS boundary has been expanded to the north to include the entire quarry area and to the south to include an area outside the quarry that was identified by the Installation as potentially containing MEC. In addition, the former landfill area has been removed from further consideration as part of the MRS.

*Demolition Area #2 (RVAAP-004-R-01)*

The 2003 US Army CTT Range/Site Inventory reported that Demolition Area #2 encompassed approximately 14.91 acres, which included a 2.5 acre interim Resource Conservation and Recovery Act (RCRA) unit that was permitted to demilitarize munitions. During the HRR research it was determined that the locations of two known munitions burial sites (i.e., Burial Sites 1 and 2) and a dump area known as the Sand Creek Disposal Area (also referred to as Rocket Ridge) had not been mapped as part of the MRS during the inventory. These areas, and the areas located between them, were found to be MMRP-eligible and have now been included as part of the Demolition Area #2 MRS.

Two areas located within the MRS footprint were determined to be non-MMRP eligible. The 2.5 acre interim RCRA unit and a majority of the area that was previously used as a 40millimeter (mm) prototype test range that overlies the interim RCRA unit have been removed from consideration as part of the MRS (RVAAP-6.A.4). Only the small portion of the old prototype test range that extends to the north and outside of the interim RCRA unit is MMRP-eligible and will be included as part of the MRS. The interim RCRA unit will be closed in accordance with all applicable state and Federal regulations and requirements at the end of the IRP investigation. Based on the realignment and addition of new areas, the MRS footprint has been increased to approximately 32.95 acres. Additional information was provided by the Installation that indicated that there is a bomb disposal area located near the northwestern portion of the MRS. While this could not be corroborated by additional documentation, the area will be recommended for further investigation during the site Inspection (SI) process.

*Load Line #1 (RVAAP-008-R-01)*

Based on the findings of IRP investigations conducted at the former load line and input from Installation personnel, the only MEC (i.e., residual propellant pellets) present at the MRS is located beside Buildings CB-13, CB-13B, and CB-14, as well as in the area of the former popping furnace. Therefore, the MRS boundary was reduced to those immediate areas surrounding the buildings (i.e., CB-13, CB-13B, and CB-14) and the popping furnace.

*Load Line #12 (RVAAP-012-R-01)*

Several IRP investigations have been conducted at the former load line with only one reported finding of potential MEC (i.e., 90mm projectiles). Furthermore, all buildings that were located at the MRS were decommissioned and have been removed, along with any potential MEC. Input from Installation personnel indicated the only suspect area at the MRS is associated with the area immediately surrounding the location where the 90mm projectiles were discovered. Based on the

comprehensiveness of IRP investigations conducted to date at the load line, and input from Installation personnel, it is reasonable to reduce the size of the boundary to the area immediately surrounding the location where the 90mm projectiles were found.

*Landfill North of Winklepeck (RVAAP-019-R-01)*

Installation personnel have reported that potential MEC (booster cups and other nondescript items) is present on the slope leading down to the small stream, outside of the current MRS boundary. To capture this potential MEC, the MRS boundary has been adjusted to cover the area between the landfill and the small stream as identified by Installation personnel. The boundary of the MRS was revised to exclude the landfill area, first identified as the original MRS location in the US Army CTT Range/Site Inventory. This landfill is covered under the IRP and any MEC/MC incidentally discovered during the investigation will be managed under the IRP.

*Firestone Test Facility (RVAAP-033-R-01)*

In the US Army CTT Range/Site Inventory, the MRS boundary only included the location of the shaped charge test pond and only one of the two test chambers. The location of the second test chamber was identified during the HRR and has been added to the MRS boundary. In addition, Installation personnel identified a third test chamber that was used for testing shaped charges, as well as a suspected test range located northeast of the former test facility. The shaped charge test chamber has been added to the MRS. All three test chambers have since been decommissioned and removed. Additional investigation of the suspected test range area will have to be conducted during the SI field work. Based on these findings, the area may or may not be included as part of the MRS footprint.

The following table provides a summary of the HRR findings and conclusions.

**Table ES-1: Summary of Findings and Conclusions**

| MRS Name | AEDB-R Site ID* | MRS Added During HRR (yes/no) | CTT Acreage | HRR Acreage | Presence of MEC/MC | | Data Gaps |
|---|---|---|---|---|---|---|---|
| | | | | | MEC Yes/No/ Unknown | MC Yes/No/ Unknown | |
| Ramsdell Quarry Landfill | RVAAP-001-R-01 | No | 3.79 | 13.43 | Unknown | Yes | Presence and type of MEC at the former OB/OD area at the bottom of the quarry and area south of the quarry are not fully known. Presence of MC at the OB/OD area has been established. Presence of MC at the area south of the quarry is not fully known. |
| Erie Burning Grounds | RVAAP-002-R-01 | No | 33.93 | Same | Unknown | IRP[1]/MMRP | Presence and type of MEC at the MRS is not fully known. Presence of MC in wet sediments is not fully understood. |
| Demolition Area #2 | RVAAP-004-R-01 | No | 14.91 | 32.95 | Yes | Yes | Presence of MEC has been established, but type is not fully known. Presence of MC at the two burial areas, Rocket Ridge, and the northwestern disposal area is not fully known. |
| Winklepeck Burning Grounds | RVAAP-005-R-01 | Removed | 317.01 | N/A | BRAC[2] | IRP[1] | Winklepeck Burning Grounds is not MMRP-eligible and has been removed from further consideration. |
| Load Line #1 | RVAAP-008-R-01 | No | 163.62 | 4.63 | Unknown | IRP[1]/MMRP | Presence and extent of triple base propellants is not fully known. MMRP will address any MEC/MC issues not addressed by the PBC contractor. |
| Load Line #12 | RVAAP-012-R-01 | No | 77.58 | 1.0 | Unknown | IRP[1] | Presence and type of potentially buried MEC is not fully known. |

**Table ES-1: Summary of Findings and Conclusions (continued)**

| MRS Name | AEDB-R Site ID* | MRS Added During HRR (yes/no) | CTT Acreage | HRR Acreage | Presence of MEC/MC | | Data Gaps |
|---|---|---|---|---|---|---|---|
| | | | | | MEC Yes/No/ Unknown | MC Yes/No/ Unknown | |
| Fuze and Booster Quarry | RVAAP-016-R-01 | No | 12.74 | Same | Unknown | Yes/IRP[1] | Presence and type of MEC in the three ponds is not fully known. Munitions debris is present. |
| Landfill North of Winklepeck | RVAAP-019-R-01 | No | 7.55 | 14.05 | Unknown | Yes | Presence and type of MEC at the revised MRS location is not fully known. Presence of MC is not fully known. Presence of munitions debris has been established. |
| 40mm Firing Range | RVAAP-032-R-01 | No | 5.17 | Same | Unknown | IRP[1] | Presence and type of MEC at the firing range is not fully known. |
| Firestone Test Facility | RVAAP-033-R-01 | No | 0.25 | 0.91 | Unknown | IRP[1] | Presence and type of MEC at the shaped charge test pond, test chambers (3), and clearing is not fully known. |
| Sand Creek Dump | RVAAP-034-R-01 | No | 0.85 | Same | Unknown | IRP[1] | Presence and type of MEC at the MRS is not fully known. |
| Building #F-15 and F-16 | RVAAP-046-R-01 | No | 12.23 | Same | Unknown | IRP[1] | Presence and type of MEC is not fully known. |
| Anchor Test Area | RVAAP-048-R-01 | No | 2.57 | Same | Unknown | IRP[1] | Presence and type of MEC is not fully known. |
| Atlas Scrap Yard | RVAAP-050-R-01 | No | 66.04 | Same | Unknown | Yes/IRP[1] | Presence of munitions debris has been established. However, presence and type of MEC is not fully known. |
| Block D Igloo | RVAAP-060-R-01 | No | 622.24 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |

**Table ES-1: Summary of Findings and Conclusions (continued)**

| MRS Name | AEDB-R Site ID* | MRS Added During HRR (yes/no) | CTT Acreage | HRR Acreage | Presence of MEC/MC | | Data Gaps |
|---|---|---|---|---|---|---|---|
| | | | | | MEC Yes/No/ Unknown | MC Yes/No/ Unknown | |
| Block D Igloo–TD | RVAAP-061-R-01 | No | 19.25 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |
| Water Works #4 Dump | RVAAP-062-R-01 | No | 6.15 | Same | Unknown | Unknown | Presence of munitions debris has been established. Presence and type of MEC is not fully known. Presence of MC is not fully known. |
| Area Between Buildings 846 and 849 | RVAAP-063-R-01 | No | 2.65 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |
| Field at the NE Corner of Intersection (Paris-Windham Rd) | RVAAP-064-R-01 | No | 91.86 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |

[1] = MC will be covered under the IRP and will not be investigated further under the MMRP.

[2] = Explosive concerns are addressed under BRAC and will not be investigated further under the MMRP.

* AEDB-R Site ID = Army Environmental Database-Restoration Site Identification Number

IRP=Installation Restoration Program, BRAC= Base Realignment and Closure, N/A = Not Applicable

# Table of Contents

# Table of Contents (continued)

# Table of Contents (continued)

# Table of Contents (continued)

# List of Figures

# List of Figures (continued)

# List of Photographs

# List of Photographs (continued)

# List of Tables

# List of Tables (continued)



# List of Appendices

| **Abbreviations and Acronyms** | |
|---|---|
| **Acronym** | **Definition** |
| AEDB-R | Army Environmental Database-Restoration |
| AOC | Area of Concern |
| AP | Armor Piercing |
| AR | Administrative Record |
| ARID | Army Range Inventory Database |
| ARNG | Army National Guard |
| ARS | Advanced Range Survey |
| ASR | Archive Search Report |
| bgs | Below ground surface |
| BRAC | Base Realignment and Closure |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COC | Contaminant of Concern |
| COPC | Contaminant of Potential Concern |
| CRREL | Cold Regions Research and Engineering Laboratory |
| CSM | Conceptual Site Model |
| CTC | Cost to Complete |
| CTT | Closed, Transferring, and Transferred |
| CWM | Chemical Warfare Materiel |
| DERP | Defense Environmental Restoration Program |
| DMM | Discarded Military Munitions |
| DNB | Dinitrobenzene |
| DNT | 2-amino-4,6-dinitrotoluene |
| DoD | Department of Defense |
| $e^2M$ | engineering-environmental Management, Inc. |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EOD | Explosive Ordnance Disposal |
| EPA | Environmental Protection Agency |
| ER,A | Environmental Restoration, Army |
| ERIS | Environmental Restoration Information System |
| ft | feet |
| FUDS | Formerly Used Defense Site |
| FY | Fiscal Year |
| HE | High Explosives |
| HMX | High Melting Explosive; octahydro-1,3,5,7-tetranitro-1,3,5,7 tetrazocine |

| **Abbreviations and Acronyms** | |
|---|---|
| **Acronym** | **Definition** |
| HRR | Historical Records Review |
| IAP | Installation Action Plan |
| IRA | Interim Removal Action |
| IRP | Installation Restoration Program |
| JMC | Joint Munitions Command |
| $km^2$ | Square Kilometers |
| m | Meters |
| MACOM | US Army Major Command |
| MC | Munitions Constituents |
| MCL | Maximum contaminant level |
| MEC | Munitions and Explosives of Concern |
| mg/kg | Milligrams per kilogram |
| mg/L | Milligrams per liter |
| mm | Millimeter |
| MMRP | Military Munitions Response Program |
| MOA | Memorandum of Agreement |
| MR | Munitions Response |
| MRA | Munitions Response Area |
| MRS | Munitions Response Site |
| NCP | National Contingency Plan |
| NDAA | National Defense Authorization Act |
| NFA | No Further Action |
| NGB | National Guard Bureau |
| NPDES | National Pollutant Discharge Elimination System |
| OB/OD | Open Burning/Open Detonation |
| OE | Ordnance and Explosives |
| Ohio EPA | Ohio Environmental Protection Agency |
| OHARNG | Ohio Army National Guard |
| ORC | Ohio Revised Code |
| OSC | Operations Support Command |
| OSD | Office of Secretary of Defense |
| PA | Preliminary Assessment |
| PCBs | Polychlorinated Biphenyls |
| PETN | Pentaerythrite Tetranitrate |
| ppb | Parts per billion |
| ppm | Parts per million |

| **Abbreviations and Acronyms** | |
|---|---|
| **Acronym** | **Definition** |
| PRG | Preliminary Remediation Goal |
| RAC | Risk Assessment Code |
| RCRA | Resource Conservation and Recovery Act |
| RD/RA | Remedial Design/Remedial Action |
| RDX | Royal Demolition or Research Department Explosive; hexahydro-1,3,5-trinitro-1,3,5-triazine, which is also known as cyclonite |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| RRSE | Relative Risk Site Evaluation |
| RTLS | Ravenna Training and Logistics Site |
| RVAAP | Ravenna Army Ammunition Plant |
| SAIC | Science Applications International Corporation |
| SARA | Superfund Amendments and Reauthorization Act |
| SI | Site Inspection |
| SRC | Site related contaminant |
| SVOC | Semi-Volatile Organic Compound |
| Tetryl | N-methyl-N-2,4,6-tetranitroaniline |
| TNB | Trinitrobenzene |
| TNT | Trinitrotoluene |
| TOW | Tube-launched, optically-tracked, wire guided |
| TPP | Technical Project Planning |
| µg/L | Microgram per Liter |
| US | United States |
| USACE | United States Army Corps of Engineers |
| USACHPPM | United States Army Center for Health Promotion and Preventive Medicine |
| USAEC | United States Army Environmental Center |
| U.S.C. | United States Code |
| USGS | United States Geological Survey |
| UXO | Unexploded Ordnance |
| VOC | Volatile Organic Compound |
| WWII | World War II |

## Glossary of Terms

**Closed Range** – A military range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a Department of Defense (DoD) component.

**Defense Site** – Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense. The term does not include any operational range, operating, storage or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions. (10 USC 2710(e)(1))

**Discarded Military Munitions (DMM)** – 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 unexploded ordnance, 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. (10 USC 2710(e)(2))

**Explosive Ordnance Disposal (EOD)** – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration.

**Explosives Safety** – A condition where operational capability and readiness, personnel, property, and the environment are protected from the unacceptable effects or risks of potential mishaps involving military munitions.

**Formerly Used Defense Site (FUDS)** – A DoD program that focuses on compliance and cleanup efforts at sites that were formerly used by the DoD. A FUDS property is eligible for the Military Munitions Response Program (MMRP) if the release occurred prior to October 17, 1986; the property was transferred from DoD control prior to October 17, 1986; and the property or project meets other FUDS eligibility criteria.

## Glossary of Terms (continued)

**Military Munitions** – All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents; chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges; and devices and components thereof.

The term does not include wholly inert items; improvised explosive devices; and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed. (10 USC 101(e)(4))

**Munitions Constituents (MC)** – Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 USC 2710(e)(4))

**Munitions and Explosives of Concern (MEC)** – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means: Unexploded Ordnance (UXO), as defined in 10 USC 2710(e)(9); Discarded military munitions (DMM), as defined in 10 USC 2710 (e)(2); or Munitions Constituents (MC) (e.g. TNT, RDX), as defined in 10 USC 2710 (e)(3), present in high enough concentrations to pose an explosive hazard.

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

## Glossary of Terms (continued)

**Munitions Response (MR)** – Response actions, including investigation, removal and remedial actions to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.

**Munitions Response Area (MRA)** – Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites.

**Munitions Response Site (MRS)** – A discrete location within a MRA that is known to require a munitions response.

**Operational Range** – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities (10 USC 101 (e)(3)). Also includes "military range", "active range", and "inactive range" as those terms are defined in 40 Code of Federal Regulations (CFR) 266.201.

**Range** – The term 'range,' when used in a geographic sense, means a designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 USC 101 (e)(1))

**Transferred Range** – A range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that is no longer under military control, but that was used under the terms of an executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. Additionally, property that was previously used by the military as a range, but did not have a formal use agreement, also qualifies as a transferred range.

## Glossary of Terms (continued)

**Transferring Range** – A range that is proposed to be leased, transferred, or returned from the DoD to another entity, including federal entities. This includes a military range that was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An operational range will not be considered a transferring range until the transfer is imminent (generally defined as the transfer date is within 12 months and a receiving entity has been notified).

**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 whether by malfunction, design, or any other cause. (10 USC 101 (e)(5))

# 1.0 INTRODUCTION

## 1.1 Authority

The Department of Defense (DoD) established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to identify and address defense sites known or suspected to contain unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC). Sites eligible for action under the MMRP include other than operational ranges and sites with known or suspected UXO, DMM, or MC where the release occurred prior to 30 September 2002 (Munitions Response Sites [MRSs]). Properties classified as operational ranges, permitted munitions disposal facilities, and operating munitions storage facilities are not eligible and, therefore, are excluded from the MMRP. This report presents the results of the MMRP Historical Records Review (HRR) conducted at the Ravenna Army Ammunition Plant (RVAAP). This HRR was prepared as part of the MMRP Site Inspection (SI) process at RVAAP.

The DoD is currently establishing policy and guidance for munitions response actions under the MMRP. However, key program drivers developed to date conclude munitions response actions will be conducted under the process outlined in the National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 United States Code (U.S.C.) 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99-499, (hereinafter CERCLA).

## 1.2 Purpose/Scope

The intent of the HRR is to perform a records search to document historical and other known information on the MRSs identified at RVAAP to supplement the United States (US) Army closed, transferring, and transferred (CTT) Range/Site Inventory information, and to support the Technical Project Planning (TPP) process designed to facilitate decisions on those areas where more information is needed to determine the next step(s) in the CERCLA process. The SI is part of the CERCLA process and will be continued following the completion of this HRR report.

## 1.3 Project Drivers

The regulatory structure for managing MRSs at RVAAP is guided by a mixture of federal, state, and local laws, as well as DoD and US Army regulations and guidance. The picture is further complicated by debates at the national level between DoD and the US Environmental Protection Agency (EPA) over key issues including uncertainty of the final structure of the MMRP. However, key legislative and

administrative precedents to date will undoubtedly influence the final regulatory framework of the MMRP. Key legislative and administrative precedents include the following:

- The Office of the Secretary of Defense (OSD) DERP Guidance (September 2001) established an MMRP element for defense sites with known or potential UXO or DMM. The history of DERP dates back to the SARA of 1986 and is defined in 10 U.S.C. §2701(b), which states the goals of the program shall include the following:
  - The identification, investigation, research and development, and cleanup of contamination from hazardous substances, and pollutants and contaminants; and
  - Correction of other environmental damage (such as detection and disposal of UXO) which creates an imminent and substantial endangerment to the public health or welfare, or to the environment.
- Sections 311-312 of the National Defense Authorization Act (NDAA) of Fiscal Year (FY) 2002 reinforced the OSD 2001 DERP Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to contain UXO, DMM, or MC.
  - Section 311 requires the DoD to develop a protocol for prioritizing defense sites for response activities in consultation with state regulators and Tribal members.
  - Section 312 requires the DoD to create a separate program element to ensure the DoD can identify and track MMRP funding.

The OSD 2001 DERP Guidance and the NDAA 2002, described above, established the MMRP. The DERP and the MMRP provide guidance and methods for conducting a baseline inventory of defense sites known or suspected to contain UXO, DMM, or MC.

The RVAAP is also bound to the "Final Findings and Orders" (Orders) issued June 10, 2004 by the Ohio Environmental Protection Agency (Ohio EPA) pursuant to the authority vested under Chapters 3734, 3745, and 6111 of the Ohio Revised Code (ORC). The objective of the Orders is to ensure that the public health, safety, and welfare, as well as the environment, is protected from the disposal, discharge, or release of contaminants (including munitions and explosives of concern [MEC] [which includes UXO, DMM, or MC at explosive concentrations] and MC) at or from the Installation, through the implementation of a CERCLA based environmental remediation program. Pursuant to the Orders, the Installation is required to develop and implement the following:

- a Remedial Investigation/Feasibility Study (RI/FS), a Proposed Plan, a Record of Decision or other appropriate document, and a remedy for each Area of Concern (AOC) or appropriate group of AOCs at RVAAP; and

- a Facility-Wide Ground Water Investigation, Monitoring, and Remediation Program at RVAAP.

## 1.4 Background

The US Army CTT Range/Site Inventory at RVAAP was considered to mark the completion of the Preliminary Assessment (PA) phase of work under CERCLA. The SI is the next phase in the CERCLA process and will complete the PA/SI requirement for the MRSs.

### 1.4.1 US Army Inventory

To meet the programmatic goals of the baseline inventory, the US Army developed a three-phase approach. Phase 1, or the Advanced Range Survey (ARS), involved a data call issued through the US Army Environmental Center (USAEC) to each of the former US Army Major Commands (MACOMs) requesting general information about ranges located on their installations. The intent of the ARS was to meet the US Army's immediate need of supporting DoD efforts to prepare Senate Report 106-50, which required an initial survey of the US Army's ranges. Once obtained, this data was submitted to the USAEC and compiled into a master database of US Army installations. Mr. Francis Coulters, National Guard Bureau-Army National Guard (NGB-ARNG) completed the combined ARS for RVAAP on 10 July 2002 (RVAAP-2.A.1).

Phase 2 involved a survey and inventory of all operational (formerly Active/Inactive [A/I]) ranges. The intent of the inventory was to collect detailed site specific information in the field from all installations, which delineated among other things, the operational range boundaries. As part of the operational inventory effort, the data were electronically uploaded to the Army Range Inventory Database (ARID) maintained by the USAEC. The Phase 2 Operational Range Inventory was performed for RVAAP during 2001 (RVAAP-2.A.1).

Phase 3 began as the US Army CTT Range/Site Inventory. However, due to congressional requirements stipulated in the NDAA, FY 2002 and consequent changes to DERP, the US Army CTT Range/Site Inventory evolved into a comprehensive inventory of other than operational ranges and sites with known or suspected UXO, DMM, or MC. Findings from the US Army CTT Range/Site Inventory are summarized in **Section 2.2**.

### 1.4.2 Site Inspection

The primary objective of the MMRP SI is to collect the appropriate amount of information to support one of the following recommendations concerning the presence of MEC and/or MC:

- No Further Action (NFA);
- Immediate Response; or

- Further Characterization

The secondary objectives of the SI are to:

- Collect information that allows for the refinement of the MMRP Cost to Complete (CTC) estimates by the US Army;
- Upload SI analytical data into the Environmental Restoration Information System (ERIS); and
- Populate the Munitions Response Site Prioritization Protocol (MRS-PP) with background information and analytical data, as appropriate, and calculate a draft Protocol score for each MRS.

## 1.5 Report Organization

This HRR report consists of the following sections: **Section 1** provides an introduction including the authority, purpose and scope of the project, project drivers, and background; **Section 2** provides a general description of the RVAAP facility and the MRSs, as well as pertinent historical details; **Section 3** outlines the data collection and document review process; **Section 4** presents the findings of the HRR research and review activities; **Section 5** provides details of the Conceptual Site Model (CSM); and **Section 6** provides conclusions. The following appendices include supporting information and analysis: **Appendix A** – Archive Documents; **Appendix B** – Interviews and Other Pertinent Correspondence; **Appendix C** – Munitions Technical Data Sheets; and **Appendix D** – Comment Response Table.

# 2.0 GENERAL SITE DESCRIPTION

## 2.1 Installation Description

RVAAP (Federal Facility Identification number: OH213820736) is located in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 kilometers (3 miles) east northeast of the city of Ravenna and approximately 1.6 kilometers (1 mile) northwest of the city of Newton Falls. The MRSs are solely located within Portage County. The Installation is approximately 17.7 kilometers (11 miles) long and 5.6 kilometers (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east (see **Figures 1 and 2**). The Installation is surrounded by several communities: Windham on the north; Garrettsville 9.6 kilometers (6 miles) to the northwest; Newton Falls 1.6 kilometers (1 mile) to the southeast; Charlestown to the southwest; and Wayland 4.8 kilometers (3 miles) to the south. Currently, the Installation is known as the Ravenna Training and Logistics Site (RTLS). During the operational years, prior to the RTLS, the entire 21,683-acre parcel was a government-owned, contractor-operated industrial facility. The RVAAP MMRP encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP, and therefore references to the RVAAP in this document are considered to be inclusive of the historical extent of the RVAAP, which is inclusive of the combined acreages of the current RTLS and RVAAP, unless otherwise specifically stated.

As of February 2006, a total of 20,403 acres of the former 21,683 acre RVAAP have been transferred to the National Guard Bureau (NGB) and have been subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site. This portion of the facility is identified as the RTLS. The current RVAAP consists of 1,280 acres scattered throughout the OHARNG RTLS which consist mostly of Installation Restoration Program (IRP) sites. These 1,280 acres consist of former industrial facilities that are being remediated and managed by the Base Realignment and Closure (BRAC) Office who have, among other responsibilities, the task of overseeing inactive status installations. Once this remaining acreage has been remediated, it will be transferred to the NGB for use by the OHARNG.

# INSTALLATION LOCATION
# Ravenna Army Ammunition Plant, OH

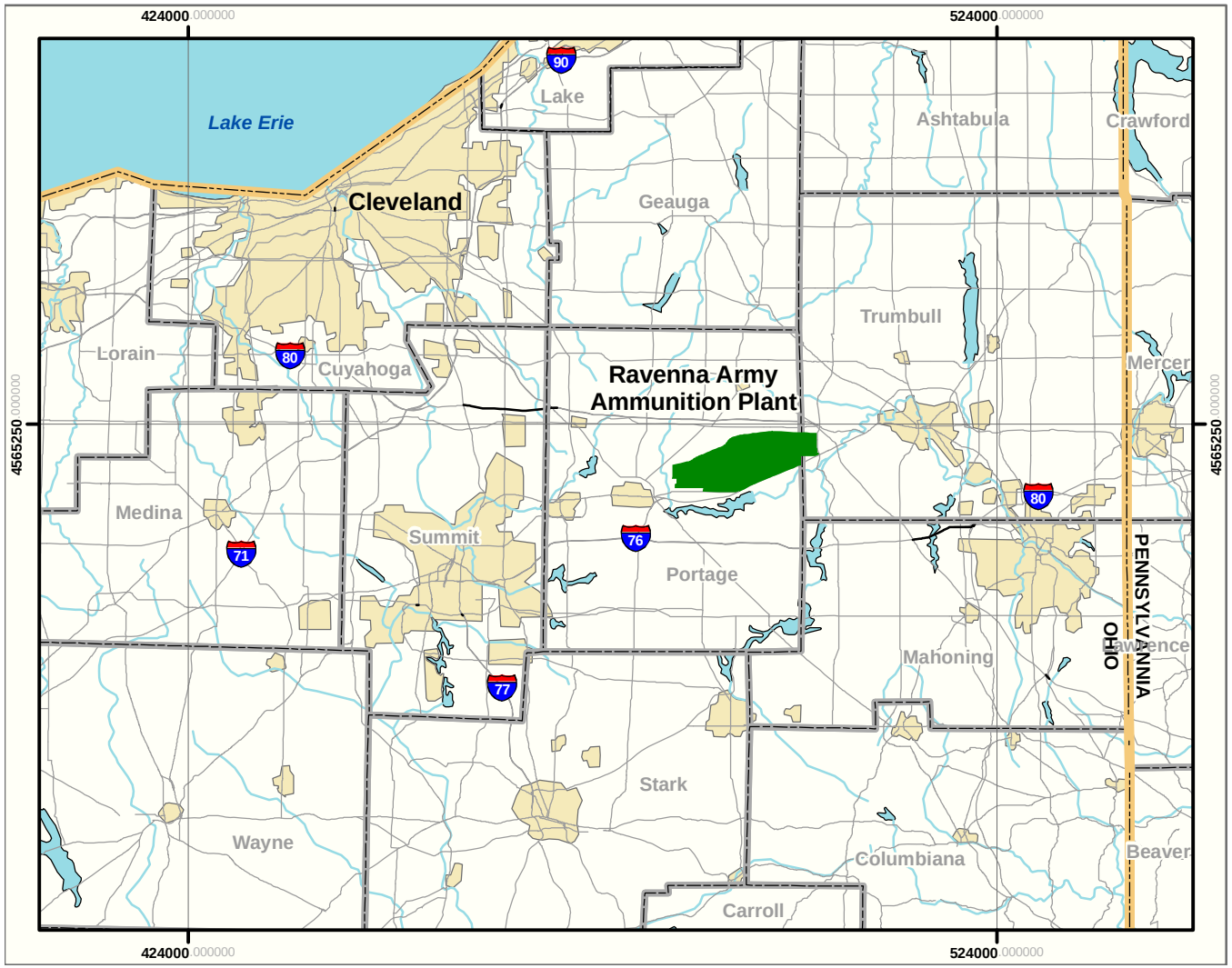



**Figure 1**

N
W E
S

- State Boundary
- County Boundary
- Urban Area
- Installation
- Interstate Highway
- Major Highway
- Stream
- Water

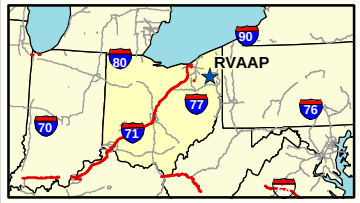
| | |
|---|---|
| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **100,000 Meter** |

1:850,000

0 3 6 9 12 15 Miles

0 10 20 30 Kilometers

Installation Location
**Ohio**



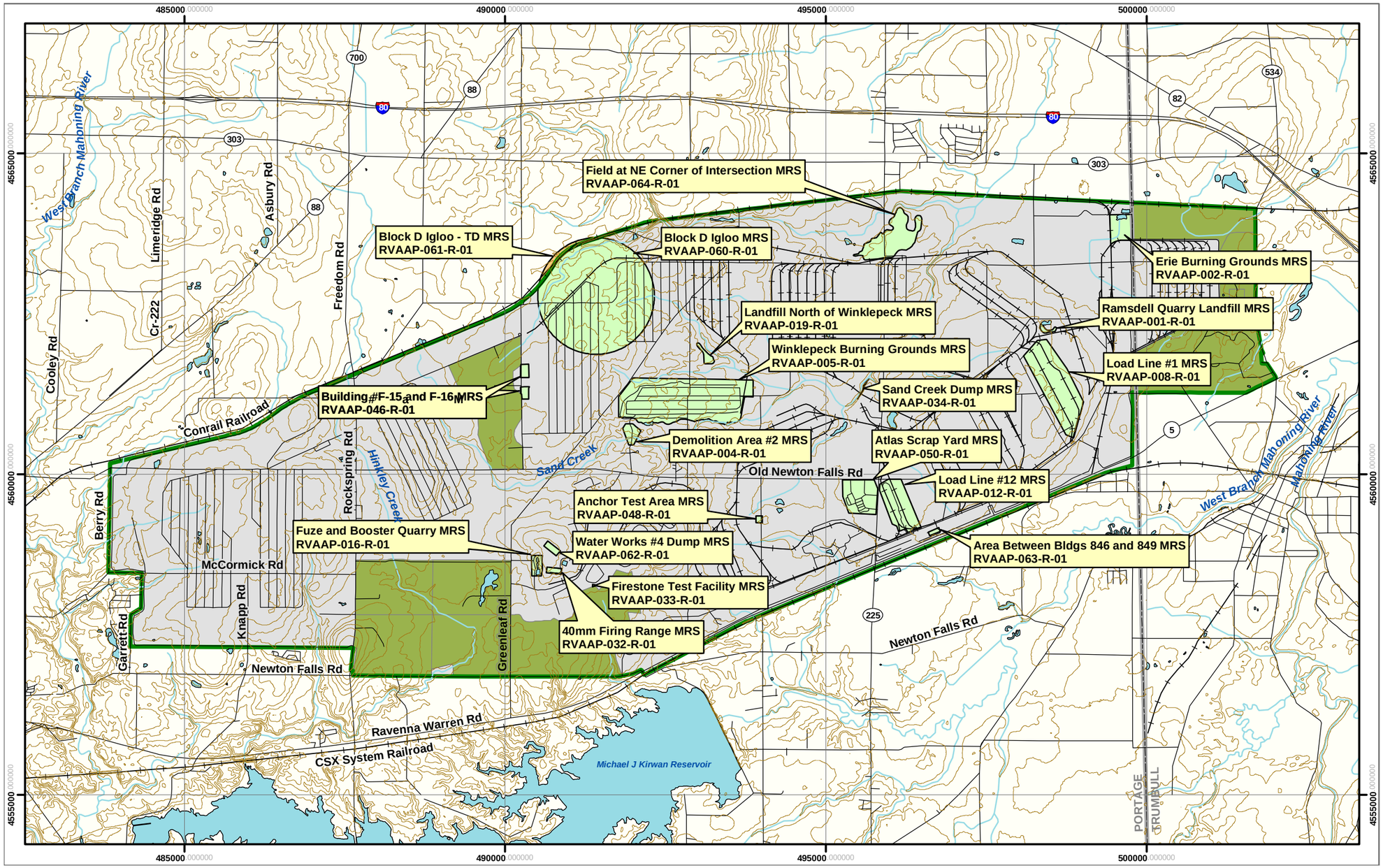

**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. (e²M)

**Date:** October 2006
**Edition:** Final

# LOCATIONS of the MRSs IDENTIFIED in the US ARMY CTT RANGE/SITE INVENTORY
# Ravenna Army Ammunition Plant, OH

**Figure 2**




N
W E
S

- Elevation Contour
- County Boundary
- Installation Boundary
- Railroad
- Road
- Stream
- Water

**Area Status**

- Operational Range
- Other than Operational
- MRS, Closed
- MRS,Transferred

**Projection:** TM Zone 17
**Datum :** GS 84
**Units:** W M eters
**Grid:** 5 ,000 Meter
**Contour Interval:** 500 Meter

1:65,000

0 0.5 1 1.5 Miles
0 0.5 1 1.5 2 Kilometers

Installation Location
**Ohio**


**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by e ngineering-environmental Management, Inc. (e²M)

**Date:** O ctober 2006
**Edition:** Final

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## 2.2 MRS Descriptions

Listed below are the MRSs that were identified during the US Army CTT Range/Site Inventory.

- Ramsdell Quarry Landfill (RVAAP-001-R-01)[2],
- Erie Burning Grounds (RVAAP-002-R-01),
- Demolition Area #2 (RVAAP-004-R-01),
- Winklepeck Burning Grounds (RVAAP-005-R-01)
- Load Line #1 (RVAAP-008-R-01),
- Load Line #12 (RVAAP-12-R-01),
- Fuze and Booster Quarry (RVAAP-016-R-01),
- Landfill North of Winklepeck (RVAAP-019-R-01),
- 40mm Firing Range (RVAAP-032-R-01),
- Firestone Test Facility (RVAAP-033-R-01),
- Sand Creek Dump (RVAAP-034-R-01),
- Building #F-15 and F-16 (RVAAP-046-R-01),
- Anchor Test Area (RVAAP-048-R-01),
- Atlas Scrap Yard (RVAAP-050-R-01),
- Block D Igloo (RVAAP-060-R-01),
- Block D Igloo–TD (RVAAP-061-R-01),
- Water Works #4 Dump (RVAAP-062-R-01),
- Area Between Buildings 846 and 849 (RVAAP-063-R-01), and
- Field at the NE Corner of Intersection (RVAAP-064-R-01).

Descriptions of these MRSs, which have been taken directly from the US Army CTT Range/Site Inventory dated 20 November 2003, are presented in the following paragraphs. **Figure 2** provides the locations of the MRSs identified in the US Army CTT Range/Site Inventory. These descriptions may not reflect current site conditions or may contain information that is no longer accurate and correct. Descriptions of the current MRS site conditions are provided in **Section 4**.

***Ramsdell Quarry Landfill (RVAAP-001-R-01)***

*Ramsdell Quarry Landfill is described as an unlined landfill covering 3.79 acres that is situated in the bottom of an abandoned quarry. The MRS is located to the north of Load Line #1 in the eastern*

[2] Army Environmental Database-Restoration (AEDB-R) Number

*portion of RVAAP and is collocated with an Installation Restoration Program (IRP) site (Army Environmental Database-Restoration [AEDB-R] Identification Number RVAAP-01). Originally (1946 through 1950), the MRS was used to thermally treat waste explosives from Load Line #1, and approximately 18,000 500-pound (lb) incendiary or napalm bombs through surface burning. Starting in 1976, the MRS was reported to have been used strictly as a non-hazardous solid waste landfill; and in 1978 to its closure in 1990, operated under a sanitary landfill permit issued by the State of Ohio. The US Army CTT Range/Site Inventory noted a data gap for the period of 1950-1976 where information was not available. The report also noted that numerous spent 81millimeter (mm) mortar rounds have been observed lying on the ground surface at the MRS, although a time period for this observation was not included in the report (RVAAP-2.A.5).*

***Erie Burning Grounds (RVAAP-002-R-01)***

*The Erie Burning Grounds is described principally as an undeveloped wetland area that covers approximately 33.93 acres located on the northeastern corner of the facility next to the Portage/Trumbull County line. The MRS, which operated between 1941 and 1951, was used to thermally treat bulk, obsolete, off-spec propellants, conventional explosives, rags, and large explosive contaminated items (e.g., railcars) through open burning on the ground surface. According to the US Army CTT Range/Site Inventory, the ash residue was left on site. The report also noted that the MRS is associated with an IRP site (AEDB-R ID RVAAP-02) (RVAAP-2.A.6).*

***Demolition Area #2 (RVAAP-004-R-01)***

*Demolition Area #2 was described in the US Army CTT Range/Site Inventory as an undeveloped parcel that encompasses 14.91 acres located in the central portion of the facility north of Old Newton Falls Road and the load lines. The MRS was reported to contain a 1.5 acre interim Resource Conservation and Recovery Act (RCRA) unit that was used to demilitarize munitions.*

*From 1948 until 1991, the MRS was used to detonate large caliber munitions and off-specification bulk explosives that could not be deactivated or demilitarized by any other means due to their condition. It was also reported that the MRS was used to bury white phosphorus and bombs. The types of bombs buried at the MRS were not disclosed. Detonation activities were conducted in pits excavated by a backhoe to a minimum depth of four feet (ft) below ground surface (bgs). After detonation, the area was policed and metal parts were picked up and removed, and the pit filled, mulched, and seeded. New pits were excavated for each activity.*

*The US Army CTT Range/Site Inventory reported that a live grenade was found on site (no date provided), and that in 1999/2000 a removal action was conducted. During the removal action, an unreported number of fuzes and components, burster tubes, and partial projectiles were removed from two small dump sites on the south side of Sand Creek and from a 1.5 acre area north of Sand Creek. At the 1.5 acre parcel, items were cleared to a depth of four ft bgs. In addition, the report noted that the MRS is collocated with an IRP site (AEDB-R ID RVAAP-04) (RVAAP-2.A.6).*

***Winklepeck Burning Grounds (RVAAP-005-R-01)***

*Winklepeck Burning Grounds encompasses 317.01 acres located in the central portion of the installation that were used between 1941 and 1992 to thermally treat munitions. Prior to 1980, open burning was conducted in pits, on pads, and occasionally along the roads. Munitions that were treated included Research Department Explosive (RDX), antimony sulfide, Composition B, lead azide, trinitrotoluene (TNT), propellants, and black powder. Typically, ash residue was abandoned at the site. Beginning in 1980 and continuing until 1992, open burns of scrap explosives, propellants, and explosives-contaminated materials were treated in raised refractory-lined trays, which were located within a 1.5 acre area (location not provided). According to interviews with installation personnel reported in the US Army CTT Range/Site Inventory, any munitions type produced at the installation may have been thermally treated at the burning grounds. The report also noted that the burning ground is associated with an IRP site (AEDB-R ID RVAAP-05).*

***Load Line #1 (RVAAP-008-R-01)***

*Load Line #1 is described as an undeveloped parcel encompassing approximately 163.62 acres located in the southeastern portion of the installation. The purpose of the line, which operated from 1941 to 1971, was to load various types of projectiles. In 2000, the majority of structures located at the MRS were demolished. According to the US Army CTT Range/Site Inventory, installation personnel have reported finding numerous black powder propellant pellets and, on one occasion, a 152mm casing. The report also noted that the MRS is associated with an IRP site (AEDB-R ID RVAAP-08) (RVAAP-2.A.8).*

***Load Line #12 (RVAAP-012-R-01)***

*Load Line #12 is described as an undeveloped parcel encompassing 77.58 acres located in the southeastern portion of RVAAP, a little over 1.5 miles southwest of Load Line #1. The line, which was in operation from 1941 to 1993, produced ammonium nitrate from 1941 to 1943, and again in 1946, while during the later years (1949 to 1993) the line was used to demilitarize artillery rounds. In 1999, approximately 110 90mm rounds were discovered buried several inches below the topsoil during an IRP*

*investigation. The rounds, which were removed and disposed of properly, were described as being composed of a shell and projectile that were void of high explosives (HE). According to the US Army CTT Range/Site Inventory, the reason for, and persons responsible for, disposing of the munitions was not determined. The report also indicated that the MRS is associated with an IRP site (AEDB-R ID RVAAP-12) (RVAAP-2.A.8).*

***Fuze and Booster Quarry (RVAAP-016-R-01)***

*The Fuze and Booster Quarry is an undeveloped parcel that encompasses 12.74 acres located in the southwestern portion of RVAAP, approximately 1.25 miles southwest of Demolition Area #2. The MRS, which operated from 1945 to 1975, consists of three elongated ponds, situated end to end and separated by berms, which were constructed within an abandoned rock quarry. Prior to the construction of the ponds, the quarry was reported to have been used for open burning of munitions. According to information reported in the US Army Range/Site Inventory, any munitions produced at the installation could have been disposed at the MRS. This would include rockets, bombs, fuzes, detonators, flares, missiles, grenades, landmines, medium and large caliber ammunition, explosives, mortars, propellant, practice ordnance, pyrotechnics, and small arms. The report also indicated that the MRS is associated with an IRP site (AEDB-R ID RVAAP-16) (RVAAP-2.A.9).*

***Landfill North of Winklepeck (RVAAP-019-R-01)***

*This MRS is reported to encompass 7.55 acres located in the central portion of the installation, less than one mile northeast of Demolition Area #2. The unlined landfill operated from 1969 until 1976 and was used to dispose of general plant refuse, including explosive wastes residue and open burn wastes generated at Winklepeck Burning Grounds. According to the US Army CTT Range/Site Inventory, some of the waste received from the Winklepeck Burning Grounds included flares and booster caps. The report also noted that the MRS includes an IRP site, which is listed as an AOC (AEDB-R ID RVAAP-19) (RVAAP-2.A.9).*

***40mm Firing Range (RVAAP-032-R-01)***

*The former firing range was described as encompassing 5.17 acres located in the southwestern portion of the installation, east and adjacent to the Fuze and Booster Quarry MRS. Reportedly, large caliber munitions were test fired at the range between 1969 and 1971. According to the US Army CTT Range/Site Inventory, installation personnel reported that UXO (not defined) exists on the MRS. The report also noted that the MRS is associated with an IRP site (AEDB-R ID RVAAP-32) (RVAAP-2.A.10).*

***Firestone Test Facility (RVAAP-033-R-01)***

*The Firestone Test Facility is situated within the Load Line 6 Fuze and Booster Area (IRP site AEDB-R ID RVAAP-33), which is located in the southwestern portion of the installation less than 0.25 miles to the east of the 40mm Firing Range MRS. The MRS (also referred to as the Shaped Charge Test Facility) is described as consisting of a pond where the shape charges were tested, and a range where tube-launched, optically-tracked, wire-guided (TOW) missiles and Dragon missiles were tested. The MRS, which operated from 1970 until 1992, encompasses approximately 0.25 acres (RVAAP-2.A.9).*

***Sand Creek Dump (RVAAP-034-R-01)***

*Sand Creek Dump is described as a 0.85 acre construction landfill centrally located in the eastern half of the installation, situated on the banks of Sand Creek. The dump, which was in operation from 1950 to 1960, was reported by former workers to have been a construction landfill for concrete, wood, asbestos debris, lab bottles, 55-gallon drums, and fluorescent light tubes. Construction and other debris is reportedly exposed at the landfill surface, although it is understood to be covered by vegetation. During removal activities performed in October 2003 under the IRP, two demilitarized 75mm rounds were discovered at the site. According to the US Army CTT Range/Site Inventory, the MRS is associated with an IRP site (AEDB-R ID RVAAP-34) (RVAAP-2.A.5).*

***Building #F-15 and F-16 (RVAAP-046-R-01)***

*The MRS encompasses 12.23 acres located in the northwestern portion of RVAAP, less than one mile northwest of Demolition Area #2. Operations at the MRS were conducted between 1941 and 1974, and included the testing of explosives produced at the installation. According to the US Army CTT Range/Site Inventory, Building F-16 has been demolished while Building F-15, although in poor condition, remains standing. The report noted that large caliber shells void of HE have been found outside the building. The report further noted that the MRS is associated with an IRP site (AEDB-R ID RVAAP-46) (RVAAP-2.A.11).*

***Anchor Test Area (RVAAP-048-R-01)***

*The Anchor Test Area encompasses approximately 2.57 acres located in the southeastern portion of the installation, less than 1.25 miles southeast of Demolition Area #2. The MRS is described as consisting of several dirt mounds and a sandpit. Operations at the MRS consisted of test firing experimental munitions into the ground to drive anchors for ropes and cables. The area was used from approximately 1941 to 1952. According to the US Army CTT Range/Site Inventory, metal debris of unknown origin*

*has been found in the area. The report further noted that the MRS has an associated AOC within the IRP (AEDB-R ID RVAAP-48).*

***Atlas Scrap Yard (RVAAP-050-R-01)***

*The Atlas Scrap Yard encompasses approximately 66.04 acres located in the southeastern portion of the installation, west and adjacent to the Load Line #12 MRS. The MRS is an old construction camp that was built to house workers during the construction of the installation; for this purpose, the MRS was used from approximately 1940 to 1969. Following World War II (WWII), the majority of buildings were demolished and the area became a scrap yard for miscellaneous materials. According to the US Army CTT Range/Site Inventory, UXO (not identified) was found on site during an RI. The report noted that in 2003, most of the ordnance and explosives (OE), OE scrap, and UXO had been sorted and removed from the MRS. Accounts from interviews with installation personnel provided in the report indicate that any of the munitions produced or used at the plant may have been disposed of in this area including: small arms, explosives, pyrotechnics, propellants, mortars, medium and large caliber munitions, landmines, hand grenades, flares, bombs, detonators, or fuzes. The report further noted that the MRS has an associated AOC within the IRP (AEDB-R ID RVAAP-50).*

***Block D Igloo (RVAAP-060-R-01)***

*This MRS is the consequence of a storage igloo (Number 7-D-15) that exploded on 24 March 1943. Igloo 7-D-15 is situated within "D" block, which is located in the northwestern portion of the installation, less than 0.25 miles northwest of Demolition Area #2. The "D" igloos were used to store OE throughout the history of the installation, starting in 1941. According to the US Army CTT Range/Site Inventory, the detonation of bombs in Igloo 7-D-15 caused multiple fatalities and sent shrapnel and demolished material up to 2.9 miles away, off installation property. However, a 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. The report further noted that cluster bombs may have been propelled from the igloo, as well.*

*A map created by installation personnel after the explosion, depicted the spread of debris from the blast. However, the map did not identify the location(s) of UXO found on the property that had been deposited by the explosion. Installation personnel also indicated that the site was considered clean of UXO some time after the explosion; however, documentation and confirmation was not provided in the US Army CTT Range/Site Inventory. Based on the report, the MRS boundary was established by*

*applying a 3,000 ft diameter [sic] circle ("for high explosive bombs") centered on and surrounding Igloo 7-D-15; this resulted in a total acreage of approximately 622.24 acres. A portion of the circle extends beyond the installation boundary and is considered separately as a transferred site (see Block D Igloo-TD) (RVAAP-2.A.12).*

***Block D Igloo–TD (RVAAP-061-R-01)***

*This MRS is comprised of the portion of the 3,000 foot diameter [sic] circle surrounding Igloo 7-D-15 that extends beyond the installation boundary. Acreage of the MRS is approximately 19.25 acres. The US Army CTT Range/Site Inventory reported that no UXO removal documentation had been identified. The report also noted that although the MRS could qualify as a Formerly Used Defense Site (FUDS), it was not on the FUDS list at the time of the inventory and, consequently, was included in the MMRP as a transferred site (RVAAP-2.A.11).*

***Water Works #4 Dump (RVAAP-062-R-01)***

*Water Works #4 Dump encompasses approximately 6.15 acres of undeveloped forested area located in the southwestern portion of the installation, immediately west of Water Works #4, and north of the Fuze and Booster Quarry MRS. According to the US Army CTT Range/Site Inventory, large caliber casings are scattered on the ground surface, as well as partially buried at the MRS. The report further noted that the origin and type of casings located at the MRS are unknown, although installation personnel estimated disposal to have taken place between 1941 and 1949. Based on the inventory report, no UXO investigations have been performed at the MRS (RVAAP-2.A.5).*

***Area Between Buildings 846 and 849 (RVAAP-063-R-01)***

*This MRS encompasses approximately 2.65 acres of open space situated between Buildings 846 and 849, which are located along the southern property boundary in the central portion of the installation. According to the US Army CTT Range/Site Inventory, the area consists of disturbed land that was being used at the time of the inventory as an industrial/production facility, while the buildings (circa 1940s) were actively used for the storage of munitions and related materials. The report noted that vehicles and equipment cross the MRS to be stored and to retrieve stored items from the nearby buildings (i.e., 846 and 849). Previous site activities may have included the burning of construction debris and rubbish.*

*In 1996, one "hammerhead" anti-personnel bomb (loaded with HE) was found by OHARNG personnel lying on the ground surface at the MRS. Other munitions reportedly found lying on the ground surface include one inert 175mm projectile; the date and entity who found the item were not provided. Based*

*on the US Army CTT Range/Site Inventory, no site investigations have been conducted at the MRS and the site has not been evaluated for UXO or DMM (RVAAP-2.A.10).*

***Field at the NE Corner of Intersection (RVAAP-064-R-01)***

*This MRS encompasses approximately 91.86 acres of open field situated adjacent to the northern property boundary in the central portion of the installation. The MRS is situated just north of the intersection of Paris-Windham Road and Smalley Road. From 1941 until 1991, the MRS was leased for agricultural use, and in 1992 the land was reassigned to RTLS.*

*In 1996, one anti-tank landmine (14 to 16 inches in diameter, pressure detonated, and potentially containing HE) was discovered by OHARNG personnel in the north-central portion of the MRS and was subsequently removed by the US Army Corps of Engineers (USACE). According to a statement attributed to OHARNG personnel, practice landmines were filled with HE. However, resolution of the contents of the landmine was not provided to the OHARNG after removal by the USACE. According to the US Army CTT Range/Site Inventory, this type of mine was refurbished at RVAAP prior to and during the Korean War (RVAAP-2.A.6).*

## 2.3 Updated MRS Status

The US Army CTT Range/Site Inventory identified eighteen closed sites and one transferred site eligible for action under the MMRP at RVAAP. Of the nineteen MMRP-eligible sites, the Winklepeck Burning Grounds [RVAAP-005-R-01]) MRS has since been removed and funded under BRAC and the IRP. Chemical contamination at the MRS is being addressed under the IRP, whereas explosive safety is being addressed under BRAC. Further, the site was turned over to the OHARNG for operation as the Mark 19 Range. Because of its current operational status and the ongoing releases occurring after 30 September 2002, it was determined this site is not eligible for evaluation as part of the RVAAP SI. Therefore, this site will not require further investigation under the MMRP, decreasing the total number of MRSs being addressed under the SI to eighteen.

Additional information collected during this HRR resulted in the modification of the original site descriptions, acreage, and/or boundaries identified during the US Army CTT Range/Site Inventory. The MRSs where site specific conditions have changed include the following:

- Ramsdell Quarry Landfill (RVAAP-001-R-01), realignment of the MRS boundary and increase in acreage from 3.79 acres to approximately 13.43 acres;

- Demolition Area #2 (RVAAP-004-R-01), realignment of the MRS boundary and increase in acreage from 14.91 acres to approximately 32.95 acres;
- Load Line #1 (RVAAP-008-R-01), realignment of the MRS boundary and decrease in acreage from 163.62 acres to approximately 4.63 acres;
- Load Line #12 (RVAAP-012-R-01), realignment of the MRS boundary and decrease in acreage from 77.58 acres to approximately 1.0 acre;
- Landfill North of Winklepeck (RVAAP-019-R-01), realignment of MRS boundary and increase in acreage from 7.55 acres to approximately 14.05 acres; and
- Firestone Test Facility (RVAAP-033-R-01), realignment of the MRS boundary and increase in acreage from 0.25 acres to approximately 0.91 acres.

The revised MRS boundaries are provided in **Figure 3**. The revised MRS descriptions and site boundaries are discussed in **Section 4.0**, **Summary of Historical Records Review**.

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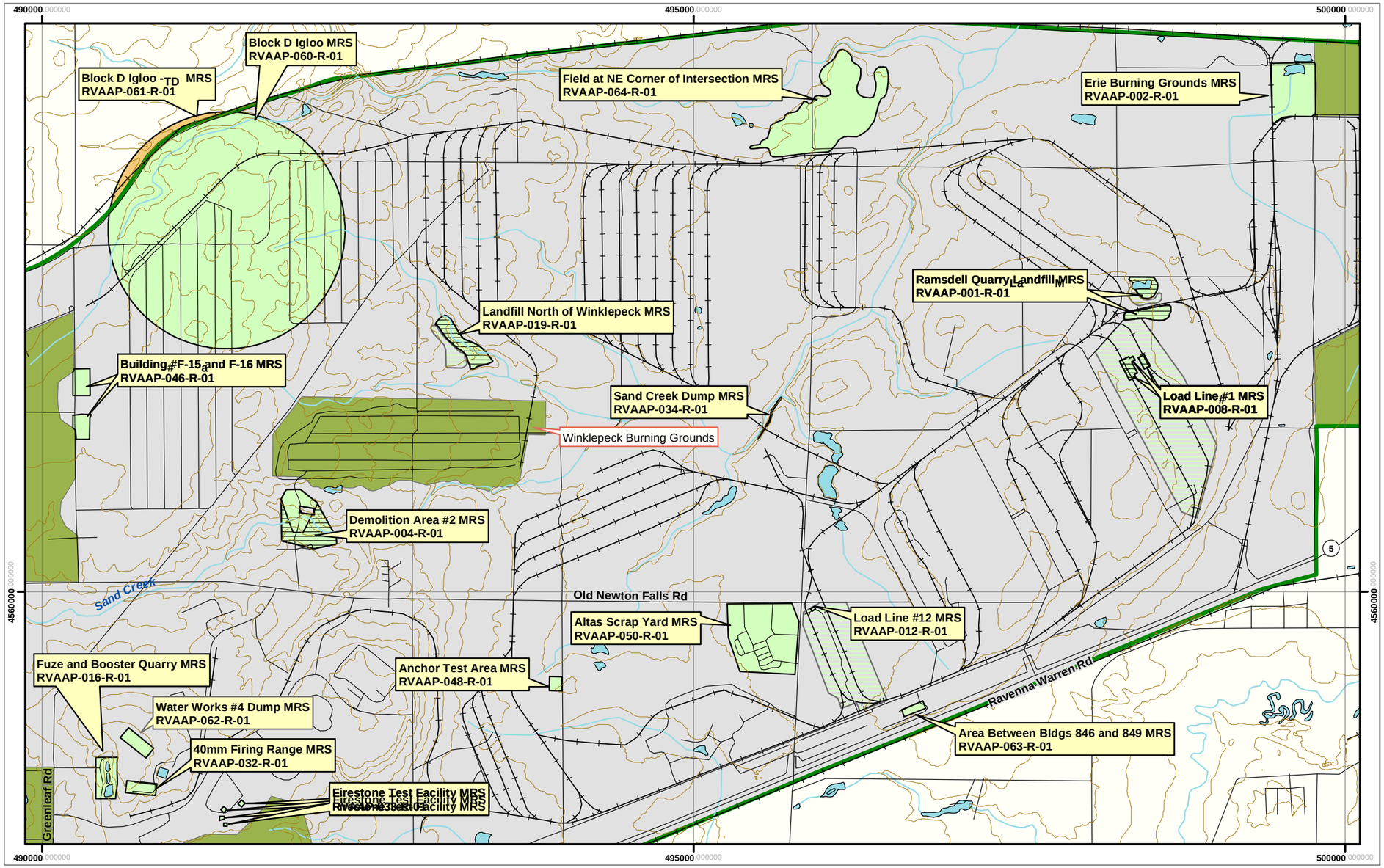
# HRR REVISED LOCATIONS of MRSs
# Ravenna Army Ammunition Plant, OH

**Figure 3**




N
W E
S

- Elevation Contour
- Installation Boundary
- Railroad
- Road
- Stream
- Water

**Area Status**

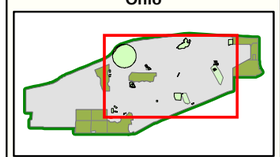
- Operational Range
- Other than Operational
- MRS, Closed
- MRS, Transferred
- MRS, Revised in the HRR
- MRS, Identified in the CTT

| | |
|---|---|
| **Projection:** | U TM Zone 17 |
| **Datum :** | W GS 84 |
| **Units:** | Meters |
| **Grid:** | 5,000 Meter |
| **Contour Interval:** | 500 Meter |

1:32,000

0 0.25 0.5 0.75 Miles
0 0.25 0.5 0.75 1 Kilometers

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. (e²M)

**Date:** January 2007
**Edition:** Final (Revised)

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# 3.0 DATA COLLECTION AND DOCUMENT REVIEW PROCESS

Five primary sources of information were researched as part of the data collection effort for this HRR report, which included:

- Installation Site Visit and Interview of Installation Personnel;
- Review of an existing Archive Search Report (ASR);
- Review of the current Administrative Record (AR);
- Internet Searches; and
- Review of the US Army CTT Range/Site Inventory and supporting documentation.

## 3.1 Data Collection Methods

### 3.1.1 RVAAP Site Visit and Interviews with Installation Personnel

engineering-environmental Management, Inc. ($e^2M$) performed a site visit at RVAAP from 12-14 December 2005 to review records maintained at the Installation, interview pertinent facility personnel, and to perform visual inspections of the MRSs. The intent of the record review was as follows:

- gather any on-site records pertaining to the MRSs regarding past and present use(s);
- gather documentation identifying, verifying, and establishing the physical limits and potential for MEC and MC for each MRS; and
- determine the environmental status and associated risk(s) for each MRS.

Two onsite repositories were searched at RVAAP: Building 1037, which contained the complete AR and historical Installation documents, maps, and photographs; and Building ESK 01located at the RTLS, which contained maps and photographs.

Installation personnel were interviewed to supplement and address data gaps identified in the US Army CTT Range/Site Inventory.

Interviews were conducted with the following Installation personnel:

- Jim McGee, On Site Facilities Maintenance Supervisor, MKM Engineers, Inc.;
- LTC Tadsen, Deputy Installation Commander, RTLS-OHARNG;
- Gail Harris, On Site Archival Librarian, SpecPro Environmental Services;
- Tim Morgan, Environmental Engineer, RTLS-AGOH; and
- Irv Venger, Facility Manager, US Army.

The interview record is provided in **Appendix B**.

Finally, a windshield tour of the Installation was conducted to gain a perspective of the physical layout of each MRS and document current site conditions.

### 3.1.2 RVAAP Archive Search Report

In 2004, the USACE, Rock Island District conducted an ASR under the authority of DERP to evaluate the presence of OE located at RVAAP. The investigation focused on the 21,683 acres that comprised the former industrial facility. The purpose of the investigation was to characterize the site for potential OE presence, to include conventional ammunition and chemical warfare materiel (CWM). Research efforts began with a thorough review of all reports, historical documents, and reference material gathered during the archival records search. During the review, an effort was made to focus on all munitions that may have been manufactured, tested or destroyed on the site. In addition to the on site sources of information, the investigators conducted research at the following locations:

- National Archives;
- Military History Institute;
- US Army Center for Military History;
- Explosive Ordnance Disposal (EOD) Units; and
- Local historical societies, libraries and museums.

(Note: Given that a fairly extensive archive search was conducted by the USACE, these efforts were not duplicated during this HRR.)

### 3.1.3 RVAAP Administrative Record

The RVAAP AR was reviewed to identify existing documents that contained information specific to the facility itself, MRSs, and potential types of MEC and MC that could reasonably be expected to be found at each site. Documents contained in the AR provided the following information:

- Site-specific information on the history of the Installation.
- Site-specific information on the physical conditions (climate, geology/hydrogeology, topography, hydrology, soil, and vegetation) existing at the MRSs.
- Area-specific land use and human receptor information.
- Area-specific ecological setting and receptor information.
- Area-specific environmental contamination information.
- Area-specific MEC removal and sampling actions.

### 3.1.4 Internet Searches

Internet research was conducted to supplement the archival data and information retrieved from the Installation repositories. The list below presents web sites searched for information on RVAAP.

- US Census: http://www.census.gov
- Global Security: http://www.globalsecurity.org/military/facility
- http://www.uxoinfo.com/uxoinfo/ordcategories.cfm#missiles
- http://en.wikipedia.org/wiki/Shaped_charge
- http://www.tpub.com/content/explosives/TM-43-0001-37/css/TM-43-0001-37_88.htm
- http://www.fas.org/
- www.rvaap.org/cleanup.html

### 3.1.5 US Army CTT Range/Site Inventory

The US Army CTT Range/Site Inventory at RVAAP focused on non-operational ranges and other sites with known or suspected UXO, DMM or MC, except where such properties were eligible as FUDS or BRAC sites. Where applicable, both FUDS and BRAC properties were inventoried under separate Phase 3 inventory efforts. As previously stated, nineteen MRSs were identified during the US Army CTT Range/Site Inventory. Since the completion of the inventory, Winklepeck Burning Grounds has been entered into and is being addressed under BRAC and IRP funding and will not require further investigation under the MMRP. Therefore, the total number of MRSs being addressed under this SI has been reduced to eighteen.

The objectives of the US Army CTT Range/Site Inventory were to identify and map all non-operational ranges and other sites with known or suspected UXO, DMM or MC, collect and upload data into ARID, prepare an assessment of the explosives safety risk using the USACE Risk Assessment Code (RAC), and determine which sites are MMRP eligible. The data collection portion of the US Army CTT Range/Site Inventory consisted of a site visit, historical records review, and interviews with installation personnel. The US Army CTT Range/Site Inventory and previously collected records were reviewed for this HRR. A summary of the MRSs is provided in **Section 2.2**.

During the US Army CTT Range/Site Inventory performed at RVAAP, 2,879 acres were identified as operational ranges/sites where OHARNG personnel performed vehicular training and dismounted troop training. The remaining balance of the land at the time was either unused or used by RVAAP for storage of equipment and munitions. Based on the findings of the US Army CTT Range/Site Inventory, most of the materials stored by RVAAP on RTLS land would be removed by the end of 2004. Under the US

Army CTT Range/Site Inventory, all property formerly incorporated as part of the original RVAAP Installation, including that property currently managed by the OHARNG (i.e., RTLS), was assessed during the inventory (RVAAP-2.A.4). For the purposes of the HRR, this process will be continued.

## 3.2 Archival/Historical and Other Records Collected

**Table 1** presents the relevant data collected from the various sources outlined above for the development of the RVAAP HRR and CSM.

**Table 1: Summary of Documents and Relevant Information**

| Document Title | MEC | MC | Environmental |
|---|---|---|---|
| Installation Assessment of RVAAP, Report No. 132. USATHAMA, November 1978. | | | |
| Phase I RI, Sampling and Analysis Plan Addendum for High Priority Areas of Concern for RVAAP, OH. SAIC, July 1996. | | | |
| Results of Preliminary Reconnaissance Archaeological Survey of RVAAP, Portage and Trumbull Counties, OH. Report No. BLA R12-1982. Cultural Resources Research Laboratory, 10 September 1982. | | | |
| Reassessment of RVAAP, OH. Report No. 132R. Chemical Systems Laboratory, December 1982. | | | |
| RVAAP Supplemental Photographic Documentation of Archetypal Buildings, Structures, and Equipment for US Army Materiel Command National Historic Context for World War II Ordnance Facilities. Geo-Marine, Inc., April 1995. | | | |
| PA for the Characterization of Areas of Contamination, RVAAP, OH. SAIC, February 1996. | X[1] | X | X |
| Phase I RI Report for the Phase I RI of High Priority Areas of Concern at RVAAP, OH. Volume I. SAIC, February 1998. | | | X |
| Draft Technical Memorandum, Human Health and Ecological Risk Assessment Approach for the Load Line 1 and Load Line 12 Phase II RIs, RVAAP, OH. SAIC, January 2001. | X | | |
| Preliminary Draft Feasibility Study for Central Burn Pits, RVAAP, OH. SAIC, November 2005. | | | |
| Preliminary Draft Feasibility Study for Fuze and Booster Quarry Landfill/Ponds, RVAAP, OH. SAIC, November 2005. | | | X |
| Preliminary Draft Feasibility Study for Load Line 12, RVAAP, OH. SAIC, November 2005. | X | | X |
| Preliminary Draft Feasibility Study for Open Demolition Area No. 2, RVAAP, OH. SAIC, November 2005. | | | X |
| Final Phase I MEC Density Survey after Action Report at Winklepeck Burning Grounds, RVAAP, OH. MKM Engineers, Inc., 1 March 2005. | X<br>X | | |
| Final Phase II Remedial Investigation Report for the Open Demolition Area No. 2 at RVAAP, OH. Volume I. Spec Pro, Inc. and SAIC, September 2005. | | | |
| Final Phase I/Phase II RI of the Fuze and Booster Quarry Landfill/Ponds, Volume One – Main Report and Volume II Appendices, RVAAP, OH. Spec Pro, Inc. and SAIC, November 2005. | | | |
| Issue Paper: Proposed Future Use of Areas of Concern (AOC) at RTLS. March 2003. | | | |

**Table 1: Summary of Documents and Relevant Information (continued)**

| Document Title | MEC | MC | Environmental |
|---|---|---|---|
| Ordnance and Explosives Archives Search Report for RVAAP, OH. USACE Rock Island District. June 2004. | X | X | X |
| MMRP Site Inspections Level of Effort for Regulatory Involvement. Thomas Symalla and USACE. September 2004. | | | |
| RVAAP Final Director's Findings and Orders. US Department of the Army. June 2004. | | | |
| Military Munitions Response Program Site Inspection (kick-off meeting presentation). USACE Omaha District and I. October 2005. | | | |
| Installation Action Plan for RVAAP, Fiscal Year 2001. Mark C. Patterson. 2001. | | | |
| Soil, Groundwater, Surface water Characterization for the Open Burning and Open Detonation Areas, RVAAP, OH. US Army Environmental Hygiene Agency. May 1992. | | | X |
| US Army CTT Range/Site Inventory, RVAAP, OH. I. November 2003. | X | X | X |
| Building the Ravenna Ordnance Plant – A Job History. Ordnance Department USA. | | | |
| The World War II Ordnance Department's Government-Owned Contractor-Operated Industrial Facilities: Ravenna Ordnance Plant Historic Investigation. USACE Fort Worth District and Geo-Marine, Inc. December 1995. | | | |
| Pistol Range Pictures | | | |
| Anchor Range Pictures | | | |
| PW and SC pictures | | | |
| RVAAP. Historic Photographs collected from the RVAAP Administrative Record. Dates Unknown. | | | |
| Werner, Phil. Site Photographs taken of MRSs at RVAAP, OH. December 2005. | | | |
| Photograph: ROP9_A Factory Worker loading finished shells on to dolley | | | |
| Demilitarization Key (Correspondence) | | | |
| DOC060110 1984 – 1990 Inventory of Demil Supplies | | | |

**Table 1: Summary of Documents and Relevant Information (continued)**

| Document Title | MEC | MC | Environmental |
|---|---|---|---|
| Environmental Assessment Thermal Decomposition and Demolition of Load Line 11, Building No. F-15 and Buildings 1200, S-4605, and T-4602, RVAAP, OH. MKM Engineers, Inc. September 2004. | | | |
| Final Phase I Remedial Investigation Report for Erie Burning Grounds (RVAAP-02) at the RVAAP, OH. SAIC. December 2001. | | | |
| Final Phase I Remedial Investigation Report for Erie Burning Grounds (RVAAP-02) at the RVAAP, OH. SAIC. September 2005. | X | X | X |
| Final Phase II Remedial Investigation Report for Erie Burning Grounds (RVAAP-02) at the RVAAP, OH. SAIC. September 2005. | X | X | X |
| Final Phase II Remedial Investigation Report for Erie Burning Grounds (RVAAP-02) at the RVAAP, OH. Volume II Appendices A through O. SAIC. September 2005. | X | X | X |
| Final Phase I/Phase II Remedial Investigation of the Fuze and Booster Quarry Landfill/Ponds (RVAAP-16), RVAAP, OH. Volume I Main Report. SAIC and Spec Pro, Inc. November 2005. | X | X | X |
| Final Phase I/Phase II Remedial Investigation of the Fuze and Booster Quarry Landfill/Ponds (RVAAP-16), RVAAP, OH. Volume II Appendices A through N. SAIC and Spec Pro, Inc. November 2005. | | | |
| FY 2006 RVAAP Installation Action Plan, RVAAP, OH. BRAC Hampton Field Office, Malcolm Pirnie, Inc, Management Solutions, OHARNG, Ohio EPA, RVAAP, US Army Environmental Center, USACE Louisville. July 2005 | X | X | X |
| Hazardous and Medical Waste Study No. 37-EF-5360-99, Relative Risk Site Evaluation for Newly added Sites at the RVAAP, OH. Volumes I and II. US Army Center for Health Promotion and Preventive Medicine. October 1998. | | | |
| Final Focused Feasibility Study for the Remediation of Soils at Load Lines 1 through 4 at the RVAAP, OH. Shaw Environmental, Inc. May 2005. | | X | X |
| Final Phase II Remedial Investigation Report for the Load Line 1 at the RVAAP, OH. SAIC. Volumes I and II. June 2003. | X | X | X |
| HTRW Drilling Sample Log for LL1, LL2, and LL3. November 2004. | | | |
| Final Phase II Remedial Investigation Report for Load Line 12 at the RVAAP, OH. Volumes I and II. SAIC. March 2004. | | X | X |
| Final Phase II Remedial Investigation Supplemental Report for Load Line 12 (RVAAP-12) at the RVAAP, OH. SAIC. November 2005. | | X | X |

**Table 1: Summary of Documents and Relevant Information (continued)**

| Document Title | MEC | MC | Environmental |
|---|---|---|---|
| Legal Description – Ravenna Training and Logistic Site. SAIC. March 2003. | | | |
| RCRA Closure, Field Investigation Report for the Deactivation Furnace Area, Open Detonation Area, Building 1601, and Pesticides Building, RVAAP, OH. SAIC. June 1998. | | | |
| Suspected Mustard Agent Burial Area of Concern (RVAAP-28), Report on the Groundwater monitoring well installation and groundwater sampling at the suspected mustard agent burial area of concern, RVAAP, OH. Spec Pro, Inc. July 2005. | | | |
| Geophysical Survey Results, Possible Mustard Agent Burial Site (RVAAP-28), Burial Site 1. SAIC. April 1998. | | | |
| Geophysical Survey Results, Possible Mustard Agent Burial Site (RVAAP-28), Burial Site 2. SAIC. March 1998. | | | |
| Final Phase I Remedial Investigation Report for the NACA Test Area at the RVAAP, OH. SAIC. December 2001. | | | |
| Final Paris-Windham Road Dump RD/RA Report (revised February 2005), RVAAP, OH. MKM Engineers, Inc. March 2004. | | | |
| Final Report on the Groundwater Investigation of the Ramsdell Quarry Landfill, RVAAP, OH. SAIC. August 2000. | | X | X |
| Final Phase I Remedial Investigation Report for the Ramsdell Quarry Landfill at the RVAAP, OH. SAIC 2005. | X | X | X |
| Final Proposed Plan for the Winklepeck Burning Grounds, RVAAP, OH. SAIC. December 2005. | | | |
| Final Phase III Remedial Investigation Report for the Winklepeck Burning Grounds, RVAAP, OH. SAIC. March 2005. | | | |
| Preliminary Draft Remedial Investigation Report for Load Line 6, RVAAP, OH. MKM Engineers, Inc. December 2005. | | | |
| Final Remedial Investigation Report for the Central Burn Pits (RVAAP-49) at the RVAAP, OH. Volume I. MKM Engineers, Inc. September 2005. | | | |
| U.S. Census Bureau. 2004. Population Finder-American Fact Finder. Available online: <http://factfinder.census.gov/servlet/SAFFPopulation>. Accessed 2 February 2006. | | | |

**Table 1: Summary of Documents and Relevant Information (continued)**

| Document Title | MEC | MC | Environmental |
|---|---|---|---|
| Preliminary Draft Report of the Characterization of 14 Areas of Concern, Characterization of Anchor Test Area. MKM Engineers, Inc. August 2005. | | | |
| Preliminary Draft Report of the Characterization of 14 Areas of Concern, Characterization of Atlas Scrap Yard. MKM Engineers, Inc. August 2005 | | | |
| Final Phase II MEC Clearance and Munitions Response At Winklepeck Burning Grounds, 12/16/2005, MKM Engineers, Order No W52H09-04-F-5120; Contract No. GS-10F-0542N. | X | | |

[1] = 'X' Indicates the type of information contained in and referenced from each report.

# 4.0 SUMMARY OF HISTORICAL RECORDS REVIEW

The Installation was originally established in 1940 when 21,000 acres were purchased by the US Government. The installation was opened in December 1941/January 1942 with the primary missions of loading medium and large caliber artillery ammunition, bombs, mines, fuzes and boosters, primers, and percussion elements, as well as to provide depot storage. To meet both missions, the Installation was split into two separate units: the Portage Ordnance Depot for depot storage, and Ravenna Ordnance Plant for ammunition loading. In August 1943, the entire Installation was re-designated the Ravenna Ordnance Center, and in November 1945 it was again re-designated as the Ravenna Arsenal (RVAAP-2.A.2).

Industrial operations at RVAAP consisted of 12 munitions assembly facilities referred to as load lines. Load Lines 1 through 4 were used to melt and load TNT and Composition B into large caliber shells and bombs, while Load Lines 5 through 11 were used to manufacture fuzes, primers, and boosters. Load Line 12 was originally used to produce ammonium nitrate for explosives and fertilizers, and was later used as a weapons demilitarization facility (i.e., TNT recovery facility). Facilities were operated by Atlas Powder Company until the end of WWII when the operation of the plant was turned over to the Ordnance Department. From 1946 to 1949, the ammonium nitrate line was operated by the Silas Mason Company for the production of ammonium nitrate fertilizer (RVAAP-2.A.2).

The plant was placed in standby status in 1950 and operations were limited to the renovation, demilitarization, and normal maintenance of equipment, along with storage of ammunition and components. Beginning in April 1951, facility operations were contracted with Ravenna Arsenal, Inc., a subsidiary of the Firestone Tire and Rubber Company of Akron, Ohio (RVAAP-2.A.2). The plant was reactivated during the Korean Conflict for the loading and packing of major caliber shells and components. By 1957, the plant was again placed in standby status (RVAAP-2.A.2).

In October 1960, the facility underwent renovation to establish facilities in the ammonium nitrate line for the processing and explosive melt-out of bombs. These operations, which commenced in January of 1961, established the first reclamation operation of this type in the ammunition industry. However, by July of 1961, the facility was again deactivated and in November 1961 the arsenal was divided. The industrial portion was re-designated as the Ravenna Ordnance Plant while the entire facility was designated the Ravenna Army Ammunition Plant (RVAAP-2.A.3).

With hostilities increasing in Southeast Asia, RVAAP was reactivated in May 1968 to load, assemble, and pack munitions on three load lines and two component lines. By 1972, RVAAP was deactivated again and only maintained the mission of demilitarizing M71A1 90mm projectiles. Demilitarization activities lasted from June 1973 through March 1974 (RVAAP-2.A.3).

Through the 1980's, responsibility of facility operations changed hands several times. In October 1982, Physics International Company, a subsidiary of Rockor Incorporated (Inc.) (Rockor), purchased Ravenna Arsenal, Inc. from the Firestone Company. In June 1985, Rockor was purchased by the Olin Corporation. During this period, the demilitarization of various munitions continued on a periodic basis through 1992 (RVAAP-2.A.3). By 1993, the Installation's status changed from inactive-maintained to modified caretaker (i.e., limited mission). Currently, MKM Engineers is the modified caretaker contractor.

As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP has been transferred to the NGB and subsequently licensed to the OHARNG for use as a military training site. This portion of the facility is identified as the RTLS. The current RVAAP consists of 1,280 acres that are scattered throughout the RTLS, which are managed by the BRAC Office. Once this remaining acreage is restored/remediated, it will be transferred to the NGB for use by the OHARNG.

Along with the production activities, the facility also operated several landfills and open burning/open detonation areas (OB/OD) which received a variety of explosives wastes, ash, dunnage, and munitions. At some of the landfills, the explosive wastes were thermally treated. The OB/OD operations were conducted to desensitize and/or destroy waste materials ranging from raw explosives to explosives contaminated wastes (e.g., rags, cardboard, etc.). Prior to 1980, these items were typically burned directly on the ground surface. Thereafter, waste explosives and munitions were either burned in metal refractory-lined trays or in a deactivation furnace located at the Winklepeck Burning Grounds.

A chronological list of significant historical events is provided in **Table 2**.

**Table 2: Timeline of Significant Events**

| Time Period | Significant Event |
|---|---|
| 1940 – 1950 | • 1940: US Government purchased 21,000 Acres to establish Installation.<br>• December 1941: Installation opened as Portage Ordnance Depot and Ravenna Ordnance Plant.<br>• 1943: Installation redesignated Ravenna Ordnance Center.<br>• 1945: Facility operated by Atlas Powder Company.<br>• 1946 – 1949: Facility operated by Silas Mason Company and produced ammonium nitrate fertilizer. |
| 1950 – 1960 | • 1950: Facility placed in stand-by status.<br>• Korean Conflict: Facility reactivated for loading and packing major caliber shells.<br>• 1957: Facility placed in stand-by status. |
| 1960 – 1970 | • 1961: Facility began the processing and explosive melt-out of bombs.<br>• 1961: Facility deactivated and then divided. Entire facility became Ravenna Army Ammunition Plant.<br>• 1968: Facility reactivated and supported loading, assembling and packing munitions. |
| 1970 – Present | • 1972: Facility deactivated, except for demilitarization.<br>• 1973 – 1974: Demilitarized M71A1 90mm projectiles.<br>• 1974 – 1992: Demilitarization of various munitions continued.<br>• 1993: RVAAP status changed to modified caretaker.<br>• 1999: 16,164 Acres transferred to NGB for use as RTLS.<br>• 2002: Additional 3,774 Acres of uncontaminated property transferred to the OHARNG.<br>• 2002-2003: OHARNG resurveyed the installation and determined that the Installation encompasses 21,683 acres<br>• 2006: NGB controls 20,403 acres of the former RVAAP, which are subsequently licensed to the OHARNG for use as a military training site. This portion of the facility is identified as the RTLS. The current RVAAP consists of 1,280 acres that are scattered throughout the RTLS. |

## 4.1 MRS Findings

A number of environmental investigations have been conducted at RVAAP; the first starting in 1978 with investigations still ongoing. Initial investigations were conducted to determine if on-site environmental contamination had resulted from historic operations involving manufacturing, storage, testing, and/or disposal activities, and to assess whether or not that contamination had migrated to groundwater. Further, these investigations focused on identifying AOCs and in later years under the IRP, focused on identifying site-specific contaminants of concern (COCs), contaminated media, and receptor exposure scenarios. In general, where munitions were a potential concern, the investigations performed laboratory analyses for explosives and metal constituents, among other analytes.

In many instances, these IRP AOCs are collocated with the MRSs that will be addressed in this HRR. The findings of these IRP investigations are summarized in the sections to follow that discuss each MRS, where applicable.

The MRS descriptions provided in the following sections represent the latest information known for each site and may differ substantially from the MRS descriptions provided in **Section 2**. The information provided in **Section 2** was taken verbatim from the US Army CTT Range/Site Inventory and may not represent current site conditions and may contain information that is no longer accurate and correct concerning the MRSs.

### 4.1.1 Ramsdell Quarry Landfill (RVAAP-001-R-01)

*4.1.1.1 Summary of Findings*

The Ramsdell Quarry Landfill MRS is described in the US Army CTT Range/Site Inventory as a 3.79 acre unlined landfill situated in the bottom of the quarry. However, the MRS footprint and landfill are shown on the inventory map located along the southern and western edge of the quarry. The US Army CTT Range/Site Inventory MRS footprint does not encompass the OB/OD area used to thermally treat explosives waste and munitions located in the bottom of the quarry to the north of the MRS footprint. Based on agreement among the Installation, stakeholders, USAEC, and USACE the MRS boundary has been moved to the north to encompass the entire quarry area including the OB/OD area and an area outside and south of the quarry that was identified by the Installation as potentially containing MEC.

Under the MMRP, any MEC that may be present in a capped and closed landfill is not eligible since this is considered a response complete action under the IRP. In such cases, the IRP action fully addressed all MEC/MC co-located at the IRP site. Therefore, the capped former landfill area was removed from the MRS footprint. The new acreage of the MRS is approximately 13.43 acres. **Figure 4** provides the revised layout of the MRS boundary. Historic and current site conditions are shown in **Photographs 1** and **2**, respectively.

**Photograph 1: Photograph of pond at Ramsdell Quarry Landfill, circa 1980. (RVAAP-9.A.1)**

**Photograph 2: December 2005 site photograph of the MRS looking east. (RVAAP-8.A.1)**

Originally (1946 through 1950), the MRS was used for OB/OD operations such as the thermal treatment of waste explosives from Load Line #1, and surface burning of approximately 18,000, 500-pound (lb) incendiary or napalm bombs. Numerous spent 81mm mortar rounds have been observed lying on the ground surface at the MRS; the date the rounds were found and the locations of the rounds are unknown. The US Army CTT Range/Site Inventory noted information regarding the area has not been identified for the period from 1950-1976 (RVAAP-2.A.5).

The quarry was mined to recover rock material, consisting of a quartz pebble conglomerate, which was used for road and construction ballast. It is reported that the excavation reached a depth of 30 to 40 ft below existing grade. After discontinuing quarry operations in 1941, the western and southern portion of the abandoned quarry was used for landfill operations from 1976 until 1989 when the landfill was closed. The landfill operated under a sanitary landfill permit issued by the State of Ohio from 1978 until final closure in 1990. The closure was conducted in accordance with state of Ohio solid waste regulations [Ohio Administrative Code (OAC) 3745-27-10]. Based on information provided by Installation personnel, the cap on the former permitted landfill covers approximately 4 acres and is comprised of two feet of compacted clay.

The entire MRS and former landfill is collocated with IRP AOC RVAAP-01 (Ramsdell Quarry), which encompasses approximately 14 acres. The former landfill is regulated under RCRA while the remaining portion of the quarry is regulated under CERCLA. In 1988, 1991, and 1998, monitoring wells were installed around the landfill to assess the nature and extent of groundwater contamination, and for quarterly monitoring (RVAAP-3.B.1). In an October 1998 report, low concentrations of explosives and metals were identified in groundwater. Finally, in 2005 six additional wells were installed up gradient of the landfill. In February 2005, the groundwater unit was transferred from the RCRA solid waste program to CERCLA (RVAAP-1.A.2). The COCs at the AOC include semi-volatile organics (SVOCs), metals, and explosives. Impacted media includes soil, sediment, and groundwater. Summaries of site-specific investigations are provided below.

# RAMSDELL QUARRY LANDFILL and LOAD LINE #1 MRS LOCATIONS
## Ravenna Army Ammunition Plant, OH

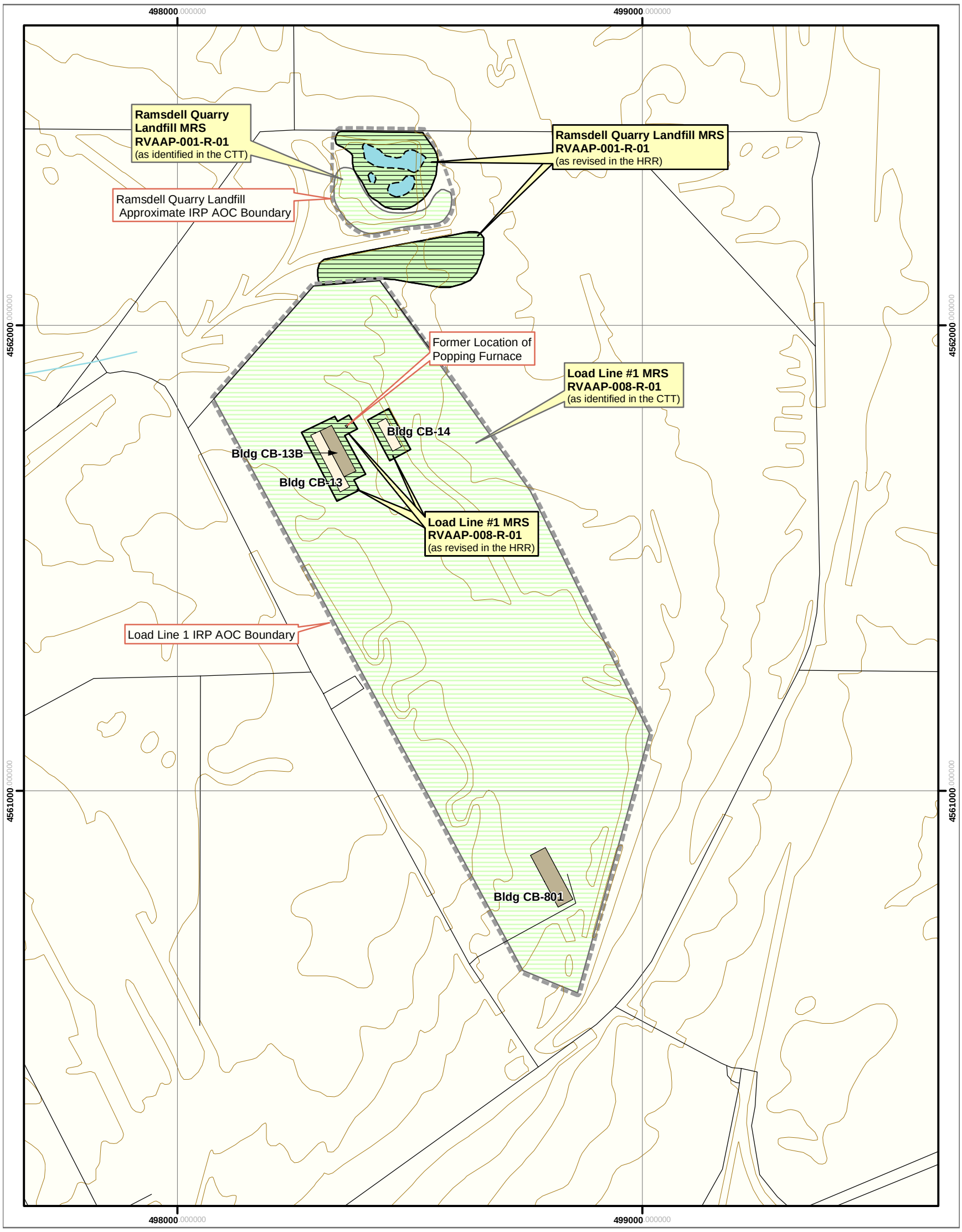


**Figure 4**

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| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **500 Meter** |

1:9,000

0 200 400 600 800 1,000 Feet
0 100 200 300 Meters

- Elevation Contour
- Road
- Stream
- Water (fluctuates in depth and extent)
- Building Locations, Existing
- Building Locations, Demolished

**Area Status**

- MRS, Revised in HRR
- MRS, Identified in CTT
- IRP Area of Concern

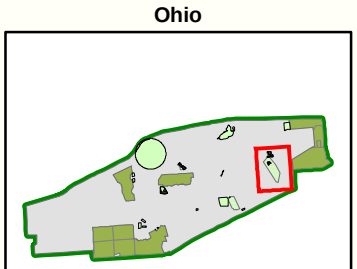
**Data Source:**

SAIC, RVAAP LL1 Phase II RI Report, Figures 4-2 and 4-22, December 20, 2002

SAIC, Final Phase II RI Report for Load Line 1 at RVAAP, OH. Figure 1-4, June 2003,

SAIC, RVAAP RQL Phase I RI Report, Figure 4-1, June 14, 2005

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. ($e^2M$)

**Date:** October 2006
**Edition:** Final

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*4.1.1.2 Previous Investigation Summaries*

**Final Report on the Groundwater Investigation of the Ramsdell Quarry Landfill, SAIC, August 2000**

Explosive compounds and the propellant nitroglycerin were consistently detected in groundwater at the AOC. The explosives concentrations were less than the EPA Region 9 tap water Preliminary Remediation Goals (PRGs). Nitroglycerin also did not exceed the PRG. In most of the samples, arsenic, iron, and manganese levels were in excess of EPA Region 9 tap water PRGs. Aluminum, arsenic, cobalt, manganese, mercury, nickel, and zinc exceeded facility-wide background criteria and Ohio drinking water standards (RVAAP-3.D.1).

In sediment samples, various metals and cyanide were detected at levels above facility-wide background criteria. "Maximum detected values for arsenic, barium, cadmium, chromium, nickel, selenium, thallium, zinc, 2,6-dinitrotoluene, and 2,4-dinitrotoluene exceed respective EPA Region 9 soil screening criteria for leaching to groundwater." In the interval of 0-0.5 ft, seven explosives compounds were identified. 2,4,6-TNT and high melting explosive (HMX) were the most commonly detected. At depths of 0.5 to 2.0 ft or greater, HMX was detected. In three samples, the propellant nitrocellulose was detected at low levels (RVAAP-3.D.1 and RVAAP-3.D.2).

In at least two sampling events, aluminum, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, thallium, vanadium, and zinc were detected in surface water above facility-wide surface water background criteria. In at least 30 percent of the surface water samples collected, arsenic, iron, manganese, and lead levels were detected in excess of EPA Region 9 tap water PRGs. The only explosive constituent detected in surface water was 4-nitrotoluene, which was detected once. No propellants were detected (RVAAP-3.D.1).

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR for RVAAP indicates the MRS is considered to have "potential OE presence (RVAAP-4.A.1)." Some explosives may remain at the site from the burning of incendiary or napalm bombs.

**Final Phase I RI Report for the Ramsdell Quarry Landfill at RVAAP, SAIC, September 2005**

During the Phase I RI field effort at the former quarry, explosives and propellants were detected at four discrete soil sample locations. Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, silver, thallium, and zinc were identified as site related contaminants (SRCs). The highest number of inorganics above background concentrations (16 SRCs) was found in the

northwest portion of the quarry. The northern and southern portions of the site contained the lowest number of metals above background concentrations (RVAAP-3.C.1).

During the Phase I RI, six new groundwater wells were established and analyzed. Twelve metals were labeled as SRCs, including aluminum, antimony, arsenic, beryllium, cadmium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc. The farthest downgradient well had the least number of SRCs (five). The wells downgradient of Ramsdell Quarry showed no explosives, indicating "the maximum horizontal extent of explosives contamination has been defined." The absence of explosives in the upgradient wells indicate the explosives detected during the previous groundwater investigation did not come from Load Line #1 (RVAAP-3.C.1). Only three metals (arsenic, lead, and manganese) were found to exceed EPA Region 9 tap water PRGs (RVAAP-3.C.2).

Arsenic, chromium, and manganese were identified in sediment samples collected from the site. Arsenic and manganese were also identified in the surface water located on site (RVAAP-3.C.2).

#### *4.1.1.3 MEC/MC Analysis*

Any MEC that remains under the landfill cap will not be addressed in this SI as it is considered Response Complete. While MEC (e.g. 81mm mortar rounds) has been observed on site at the bottom of the quarry, Installation personnel reported that the majority of debris was removed in the 1980s. However, there were no records to support this claim. Further, there is very little information describing the activities that were conducted in the area south of the quarry identified by Installation personnel as potentially containing MEC (i.e., the area identified by Installation personnel during the HRR), or records of any removal actions performed.

As such, the entire MRS is considered to potentially contain MEC and will require further characterization. Historic evidence that munitions were thermally treated at the MRS is shown in **Photograph 3**.

**Photograph 3: Photograph circa 1940s of MEC at Ramsdell Quarry Landfill. (RVAAP-9.A.1)**

Analytical data generated by IRP investigations

have confirmed the presence of explosives and metals in the soil, and in excess of background concentrations in groundwater and sediment at the former quarry area. In surface water, many metals exceeded background concentrations. Therefore, the former quarry area associated with the MRS is considered to contain MC. Under the IRP, all MC associated with this area (i.e., Ramsdell Quarry AOC) will be addressed under that program and will not be evaluated further under the SI. The area to the south of the former quarry area contained within the MRS boundary will be evaluated further under the SI process for MC. Furthermore, MEC will be addressed in both the northern and southern areas under the MMRP SI process.

## 4.1.2 Erie Burning Grounds (RVAAP-002-R-01)

*4.1.2.1 Summary of Findings*

Erie Burning Grounds was used to thermally treat bulk, obsolete, off-spec propellants, conventional explosives, rags, and large explosive contaminated items (e.g. railcars) by open burning on the ground surface between 1941 and 1945 (RVAAP-2.A.6). Prior to its acquisition by the US Army in 1940, the area may have been used for brick manufacturing. Aerial photos of the site from the 1940s and 1950s depict open boxcars staged at the end of the rail spur, known as Track 49. Presumably, materials were tipped out of the cars on either side of the embankment to be burned (See **Figure 5**, Burn Areas A &B). Ash residue was left on site after the burn. Engineering drawings from 1941 also identify two additional burning areas: one 200 ft to the northeast that was fed by a chute (See **Figure 5**, Burn Area C) and another (known as the "T-Area") to the south of the rail spur (See **Figure 5**, Burn Area D). Historic site conditions are shown in **Photographs 4 and 5**.

**Photograph 4: Aerial photograph of the Erie Burning Grounds, circa 1990s (Note Flooding). (RVAAP-9.A.1)**

**Photograph 5: Dense vegetation characteristic of dry areas at Erie Burning Grounds, circa 1990s. (RVAAP-9.A.1)**

Current site conditions at the MRS differ greatly from those during its operational years. In the early 1990s, the area became a wetland when the primary outflow culvert became plugged and the small streams that drained the burning ground were damned by beaver activity. As a result, four main surface water basins developed in the low-lying areas at the MRS. The largest surface water basin is located to the north of Track 49. Generally, the depth of the water is less than two feet across the impoundment, but may reach a maximum of 5 feet within the former drainage channel. Periodically, this surface water body will drain on its own accord. Recently, the loss of beaver activity has resulted in some draining of these surface water basins at the MRS. Partially buried metal debris (i.e., munitions debris), tentatively

# ERIE BURNING GROUNDS MRS LOCATION
## Ravenna Army Ammunition Plant, OH

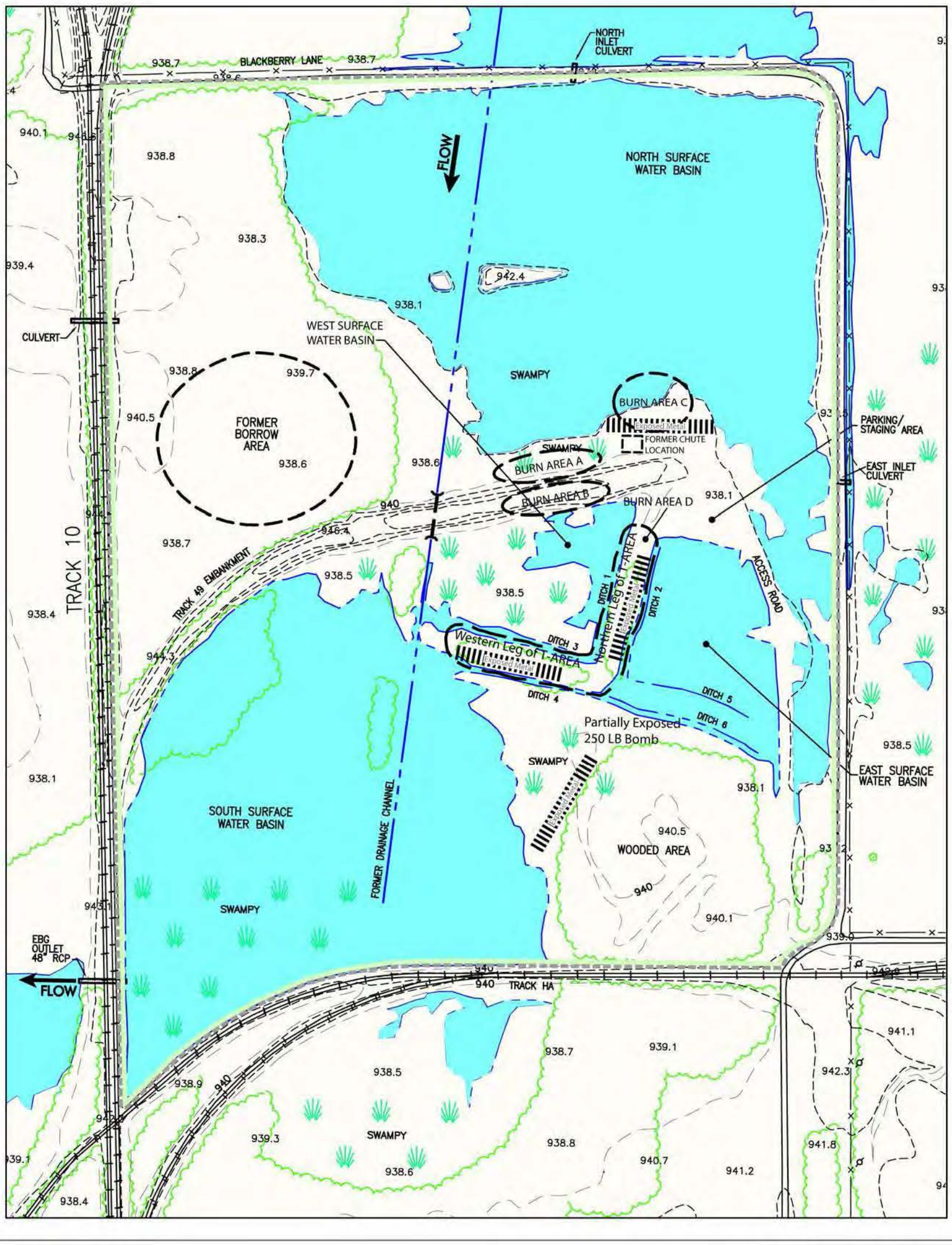


**Figure 5**

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| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **500 Meter** |

1:2,000

0 50 100 150 200 250 Feet
0 25 50 75 Meters

Road, Gravel
Railroad
Contour, 10-Foot Interval
Contour, 2-Foot Interval
923.8 Spot Elevation
Tributary
Stream
Treeline
MRS Boundary
IRP Area of Concern

**Data Source:**

SAIC, RVAAP EBG Phase II RI Report, Figure 1-5, December 08, 2003

Installation Location
**Ohio**

**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**
**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. (eM)
**Date:** October 2006
**Edition:** Final

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identified by Installation and USACE personnel as remnants of burned out bombs (size and type not identified), have been observed across the MRS. **Figure 5** shows four areas (hatched areas labeled as exposed metal) where the partially buried items have been observed. Installation personnel have also reported sighting MEC (type and condition unknown) located at the MRS.

The areas that remain above water include the Track 49 embankment, former chute location, northern and western legs of the T-Area, a portion of the site northwest of the former borrow area, and a wooded area in the southeast corner of the MRS. Dense brush and woodland vegetation cover the portions of the site that are not submerged. The current site layout of the MRS is shown in **Figure 5**. This figure was part of the Final Phase II Report for the IRP site and was prepared by SAIC for the USACE, Louisville District (RVAAP-3.F.3).

As previously mentioned, the MRS is collocated with IRP AOC RVAAP-02 (Erie Burning Grounds), which encompasses approximately 35 acres. In general, the MRS and IRP AOC share the same footprint and boundary. Based on the findings from IRP investigations, COCs include explosives, metals, and SVOCs in the surface soil, sediment, groundwater, and surface water. MC in soils and dry sediments has been addressed under the IRP, with a likely decision (based on the risk assessment) of NFA. However, a decision concerning MC in wet sediments, surface water, or ground water has not been made. As such, MC will be further investigated under the MMRP.

#### *4.1.2.2 Previous Investigations*

**Final Phase I RI Report for Erie Burning Grounds at RVAAP, SAIC, December 2001**

Surface Soil

During the Phase I RI, 2,4,6-TNT was the most persistent explosive identified in surface soil at the AOC. The highest concentration of 2,4,6-TNT was found at the Track 49 embankment area at a concentration of 7.1 milligrams/kilogram (mg/kg). "The propellant nitrocellulose was detected in four surface soil samples, with no apparent pattern of distribution (RVAAP-3.E.1)."

"Inorganics are pervasive in surface soil. Aluminum, arsenic, chromium, manganese, nickel, and vanadium were detected in 100 percent of the surface soil samples, but they occurred above background in less than about 30 percent. Barium, copper, lead, and zinc were detected in 100 percent of the samples and were above background in at least 50 percent of the samples. Antimony and mercury were detected about 30 percent of the time, but nearly all detects exceeded background. The

highest concentrations are associated with the former burn area, Track 49 embankment, and T-Area (RVAAP-3.E.1)."

Subsurface soil

The Track 49 embankment and gravel access road contained the highest explosives concentrations found in subsurface soil. The explosive 2,4,6-TNT was the most commonly detected, and the highest concentration was again found at the Track 49 embankment. Nitrocellulose was also detected in one sample (RVAAP-3.E.1).

"Aluminum, arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were detected in 100 percent of the subsurface soil samples. As with surface soil, the Track 49 embankment, gravel access road, and T-Area were the primary areas of metals contamination. Concentrations above background are lower in subsurface soil than in surface soil (RVAAP-3.E.1)."

Sediment

Explosives and polycyclic aromatic compounds (PAHs) were detected at the Track 49 embankment. "The Track 49 embankment and the staging/parking area closest to the eastern terminus of the spur represent the primary sources for metals, likely due to the presence of metallic debris and abundant slag that was placed as ballast material. Mercury is present almost exclusively in the T-Area (RVAAP-3.E.1)." There were relatively high concentrations of site-related metals and explosives in the former burn area. Nitrobenzene was detected at the outlet located at the South Surface Water Basin. At the same location, the only metal detected above background was nickel. Just downstream from the outlet, no explosives or metals were detected above background. A few metals were detected at concentrations above background but no explosives were identified at off-site stations (RVAAP-3.E.1).

Surface Water

Surface water in the T-Area contained the most explosives. 1,3-dinitrobenzene (DNB) was the most consistently detected explosive, while 2,4,6-TNT was detected at three stations. Nitrocellulose was also detected in the T-Area. The T-Area contained the most metals above background concentrations. Arsenic, barium, and manganese were detected above background at the outlet, and the north, west, and south surface water basins. Multiple metals above background were detected in the east surface water basin. Station EBG-114, located off-site, contained 1,3-DNB; 2,4,6-TNT; 2,4-dinitrotoluene; HMX; and nitrobenzene. At the drainage way (EBG-114 and EBG-116), arsenic, barium, and manganese were detected above background (RVAAP-3.E.1 and RVAAP-3.E.2).

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR indicated that the potential exists for MEC to be present at the MRS. "It appears that bomb bodies were transported to this area for flashing after they were washed out; the area is too close to the installation border to burn out filled bombs. It is unknown at this time if all of the explosives were removed from the metal parts (RVAAP-4.A.1)."

**Final Phase II RI Report for Erie Burning Ground at RVAAP, SAIC, September 2005**

Surface Soil

In the Phase II investigation, four explosive SRCs were identified: 2,6-dinitrotoluene; 2-amino-4,6-dinitrotoluene (DNT); 4-amino-2,6-dinotrotoluene; and RDX. In the northwestern area of the MRS, no explosives were detected. "Inorganic SRCs included between 10 and 14 metals in each of the Phase II stations on the north and south sides of the Track 49 embankment. With the exception of cadmium, metals were not present in the wooded area in the northwest or southeast portions of the AOC (RVAAP-3.F.1)."

Sediment

In the former drainage channel in the south basin and at the north inlet, explosives or propellants were detected in sediment. In sediment samples collected downstream of the outlet, no explosives were observed. At the north and east inlets, the former drainage channel in the south basin, and downstream of the outlet, inorganic SRCs were detected (RVAAP-3.F.1). Antimony, beryllium, cadmium, and silver were detected above background in at least five of six Phase II sediment samples. These SRCs were identified as pervasive across the site (RVAAP-3.F.2).

Surface Water

During the Phase II RI, eight surface water stations were sampled and no explosives were detected. In the surface water sample collected from the east inlet, nitrocellulose was detected. Antimony, beryllium, cadmium, cobalt, lead, nickel, and vanadium were detected above background. The most metals were found above background in the sample collected from the former drainage channel in the south basin. At the outlet (EBG-157) and downstream stations (EBG-158 and -159), metals were detected above background (RVAAP-3.F.1).

Groundwater

In the groundwater wells established and analyzed during the Phase II RI, no explosives were detected. In at least one of the eight monitoring wells located at the IRP Site, antimony, arsenic, barium, cobalt, copper, lead, nickel, vanadium, and zinc were detected. Wells at the MRS boundary on the northeast and southwest corners of the IRP Site showed metals above background as often as in wells located in areas of known contamination in sediment and surface soil. For background criteria that were greater than zero, some SRCs showed levels 2 to 3 times background concentrations (RVAAP-3.F.1).

### *4.1.2.3 MEC/MC Analysis*

MEC and/or munitions debris have been observed periodically on site as evident in **Photographs 6 and 7**. Further, Installation personnel have indicated that MEC remains at the MRS. This is supported by the ASR report, which stated that the site has the potential to contain MEC. Notwithstanding, a UXO avoidance sweep was performed in conjunction with the Phase II RI field work and although subsurface anomalies were identified, MEC items were not discovered lying on the ground surface. A metal fragment was discovered that was suspected of being a part of a shell casing. The anomalies were not investigated further to determine their true identification (RVAAP-3.F.6). Adequate documentation of the presence (or absence) of MEC or munitions debris has not been compiled for the MRS. As such, the entire MRS (approximately 33.93 acres) is considered to contain MEC.

**Photograph 7: Portion of a Burned Out Bomb found at the Erie Burning Grounds, circa 1990s. (RVAAP-4.A.2)**

**Photograph 6: Burned Out Bomb at water's edge at Erie Burning Grounds, circa 1990s. (RVAAP-4.A.2)**

Explosives and metals above background concentrations were detected in surface soil, subsurface soil, and surface water at the site. Explosives and metals were also detected in sediment at the site. MC in soils and dry sediments has been addressed under the IRP, with a likely decision (based on the risk assessment) of

NFA. However, a decision concerning MC in wet sediments, surface water, or ground water has not been made. As such, MC will be further investigated under the MMRP.

### 4.1.3 Demolition Area #2 (RVAAP-004-R-01)

*4.1.3.1 Summary of Findings*

The 2003 US Army CTT Range/Site Inventory reported that Demolition Area #2 encompassed approximately 14.91 acres, which included a 2.5 acre interim RCRA unit that was permitted to demilitarize munitions and a 40mm prototype test range. During the HRR research it was determined that the locations of two known munitions burial sites (i.e., Burial Sites 1 and 2) and a dump area known as the Sand Creek Disposal Area (also referred to as Rocket Ridge) had not been mapped as part of the MRS during the inventory. These areas were found to be MMRP-eligible and have now been included as part of the Demolition Area #2 MRS, as well as the buffer areas between these sites. Two areas were determined to be non-MMRP eligible: the 2.5 acre interim RCRA unit and a majority of the area that was previously used as a 40mm prototype test range that overlies the interim RCRA unit. These areas have been removed from consideration as part of the MRS (RVAAP-6.A.4). Only the small portion of the old prototype test range that extends to the north and outside of the interim RCRA unit is MMRP-eligible and will be included as part of the MRS. The test range was used to fire test munitions at targets, which have since been removed. The interim RCRA unit will be closed in accordance with all applicable state and Federal regulations and requirements at the end of the IRP investigation. It was further determined that the size of the interim RCRA unit was actually 2.5 acres and not the 1.5 acres that had been reported in the US Army CTT Site/Range Inventory. Based on the addition of these new locations and realignment of the boundaries, the MRS footprint has been increased to approximately 32.95 acres. Additional information was provided by the Installation that indicated that there is a bomb disposal area located near the northwestern portion of the MRS. While this could not be corroborated by additional documentation, the area will be recommended for further characterization during the SI. **Figure 6** depicts the new boundary of Demolition Area #2.

Additional information researched during the HRR revealed that the MRS had multiple configurations during its operation, including demolition operations on the south side of Sand Creek. The standard operating procedures for open detonation were to place the explosives in a pit excavated to a minimum depth of 4 ft, which was then backfilled with 2 ft of soil prior to detonation. After detonation, the site was reportedly policed for shrapnel, scrap metal, or any UXO. It was also noted in the Phase II RI that fragments of exploded or unexploded ordnance items forcefully propelled away from the pits (i.e., kick-outs) can be found several thousand ft away from the detonation site. This statement, in part, was based on a DoD document (Ammunition and Explosives Safety Standards, 1999) that establishes default

distances for non-fragmenting explosives at 1,250 ft, and 4,000 ft for munitions of 5-inch caliber or larger.

Based on the current information, the MRS consists of the following components:

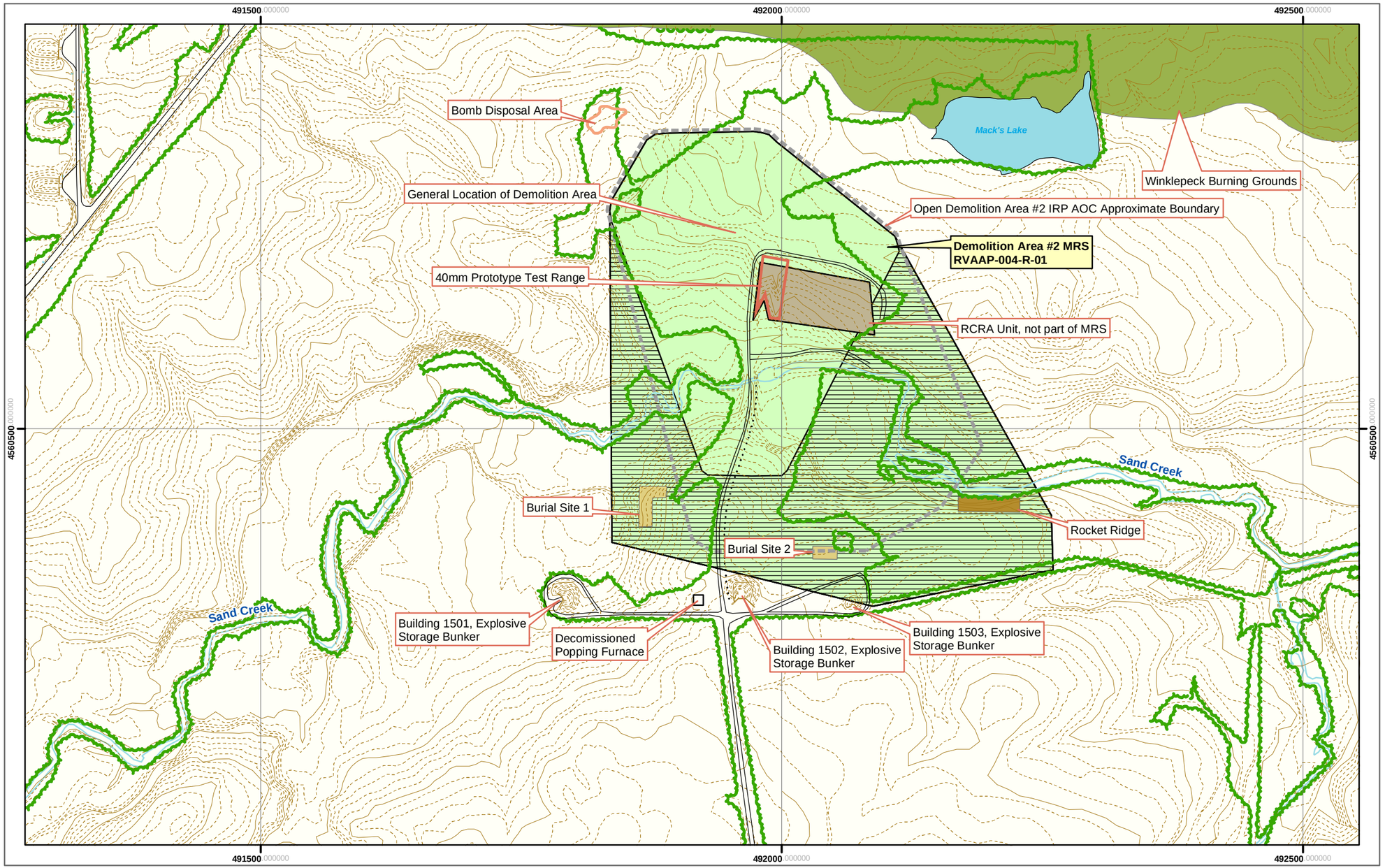
- The former demolition area (excluding the non-MMRP eligible interim RCRA unit).
- The portion of the 40mm prototype test range that extends to the north and outside of the interim RCRA unit.
- Burial Sites 1 and 2 where possible MEC may have been buried. Burial Site 1 is approximately two acres in size and located approximately 200 feet northeast of Building 1501 (explosives storage bunker). Burial Site 2 is approximately one acre in size and is located approximately 100 feet north of Building 1503 (explosives storage bunker).
- Rocket Ridge area where rocket bodies and various other potential MEC items have been discarded on the ground surface and into Sand Creek. Rocket Ridge is located along a 70-foot embankment northeast of Building 1503 overlooking Sand Creek.
- The MRS also includes all of the area located between the areas identified in the previous bullets.

The remaining site features include out-of-service electric lines used to remotely detonate munitions, and the gravel/paved access roads. Other features not included as part of the MRS but worthy of note include the three above ground earth-covered explosives storage bunkers (i.e., Buildings 1501, 1502, and 1503) and the decommissioned popping furnace located to the south of the site. Historic site conditions at the MRS are shown in **Photograph 8**; current site conditions are shown in **Photographs 9, 10,** and **11**.

As previously mentioned, the MRS is collocated with IRP AOC RVAAP-04 (Open Demolition Area # 2), which encompasses approximately 25 acres. The IRP AOC encompasses the former demolition area, 40mm prototype testing range, and the interim RCRA unit. The interim RCRA unit is not eligible for Environmental Restoration, Army funding (ER, A); rather, the unit will be addressed with compliance cleanup program funds at the time of closure (not yet determined).

Previous investigations conducted under the IRP have found concentrations of explosives, particularly TNT, and several inorganics including cadmium, lead, and mercury in both the surface and subsurface soils. Concentrations of inorganic compounds in sediment appear to be within the range of AOC-wide background values. Summaries of site-specific investigations are provided below.

# DEMOLITION AREA #2 MRS
# Ravenna Army Ammunition Plant, OH




## Figure 6

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- Contour, 10-Foot Interval
- Contour, 2-Foot Interval
- Road
- Stream
- Water
- Vegetation
- Burial Site
- RCRA Unit, MMRP Non-eligible
- Rocket Ridge
- 40mm Prototype Test Range
- Bomb Disposal Area
- Out-of-service electric lines used to remotely detonate munitions
- Explosive Storage Bunker

**Area Status**

- Operational Range
- MRS, Closed
- MRS, Added in HRR
- IRP Area of Concern, Approximate Boundary

**Data Source:**
SAIC, RVAAP ODA2 Final RI Report, Figure 1-6, September 15, 2005

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| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **500 Meter** |

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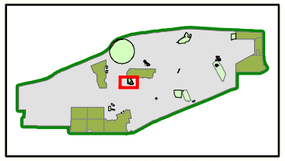
0 100 200 300 400 500 Feet
0 50 100 150 Meters

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. ($e^2M$)

**Date:** October 2006
**Edition:** Final

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**Photograph 8: Photograph of Demolition Area #2, facing south along entrance road. Large mound in the background is Building 1502 (Control Building and Storage Bunker), circa 1980. (RVAAP-9.A.1)**


**Photograph 9: December 2005 photograph of the control Building/Storage Bunker (Building 1502) south of Demolition Area #2. (RVAAP-8.A.1)**

**Photograph 10: December 2005 photograph of decommissioned Popping Furnace south of Demolition Area #2. (RVAAP-8.A.1)**

**Photograph 11: December 2005 photograph of former detonation area at Demolition Area #2. (RVAAP-8.A.1)**

*4.1.3.2 Previous Investigations*

**Soils, Ground Water, and Surface Water Characterization for the OB/OD Areas, RVAAP, USAEHA, 1992**

Soil

Results from the investigation found "slight" contamination in the top two ft of soil at the Demolition Area. Constituents detected included explosive compounds, barium, cadmium, mercury, lead, and minor amounts of arsenic. As soil samples increased in depth, the levels of contamination were found to decrease. Below eight ft bgs, there was only one sample that exhibited explosives concentrations (RVAAP-5.A.1).

Water

Low levels of 2,4-dinitrotoleune (1.1 micrograms per liter [µg/L]) and 2,4,6-TNT (14 µg/L) were observed migrating offsite through surface runoff, in addition to elevated levels of RDX (230 µg/L). Lead (0.08 milligrams per liter [mg/L]), copper (0.03 mg/L), zinc (0.10 mg/L), iron (2.4 mg/L and 3.3 mg/L), and mercury (0.0004 mg/L) were detected at levels which exceeded the state ambient water quality criteria for warm water habitats. Copper levels were reported to be naturally occurring (RVAAP-5.A.2).

Sediment

Sample results for sediment found no evidence of contamination. Iron levels were high in all sediment samples, but were thought to be naturally occurring (RVAAP-5.A.2).

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR indicated that the MRS has "confirmed OE presence." The ASR reported that a large amount of munitions debris is present at the Rocket Ridge dump site in the eastern portion of Demolition Area #2. The ASR further reported that metal scrap is also buried in the western portion (i.e., Burial Areas 1 and 2) of the site (RVAAP-4.A.1).

**Final Phase II RI Report for the Open Demolition Area No. 2, RVAAP, Spec Pro, Inc. and SAIC, September 2005**

The Phase II RI report focused on five known potential source areas at the Open Demolition Area:

- Open Detonation Areas (including the RCRA Unit);
- Open Burning Area (area within the RCRA unit in which, from 1981-1986, the sludge from the Load Line 6 Evaporation Unit was thermally destroyed);
- 40mm Prototype Testing Range;

- Burial Sites 1 and 2; and
- Sand Creek Disposal Area (also known as Rocket Ridge) (RVAAP-6.A.4).

Surface Soils

Explosives and propellants were found at the highest concentrations at sample locations south (samples DA2-053 and DA2-072) and north (sample DA2-045) of Sand Creek. Tetryl, which was detected in 24 percent of the samples collected, was the most widespread compound detected in the surface soil (RVAAP-6.A.2). The report stated that most explosives and propellants in surface soil were found at sampling locations in the floodplain south of Sand Creek. The sampling results of the Phase II RI do not provide confidence that all portions of Open Demolition Area No. 2 have been fully characterized. To define the degree of explosive and propellant contamination to the north of Sand Creek and at the perimeter of the site, further sampling will be conducted. Metal concentrations north of Sand Creek had a higher occurrence of concentrations exceeding background levels than the area sampled south of Sand Creek (RVAAP-6.A.1).

Subsurface Soil

The report stated that explosives and propellants are present in subsurface soil at eight sampling locations north of Sand Creek. The most common explosives detected were 2,4,6-TNT and tetryl. One sample location (DA2-045) was found to contain multiple (five) explosives and propellant compounds. South of Sand Creek, explosives and propellants were detected at eleven locations, with sample locations DA2-067 and DA2-111 having the highest number detected (four). The explosives 2,4,6-TNT and tetryl were the most common compounds detected in the subsurface soil sampling locations south of Sand Creek (RVAAP-6.A.1).

North of Sand Creek, there were five sample locations with six or more SRCs above background concentrations. To the south of Sand Creek, two sample locations had six or more SRCs above background concentrations (RVAAP-6.A.1 and RVAAP-6.A.2).

Sediment

Aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, and vanadium were detected in sediment above background concentrations.

**Table 3** presents the sediment sample locations and constituents that had the highest concentrations of inorganic SRCs:

**Table 3: Sediment Sample Locations for Demolition Area #2**

| Sample Location | SRC in highest concentration |
|---|---|
| Downstream floodplain of Sand Creek | Mercury |
| Upstream floodplain south of Sand Creek | Copper |
| Ditch north of Sand Creek | Barium, Cadmium, Cobalt, and Lead |
| Ditch upgradient of Sand Creek Dump | Beryllium, chromium, nickel, and vanadium |

(RVAAP-6.A.1)

Surface Water

No explosives were detected in surface water collected from Demolition Area #2. Nonetheless, the propellant nitrocellulose was detected in all three surface water samples collected in September 2002. At one sampling location, nickel and chromium were detected above background concentrations in April 2003 (RVAAP-6.A.1).

Groundwater

The majority of monitoring wells sampled exhibited metal concentrations that were attributed to site contamination. The highest number of inorganic SRCs was detected in the northern part of the site in well DA2-104. Only two monitoring wells exhibited concentrations of explosives and/or propellants (RVAAP-6.A.1).

*4.1.3.3 MEC/MC Analysis*

MEC and/or munitions debris exists at the Rocket Ridge dump site and potentially buried at the two burial sites (Burial Sites 1 and 2). In addition, white phosphorus is reportedly buried at one of the burial sites. The presence of MEC has been documented at the former detonation area, especially within the RCRA Unit. In 1999, a removal action was conducted where the soil was excavated to a depth of 4 ft over the entire 1.5 acre RCRA unit. Once excavated, the soil was screened and MEC, shrapnel, or scrap metal was removed and the screened soil placed back on site. The area was then graded and seeded. Over 100,000 items were recovered during this effort, including over 45,000 primer detonators, 19,000 T-bars, several thousand fuzes of various sizes, and several thousand artillery rounds ranging from 22mm to 155mm in size. MEC removed from the RCRA unit are shown in **Photograph 12**. No other removal actions involving MEC have been conducted at the MRS. MEC is expected to be present across the remainder of the site; specifically, at the burial sites and the Rocket Ridge area. Evidence of MEC remaining at the site is shown in **Photograph 13**.

Analytical data from IRP investigations have confirmed the presence of explosives and metals in the surface and subsurface soil, and groundwater in two distinct areas along Sand Creek (RVAAP-6.A.6). Investigative work is ongoing under the IRP. Currently, a feasibility study is being conducted with plans to perform supplemental remedial investigative field work. The additional field work, which will include surface and subsurface soil sampling, will be performed to define the nature and extent of contamination at the AOC and to finalize the RI. Areas within the MRS that are being investigated under the IRP include the open detonation/burn area, 2 burial sites, 40mm test range, and the three explosives storage bunkers. Rocket Ridge is not covered under the IRP and will require further characterization under the MMRP. Further evaluation of MC under the SI will be required and any contaminated soils found above risk based values will be covered under the MMRP.

**Photograph 12: Recovered Projectiles from RCRA Unit Awaiting Destruction (1999). (RVAAP-4.A.2)**

**Photograph 13: View downhill of the Rocket Ridge Dump Site at Demolition Area #2, circa 1990s. (RVAAP-4.A.2)**

### 4.1.4 Load Line #1 (RVAAP-008-R-01)

*4.1.4.1 Summary of Findings*

Load Line #1 is described in the US Army CTT Range/Site Inventory as encompassing approximately 163.62 acres, which consisted of the industrial buildings (i.e., load lines), associated infrastructure (e.g., utilities, settling tanks, water tower, etc.), and a large wooded area to the east of the industrial area. In 1971, the load line was declared inactive when the buildings with residual explosive dust were washed down, and the freestanding equipment was removed. Salvage operations continued with the removal of the overhead steam lines and major rail spurs, and the removal of all telephone lines from 1996 through 1998 (RVAAP-3.G.2). By FY 2000, the majority of the buildings were demolished and removed. Currently, the only remaining buildings include CB-13B and CB-801. Floor slabs of the demolished buildings, walkways, and all below-grade infrastructures remain on site. However, some of the manholes and storm/sanitary sewer access points were filled in or obstructed during the demolition activities (RVAAP-3.G.2).

Load Line 1was used to melt and load TNT and Composition B explosives into large-caliber shells during WWII and the Korean War. As a result of the load operation, explosive dust, spills, and vapors collected on the floors and walls of several buildings, which were periodically washed from the walls and floors with water and steam. During building wash down, pink water or loose explosive flakes, chips, or dust were occasionally swept out of doorways onto the ground surface. The majority of the wastewater, known as pink water, was collected in a series of concrete sumps that were located throughout the load line. The pink water was then pumped to a sawdust filtration unit for clarification and removal of nitro-compounds prior to discharge. Sawdust filtration units consisted of a set of three parallel concrete settling tanks (10- × 30- × 3-ft) and a set of three filter blocks (5- × 15- × 3-ft) that were located in the bottom of the filtration tanks. In addition to the munitions loading operations, ordnance was painted, drilled, and boostered. In 1951, the load lines were rehabilitated to remove and replace soils contaminated with accumulated explosives, and to remove and replace waste water lines, particularly at Buildings CB-4 and CB-4A. However, many contaminated storm drain lines remained in each load line after 1951. From 1961 until 1967, operations at the MRS included the rehabilitation of munitions, including the dismantling, replacing of components, and repainting of M15 land mines. The majority of the rehabilitation work was conducted in Buildings CB-13 and CB-14. In addition to the rehabilitation work, primers were demilitarized in the southeastern area of Building CB-13. It is suspected that these activities may have contributed to propellant contamination (RVAAP-3.G.2).

A Phase I RI conducted in 1996 found elevated concentrations of explosives, inorganics, and organics in soils in the central portion of the complex. Contaminants were found to be prevalent around the doorways, drains, and vacuum pumps associated with the melt and pour Buildings CB-4 and CB-4A, as well as the main concrete settling tank. During Phase I RI field activities, residual propellant pellets were found on the ground beside Buildings CB-13, CB-13B, and CB-14, as well as in the area of the former popping furnace. According to interviews with RVAAP personnel, triple base propellants still exist at the MRS. Further, the US Army CTT Range/Site Inventory reported that a 152mm casing was found on site (RVAAP-2.A.8). Although the exact location of the shell casing was not disclosed, it is known that Building CB-801 was used to store inert material, such as shell casings. Based on these findings, it would appear that potential MEC and/or MC is limited to several areas associated with Buildings CB-13, CB-13B, CB-14, and the former popping furnace. As such, it is reasonable to reduce the total acreage of the MRS to those immediate areas surrounding the buildings (i.e., CB-13, CB-13B, and CB-14) and the popping furnace. According to Installation personnel, this would encompass approximately four acres. The revised MRS boundaries are presented in **Figure 4**. This figure was taken from the Final Phase II RI Report for Load Line #1 and was prepared by SAIC for the USACE, Louisville District (RVAAP-3.G.3 and RVAAP-3.G.4). Current site conditions are shown in **Photograph 14**.

**Photograph 14: December 2005 photograph of Load Line #1. (RVAAP-9.A.1)**

As previously mentioned, the MRS is associated with an AOC (RVAAP-08) that's being addressed under the IRP. The AOC includes the former production facility and some outlying areas, and covers 160 acres. In September 2003, a performance based contract was awarded to Shaw Environmental to complete an interim soil and sediment removal action at multiple locations at RVAAP, including Load

Line #1 (RVAAP-2.A.8). MEC or MC that fall outside the scope of this contract will be covered under the MMRP. As such, the presence of MEC or MC will be field verified during the SI field work.

#### *4.1.4.2 Previous Investigations*

**Final Phase II RI Report for the Load Line 1, RVAAP, SAIC, June 2003**

Surface soil

The Final Phase II RI provided a summary of previous investigations conducted to date. The findings of these investigations are briefly described below.

In 1997, the Cold Regions Research and Engineering Laboratory (CRREL) conducted a study of explosives contamination in surface soils. During this investigation, 2,4,6-TNT, DNT, and RDX were detected in soils at the facility (RVAAP-3.G.1).

SAIC conducted a Phase I RI for 11 High-Priority AOCs in 1998, which included Load Line #1. The investigation found elevated concentrations of explosives and inorganics in soils in the central portion of the site. Aluminum, arsenic, barium, cadmium, chromium, iron, lead, manganese, magnesium, mercury, selenium, and zinc were all detected in soils above their respective background criteria (RVAAP-3.G.2).

The Phase II RI surface soil sampling results indicated 16 explosive and propellant compounds are present at Load Line #1. The most commonly detected explosive was 2,4,6-TNT with 85 detections, and the most commonly detected propellant was nitrocellulose detected at 65 locations (RVAAP-3.G.3). Cadmium, chromium, copper, lead, mercury, and zinc were the metals most commonly detected and/or the metals detected at the highest concentrations above background (RVAAP-3.G.3). The most heavily contaminated area at the MRS is the immediate area surrounding the Building CB-4A pad, with high concentrations of explosives (maximum 4,800 mg/kg of 2,4,6-TNT), propellants (maximum 2,300 mg/kg nitrocellulose), and metals (RVAAP-3.G.1).

Subsurface soil

During the Phase II RI, nine explosive and propellant compounds were detected in 16 subsurface soil samples collected. The most commonly detected explosives were 2,4,6-TNT (13 detections), RDX (9 detections), and 2,4-dinitrotoluene (8 detections). "Nitrocellulose was the only propellant detected in subsurface soils with occurrences limited to the melt-pour area, Building CB-13, Building CB-17, and Track CB" (RVAAP-3.G.3). In the subsurface soils, cadmium, lead, and zinc were the metals most

frequently detected above background. Barium, chromium, mercury, and selenium were also detected above background levels (RVAAP-3.G.4).

Sediment

During the 1997 SAIC Phase I RI, no explosives were found in pond sediments. Four sediment samples in drainage ditches contained detectable concentrations of explosives. The most concentrated metal results were taken near Building CB-3A and the ditch along Outlet D (RVAAP-3.G.2).

The Phase II RI results indicated 12 explosive and propellant compounds were detected in 17 sediment samples collected. "Eight of these samples tested positive for field explosives; the others tested negative but were analyzed for laboratory explosives and propellants as dictated by the scope of work." The most commonly detected explosives compounds were 2,4-dinitrotoleune, 4-amino-2,6-dinitrotoluene, 2,4,6-TNT, and DNT. Three propellants were detected in sediments; the most commonly detected propellant was nitrocellulose with three detections. "The maximum concentrations for any explosive or propellant compounds in sediment were encountered in Outlets A and B, in ditches adjacent to Buildings CB-13 and CB-13A (RVAAP-3.G.4)."

"The 23 target analyte list (TAL) metals were consistently detected in every sediment sample with the following exceptions: antimony was detected in 10 of 25 samples, beryllium was detected in 17 of 27 samples, cadmium was detected in 35 of 37 samples, magnesium was detected in 36 of 37 samples, selenium was detected in 28 of 37 samples, sodium was detected in 6 of 25 samples, thallium was detected in 33 of 37 samples, and silver was not detected in any of the samples (RVAAP-3.G.4)." Metals were concentrated and most abundant along Outlets A, B, and C, and Outlets D, E, and F upstream of the ponds (RVAAP-3.G.1 and RVAAP-3.G.4).

Surface water

Eleven explosive compounds were detected in 14 surface water samples collected at the MRS. "The most commonly detected explosives compounds were 4-Amino-2,6-dinitrotoluene (three detections) and 4-Nitrotoluene (three detections). Propellants were not detected in surface water (RVAAP-3.G.4)."

"Metals were detected in all surface water samples, but were most abundant at Charlie's Pond at the AOC boundary along Drainage C and at station LL1-318, which is upstream of the confluence with the

facility drainages (RVAAP-3.G.1)." Barium, calcium, iron, magnesium, and manganese were consistently detected in every surface water sample (RVAAP-3.G.4).

Groundwater

In 1997, the Ohio EPA conducted a residential groundwater survey. No explosive compounds were detected in domestic water supplies. Arsenic exceeded its maximum contaminant level in one result (RVAAP-3.G.1).

In the 1997 Phase I RI, conducted by SAIC, no explosives were detected in six monitoring wells. Inorganic constituents detected included: cyanide, arsenic, barium, beryllium, cobalt, copper, manganese, mercury, nickel, and zinc (RVAAP-3.G.2).

During the Phase II RI, 12 explosive and propellant compounds were detected in groundwater samples collected with the most frequently detected being 1,3-DNB and 2,4,6-TNT. "The highest concentrations of explosives and propellants were found at monitoring wells located within the main process areas. The highest concentration was for RDX (88 μg/L) at monitoring well LL1mw-080 (RVAAP-3.G.4)."

"Eleven of the 23 detected TAL metals are considered site-related based on the SRC screening process." Aluminum, arsenic, cobalt, manganese, nickel and zinc were the most frequently detected SRCs (RVAAP-3.G.1). Other non-nutrient metals that were detected at least once include antimony, cadmium, copper, selenium, and thallium (RVAAP-3.G.4). The maximum metal detections occurred at three monitoring wells located in the main process areas (RVAAP-3.G.1).

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR indicated that MEC presence is confirmed at the MRS. The report cited that propellant grains have been confirmed to be in this area. The report further stated that while not particularly hazardous, they are still considered to be OE.

**Final Focused FS for the Remediation of Soils at Load Lines 1 through 4, RVAAP, Shaw Environmental, May 2005**

Soil

Arsenic, antimony, TNT, 2,4-dinitrotoluene, 2,6-dinitritoluene, and RDX were identified as COCs for direct exposure by the Resident Subsistence Farmer. Additional metals and explosives were identified

for indirect exposure via ingestion by the Resident Subsistence Farmer. RDX and 2,4,6-TNT were identified as COCs in subsurface soil for the Resident Subsistence Farmer. Antimony was identified as the only subsurface soil COC (RVAAP-7.A.1).

Sediment

Arsenic, cadmium, and manganese are identified as COCs in sediment for National Guard receptors. Antimony, arsenic, and manganese are identified as COCs in sediment for residential use. Arsenic and antimony are identified as COCs for waterfowl ingestion. Arsenic is a COC in sediment for fish ingestion by the Resident Subsistence Farmer. The explosive 2,4-dinitrotoluene and arsenic were identified as COCs for the Resident Subsistence Farmer. Lead was identified as a contaminant of potential concern (COPC) in the sediment (RVAAP-7.A.1).

#### *4.1.4.3 MEC/MC Analysis*

Triple based propellants are known to exist at the MRS at Buildings CB-13, CB-13B, and CB-14. There was also a report that a 152mm shell casing was found in a building located on site (RVAAP-1.A.2). As previously mentioned, a performance based contract was awarded to Shaw Environmental in September 2003 to complete an interim soil and sediment removal action at multiple locations at RVAAP, including Load Line #1. MEC or MC that fall outside the scope of this contract will be covered under the MMRP. As such, the presence of MEC or MC will be field verified during the SI field work.

Based on previous investigations, surface soil, subsurface soil, sediment, surface water, and groundwater are impacted by explosives and metals. MC contamination that is not covered under the IRP will be addressed further during the MMRP SI process.

### 4.1.5 Load Line #12 (RVAAP-012-R-01)

*4.1.5.1 Summary of Findings*

Load Line #12 is described in the US Army CTT Range/Site Inventory as encompassing approximately 77.58 acres. Multiple buildings were located at the MRS during its operational years which included a neutral liquor building (FE-19), seven evaporation/crystallization units (Buildings 900, 901, 902, 903, 904, 905, and 906), Water Works No. 2, Power House No. 3 (FE-17), a bagging and shipping building (FN-54), a compressor building (FA-20), an administration building (FE-53), a change house (FEWP-22), a laboratory (FE-52), and a clock house (4-51). Currently, no above-grade structures remain at the MRS, except for a small portion of the floor slab at Building FF-19. Buildings 901, 902, FF-19, and 906 were removed between 1973 and 1975 by open burning. Building FN-54 was demolished in the 1980s, and the remaining structures were removed between 1998 and 2000. During the recent demolition activities, a former blast berm at Building 903 was removed and placed as fill/groundcover around portions of Buildings FE-17 and 903. Structural features that remain on site include gravel access roads, man-made ditches, sanitary sewer lines, manholes, and the remains of three main rail tracks and several secondary tracks (RVAAP-3.H.2). Access is controlled by a perimeter fence and a locked gate (RVAAP-2.A.13). Historic and current site conditions are shown in **Photographs 15 and 16**, respectively. **Photograph 16** shows that the load line buildings have been removed.

**Photograph 15: Photograph of Load Line #12, circa 1970.**
**(RVAAP-9.A.1)**

**Photograph 16: December 2005 photograph of Load Line #12.**
**(RVAAP-8.A.1)**

During IRP work in the fall of 1999 to address chemical contamination, approximately 110 90mm artillery rounds were found just below the ground surface (covered with a small amount of topsoil) just north of the access road in the northwest corner of the MRS. The rounds were each composed of a casing and projectile, but were void of HE. The rounds were removed by MKM Engineers in March 2004 and placed in storage at Igloo 1500. It is unknown who was responsible for dumping and covering

the items. On-site personnel indicate the contractor screened the immediate area where the projectiles were found for UXO/OE, but did not extend this search any further. There are no other reports of munitions debris (or MEC) having been found at the MRS (RVAAP-2.A.8). Based on the one reported finding of munitions debris, the breadth of IRP investigations conducted to date at the load line, and input from Installation personnel, it is reasonable to reduce the size of the boundary to the area immediately surrounding the location where the 90mm projectiles were found. As such, the new acreage of the MRS would be no greater than approximately one acre. The layout of the MRS is provided in **Figure 7**. This figure was taken from the IRP document "Preliminary Draft Feasibility Study for Load Line 12" prepared by SAIC (RVAAP-3.H.3).

Originally known as the Ammonium Nitrate Plant, Load Line 12 produced granular ammonium nitrate through an evaporation and crystallization procedure using neutral liquor. The finished product was then transferred to the melt-pour lines for blending with 2,4,6-TNT to produce Amatol. After the termination of ammonium nitrate production in 1943, Buildings 900, 904, and 905 were renovated for demilitarization of munitions using a hot-water washout process. In order to improve the quality of TNT recovered, washout operations were converted to a steam melt-out process in the late 1950s. The demilitarization process involved removing the fuze and booster assemblies from bomb casings and placing the projectiles into a double-jacketed steam canister. The explosives were liquefied and poured into a tray where it was allowed to solidify. Once a solid, the explosives were knocked out of the tray, packed, and shipped from the site (RVAAP-3.J.9).

Reports of interviews conducted with personnel familiar with the operation, indicated that spillage was routinely cleaned from floors and equipment with hot water/steam. In the early years of operation, the rinsate water was allowed to flow out of the buildings and onto the ground surface. This operation was later replaced by a system of scuppers and gutters that were installed around the perimeter of the building floor, which directed the rinsate to a series of stainless steel tanks, one used for settling and the other for filtration. Prior to 1981, the effluent from the tank system flowed from Building 904 through a ditch to a holding pond east of the building. From here, the water drained to Upper Cobb's Pond and then to Lower Cobb's Pond. After 1981, the effluent was pumped to the Load Line 12 Pink Water Treatment Plant for treatment prior to discharge (RVAAP-3.J.9).

The MRS is collocated with an IRP AOC (RVAAP-012), which includes IRP AOC RVAAP-18 (Load Line 12 Wastewater Treatment System). The AOC covers the former Load Line 12, which is described as encompassing approximately 80 acres. The intent of the IRP work is to assess the nature and extent of

contamination, evaluate the fate and transport of contaminants, and assess potential risk to human health and the environment resulting from former operations at the AOC. According to IRP investigations conducted at the load line, explosives and metals have been detected in surface and subsurface soil, sediment, surface water, and groundwater. Summaries of these IRP investigations are provided below.

*4.1.5.2 Previous Investigations*

**Final Phase I RI Report for the Phase I RI of High Priority AOCs at RVAAP, SAIC, February 1998**

Surface Soil

Trinitrobenzene (TNB), TNT, DNT, HMX, and RDX were detected in surface soil samples collected from the load line. By far the most common explosive detected and at the highest concentrations was TNT, which was found at 18 locations with levels ranging from 0.45 to 19,000 mg/kg (RVAAP-3.K.1). The second most frequently detected explosive was RDX, which was found at eight locations with concentrations ranging from 2.8 to 6,800 mg/kg (RVAAP-3.K.2). The remaining detections were as follows: TNB was detected at three locations with concentrations ranging from 0.25 to 4.60 mg/kg; DNT was detected at one location at 13 mg/kg; and HMX was detected at five locations ranging from 4 to 180 mg/kg (RVAAP-3.K.2).

Aluminum, barium, cadmium, chromium, lead, manganese, mercury, silver, and zinc were detected above site background levels. Copper and nickel were detected above the maximum range of US Geological Survey (USGS) reference values in one sample (RVAAP-3.K.2).

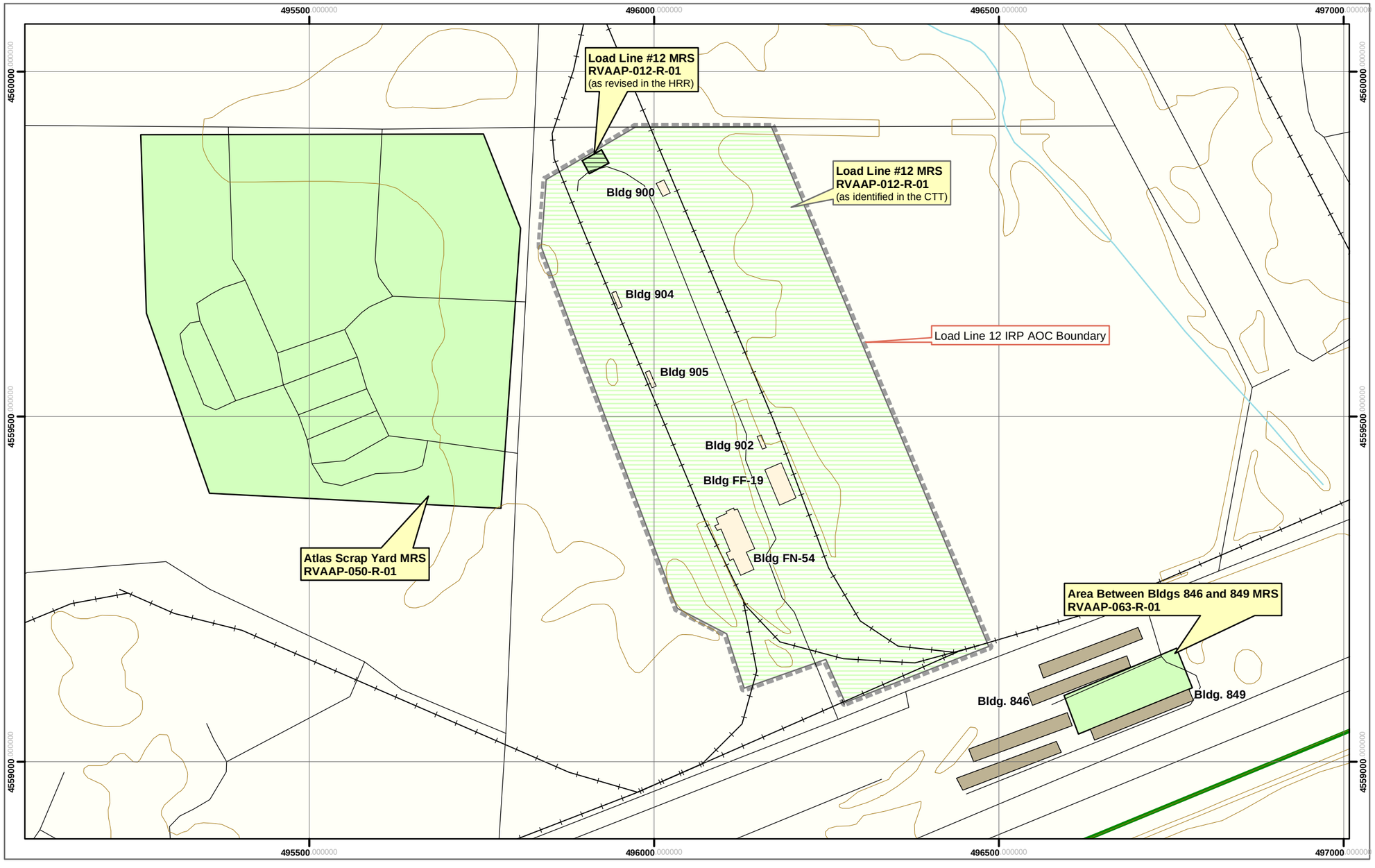
Sediment

TNT was detected in five sediment samples collected at Load Line #12 with concentrations ranging from 0.016 mg/kg to 170 mg/kg. TNB was detected in one sediment sample with a concentration of 0.66 mg/kg (RVAAP-3.K.3).

Zinc, lead, cadmium, mercury, barium, chromium, arsenic, silver, aluminum, and manganese were detected above background levels. Beryllium, cobalt, copper, and nickel were detected at concentrations exceeding the maximum USGS reference value (RVAAP-3.K.3).

# LOAD LINE #12, ATLAS SCRAP YARD, and AREA BETWEEN BLDGS 846 AND 849 MRS LOCATIONS
## Ravenna Army Ammunition Plant, OH

**Figure 7**




N
W E
S

- Elevation Contour
- Installation Boundary
- Railroad
- Road
- Stream
- Building Locations, Existing
- Building Locations, Demolished

**Area Status**

- MRS, Closed
- MRS, Revised in HRR
- MRS, Identified in CTT
- IRP Area of Concern

**Data Source:** SAIC, Phase II RI Report for Load Line 12 at the RVAAP, OH, March 2004
SAIC, RVAAP 6 High Priority AOC's Feasibility Study, Preliminary Draft Figure 2-3, August 25, 2005

| | |
|---|---|
| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **500 Meter** |

1:6,000

0 150 300 450 600 750 Feet
0 50 100 150 200 Meters

Installation Location
**Ohio**

**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**
**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. ($e^2M$)
**Date:** October 2006
**Edition:** Final

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**Final Phase II RI Report for Load Line 12, RVAAP, SAIC, March 2004**

Surface Soil

Ten explosives were detected at least once in surface soil samples with the most widespread being 2,4,6-TNT. The remaining nine detected were DNT; 4-amino-2,6-dinitrotoluene; 1,3,5-TNB; 2,6-dinitrotoluene; 3-nitrotoluene; 4-nitrotoluene; nitrobenzene; HMX; and RDX. Nitroguanidine and nitrocellulose were the only two propellants detected. Nitrocellulose was the most prevalent (RVAAP-3.J.1).

Metals exceeding background concentrations included antimony, barium, chromium, copper, lead, mercury, nickel, silver, thallium, vanadium, and zinc. Mercury was the most frequently detected metal above background concentrations (RVAAP-3.J.2).

Subsurface soil

Twelve explosives were detected at least once in subsurface soil samples. The most frequently detected explosive was 2,4,6-TNT (RVAAP-3.J.2), while the remaining compounds included RDX; HMX; DNT; 4-amino-2,6-dinitrotolune; 2,4-dinitrotoluene; 2-nitrotoluene; 3-nitrotoluene; nitrobenzene; 1,3,5-TNB; 1,3-dintrobenzene; and 2,6-dinitrotoluene. Nitrocellulose was the only propellant detected in the subsurface soils (RVAAP-3.J.2).

Antimony, copper, lead, mercury, and zinc were detected at concentrations exceeding their respective site background levels (RVAAP-3.J.3).

Sediment

Four explosives were detected in only two of the sediment samples collected at the load line. All detections were less than 1 mg/kg and included 2,4,6-TNT, DNT, 4-amino-2,6-dinitrotoluene, and 1,3-DNB. No propellants were detected in the sediment samples (RVAAP-3.J.3).

Twenty-two metals and cyanide were detected at least once in sediment samples. Cyanide was the only inorganic detected above background, occurring only in one sample (RVAAP-3.J.3).

Surface Water

Eleven explosives were detected in the surface water samples collected from the load line area. The most frequently detected were 2,4-dinitrotoluene and RDX (RVAAP-3.J.3). Other explosives detected

included 1,3,5-TNB; 2,4,6-TNT; HMX; Tetryl; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 2-Nitrotoluene; 3-Nitrotoluene; and 4-Nitrotoluene. No propellants were detected (RVAAP-3.J.3).

Metals detected at concentrations exceeding their respective background values were barium, cadmium, chromium, cobalt, copper, nickel, and zinc. Surface water sampled in the West Ditch had the highest metal concentrations detected on site (RVAAP-3.J.4).

Groundwater

Thirteen explosives and propellant compounds were detected in groundwater samples collected from the load line area. The most frequently detected explosives were 2-nitrotoluene and 4-nitrotoluene (RVAAP-3.J.5).

Barium was the only metal detected above background in the groundwater samples collected. Arsenic, nitrate and thallium exceeded their respective maximum contaminant levels (MCLs) for drinking water (RVAAP-3.J.5).

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR confirmed the discovery of the 90mm "ammunition" at the MRS. The report further disclosed that unauthorized burial areas are hard to evaluate, stating that "even after the discovered munitions are removed, there is always the question regarding the size of the area and undiscovered munitions. In that the possibility of munitions buried nearby cannot be excluded, this area is considered to have potential ordnance presence". The ASR concluded that the MRS is considered to have potential OE presence.

**Preliminary Draft FS for Load Line 12, RVAAP, SAIC, November 2005**

Surface Soils

Explosives were somewhat widespread in soils located within the industrial portion of the AOC, while soils in the non-industrialized section were not impacted. Nine inorganic SRCs were detected in the industrial area that exceeded their respective background levels by more than 10 times (RVAAP-3.H.1).

Subsurface Soils

Explosives were also detected in the subsurface soil in the vicinity of Buildings FF-19, 900, 904, and 905. The explosive 2,4,6-TNT was the most frequently detected compound, with the highest concentrations

found in the footprints of Buildings 904 and 905. Nitrocellulose was the only propellant detected in the subsurface soil (RVAAP-3.H.1).

Antimony, copper, lead, mercury, and zinc were the most frequently detected inorganics found at concentrations in excess of background levels. The highest inorganic concentrations exceeding background levels were found in the subsurface soils in the vicinity of Building FF-19 (RVAAP-3.H.1).

Sediment

Explosives concentrations in sediment were less than 1 mg/kg and limited to the West Ditch at Building 905 and the area near Upper Cobb's Pond (RVAAP-3.H.1).

Cadmium, copper, and mercury were detected at concentrations exceeding their respective background levels in sediment near Buildings FF-19, FN-54, 902, and 905 (RVAAP-3.H.1).

Surface Water

Explosives were detected in low concentrations in all surface water samples collected from the industrialized area. The highest concentrations were found in the surface water samples collected from the active area channel (RVAAP-3.H.1).

Barium, cadmium, chromium, cobalt, copper, nickel, and zinc were detected at concentrations exceeding their respective backgrounds at every sampling location near Buildings 900, 905, and FN-54 (RVAAP-3.H.1).

Groundwater

With the exception of nitrocellulose, there has been a decrease in the total number of explosives and propellants detected in groundwater at the load line monitoring wells since the 2000 RI was conducted. Nitrocellulose exhibited an increase in concentration between sampling events.

Zinc exceeded its background level in one sample, while arsenic exceeded its primary drinking water MCL and background level at several wells (RVAAP-3.H.1).

**Final Phase II RI Supplemental Report, SAIC, November 2005**

"Results for the 2004/2005 groundwater monitoring events indicated a decrease in the total number of explosives and propellants detected in groundwater at Load Line 12 since the time of the RI. Five of the

13 explosives compounds identified as SRCs during the Phase II RI (2,4-dinitrotoluene; 2-nitrotoluene; 3-nitrotoluene; nitrobenzene; and tetryl) were not subsequently detected (RVAAP-3.I.1)." Nitrocellulose increased in frequency of detection in the 2004/2005 sampling of the existing Phase II RI monitoring wells. HMX was detected as a new SRC in groundwater in one sample (RVAAP-3.I.1).

#### *4.1.5.3 MEC/MC Analysis*

During IRP work conducted in the fall of 1999, a large number of empty 90mm artillery projectiles (i.e., munitions debris) were found buried just below the ground surface, north of the access road in the northwest corner of the MRS. The rounds were determined to be void of HE and were removed by MKM Engineers in March 2004 and placed in Building 1501. However, during the course of the RI field work, the UXO clearance was not extended outside of the area where the inert projectiles were found. As such, there is still uncertainty whether or not all of the buried items were found and recovered.

Explosives and metals have been identified in all media (i.e., soil, sediment, groundwater, surface water) at the IRP AOC. Further work concerning MC at the site; however, will be addressed under the IRP and will not be evaluated under the SI process.

### 4.1.6 Fuze and Booster Quarry (RVAAP-016-R-01)

*4.1.6.1 Summary of Findings*

The Fuze and Booster Quarry MRS is described in the US Army CTT Range/Site Inventory as encompassing approximately 12.74 acres and located near the Fuze and Booster load lines (possibly where the MRS name was derived). Originally excavated to provide building material, the quarry site was subsequently used from 1945 until 1949 as an open burn area where sawdust waste potentially from Load Lines 6 and 11 were thermally treated. Thereafter, the quarry was used as a landfill that reportedly accepted fuze and booster assemblies, projectiles, residual ash, and sanitary waste. Reportedly in 1976, the existing debris in the area was removed from the quarry bottom and either transferred to Ramsdell Quarry or one of the existing burning grounds. It was at this time that the three elongate ponds were constructed. From 1987 through 1993, spent brine regenerate and sand filtration backwash water from one of the groundwater treatment plants was discharged into the ponds. This discharge was regulated under a National Pollutant Discharge Elimination System (NPDES) permit (RVAAP-3.B.2).

The current configuration of the MRS consists of three elongated ponds situated end to end and separated by earthen berms. The surface water in the ponds is approximately 20 ft below current grade, while the total depth of the ponds is believed to be 30 ft deep. The ponds are surrounded by mature hardwood forest, and a gravel road leads up to the western side of the site. **Figure 8** provides the layout of the Fuze and Booster Quarry. This figure was taken from the Phase I/Phase II RI Report of the Fuze and Booster Quarry Landfill/Ponds by SAIC and Spec Pro, Inc. (RVAAP-6.B.4). Current site conditions at the middle pond are shown in **Photograph 17**.

**Photograph 17: December 2005 photograph of the Middle Pond at the Fuze and Booster Quarry. (RVAAP-8.A.1)**

According to RVAAP personnel, any type of munitions produced at the plant may have been destroyed here such as rockets, bombs, fuzes, detonators, flares, missiles, grenades, landmines, medium and large caliber ammunitions, explosives, mortars, propellant, practice ordnance, pyrotechnics, and small arms. Further, Installation personnel have stated that the northern and southern ponds contain MEC, while it

is uncertain if the middle pond contains MEC. At the northern pond, MEC is reportedly visible when the water level is low. At the southern pond, MEC is apparently visible on the banks at all times.

The MRS is associated with IRP AOC RVAAP-016, Fuze and Booster Quarry. The AOC consists of the three large ponds located in an abandoned rock quarry, which is situated in the eastern half of the AOC, and the western part of the AOC consists of 11 smaller, shallow settling basins. In 1998, this AOC was expanded to include three other shallow settling ponds and two debris piles bringing the AOC to approximately 45 acres in size. The settling ponds are located approximately 400 feet to the west of the three large ponds. Based on information provided by the Installation, the two debris piles may be located along the northern rim of the northernmost pond. Figures outlining the AOC boundary could not be located during the records search; therefore, the exact boundary of the AOC could not be determined. Based on the operational history, waste constituents and potential contaminants at this AOC include explosive compounds, propellants, and inorganics (RVAAP-6.B.4).

#### *4.1.6.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR indicated that the MRS has "potential OE presence." The report further stated that metal debris is present at the site, but that it was unknown if any of the debris still contained energetic material (RVAAP-4.A.1). The report did not attempt to identify what the metal debris consisted of or the location where the debris was sighted.

**Final Phase I/Phase II RI of the Fuze and Booster Quarry Landfill/Ponds, RVAAP, SAIC and Spec Pro, Inc., November 2005**

Surface Soil

Nine explosive/propellant compounds were detected in surface soil at the Fuze and Booster Quarry including: nitrocellulose; 2,4,6-TNT; nitrobenzene; DNT; 4-amino-2,6-dinitrotoluene; 1,3,5-TNB; 2,4-dinitrotolune; 2,6-dinitrotoluene; and RDX (RVAAP-6.B.1). The greatest number of detections was found at the higher elevations northeast of the quarry ponds (RVAAP-6.B.1).

Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, manganese, nickel, selenium, silver, vanadium, and zinc were all detected in excess of background concentrations. The sample locations with the highest levels of inorganics were generally located in the higher elevations northeast of the northern-most quarry pond (RVAAP-6.B.1).

# FUZE AND BOOSTER QUARRY, WATER WORKS #4 DUMP, 40mm FIRING RANGE, and FIRESTONE TEST FACILITY MRS LOCATIONS
## Ravenna Army Ammunition Plant, OH

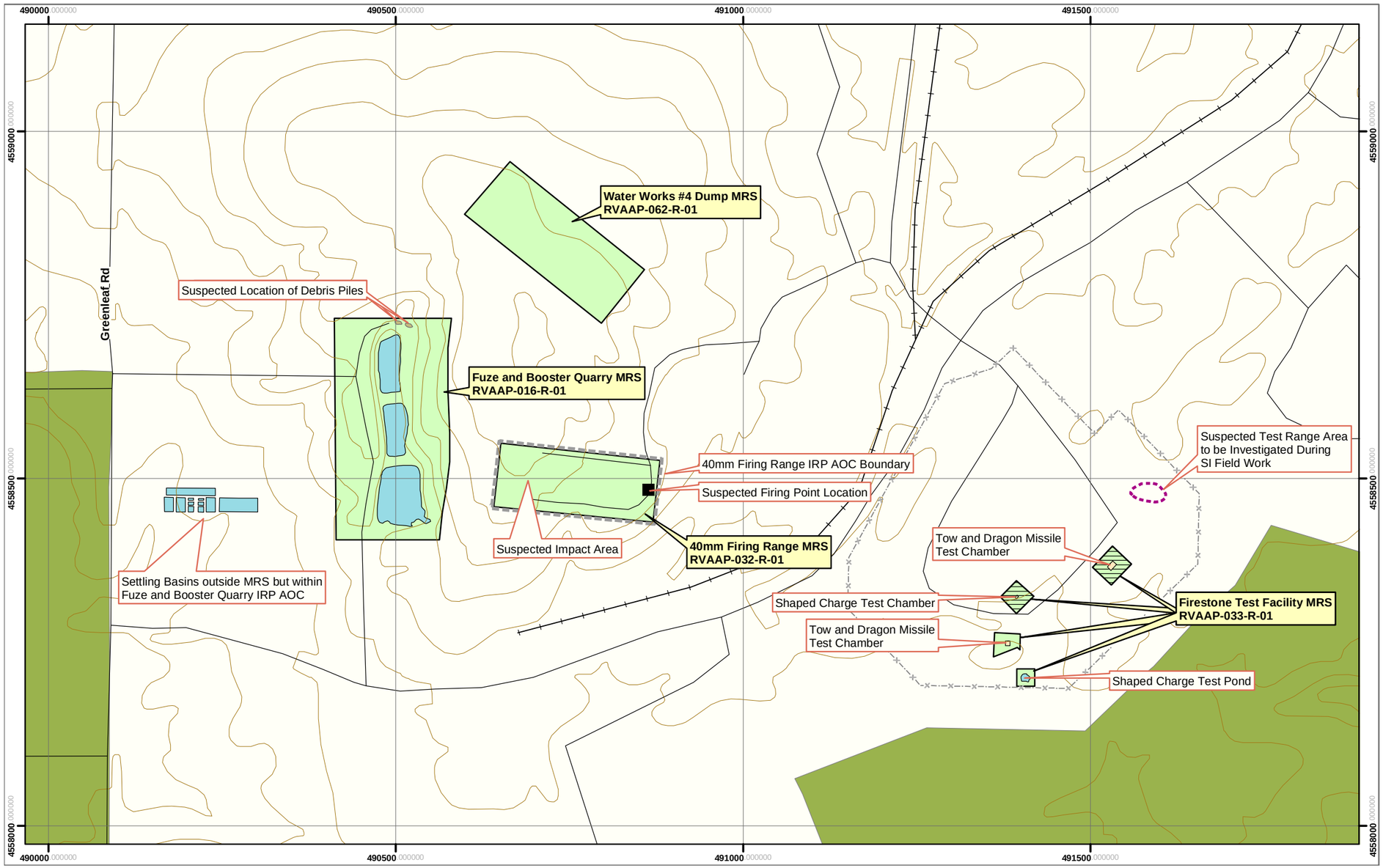


**Figure 8**

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- Elevation Contour
- Railroad
- Road
- Water
- Former Location of Test Chamber Buildings
- Suspected Location of Debris Piles
- Suspected Test Range
- Suspected Firing Point Location
- Fence

**Area Status**

- Operational Range
- MRS, Closed
- MRS, Added in HRR
- IRP Area of Concern

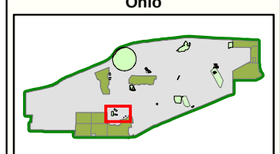
**Data Source:**
SpecPro, RVAAP Fuze and Booster Quarry Landfill/Ponds Phase I and II RI Report, January 22, 2005

**Projection:** TM Zone 17
**Datum :** U WGS 84
**Units:** Meters
**Grid:** 5000 Meter

1:6,000

0 150 300 450 600 750 Feet
0 80 160 240 Meters

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. ($e^2M$)

**Date:** January 2007
**Edition:** Final (Revised)

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Subsurface Soil

Nitrobenzene and nitrocellulose were detected in several sub-surface sampling locations. Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, vanadium, and zinc were detected above background concentrations in subsurface soil (RVAAP-6.B.1).

Sediment

Eleven explosive/propellant compounds were detected in sediment samples collected at the Fuze and Booster Quarry including: 1,3,5-TNB; 1,3-DNB; 2,4,6-TNT; 2,6-dinitrotolune; DNT; 4-amino-2,6-dinitrotoluene; HMX; 3-nitrotoluene; DNB; nitrocellulose; and nitroglycerine (RVAAP-6.B.1).

Sixteen inorganics were detected in sediment samples at concentrations that exceeded their associated background concentrations. These included the following: aluminum; antimony; arsenic; barium; beryllium; cadmium; chromium; cobalt; copper; lead; manganese; mercury; nickel; selenium; silver; vanadium; and zinc (RVAAP-6.B.1). The greatest number of detections was found in sediment samples collected from the southwestern-most corner of the AOC (RVAAP-3.L.1).

Surface Water

DNT and 4-amino-2,6-dinitrotoluene were detected in the surface water samples collected from one of the smaller settling basins located in the western half of the site. In addition, 12 of the 15 sampling locations revealed nitrocellulose at detectable concentrations (RVAAP-6.B.2).

Aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, manganese, nickel, silver, vanadium, and zinc were all detected in excess of background concentrations in surface water at the smaller settling basins. The quarry ponds generally had lower concentrations of inorganics than the settling basins (RVAAP-6.B.2).

Groundwater

Explosives and propellants were detected in groundwater samples collected from the AOC. These included 2,4,6-TNT; 2,4-dinitrotoluene; DNT; 4-amino-2,6-dinitrotoluene; nitrobenzene; and nitrocellulose. In addition, barium, manganese, aluminum, nickel, zinc, cobalt, copper, and cadmium were detected in the groundwater (RVAAP-6.B.2).

*4.1.6.3 MEC/MC Analysis*

Records were not available to quantify the volume of munitions and other related items burned or disposed of at the MRS. Further, there are no recorded instances of MEC being found at the MRS. However, according to Installation personnel, MEC is present at both the northern and southern ponds. The type, condition, and quantity of MEC located at the ponds were not disclosed. While MEC is reported to be present at the two aforementioned ponds, little is known about the middle pond.

In surface and subsurface soil at the site, explosives and propellants were detected and metals were present in excess of background concentrations. In sediment and surface water at the site, explosives and propellants were detected and many metals exceeded background concentrations. Explosives, propellants, and metals were all detected in groundwater at the site. MC is being addressed under the IRP and will not be further evaluated under the SI.

### 4.1.7 Landfill North of Winklepeck (RVAAP-019-R-01)

*4.1.7.1 Summary of Findings*

This MRS is described in the US Army CTT Range/Site Inventory as a 7.55 acre unlined landfill that accepted general plant refuse, explosive wastes residue, and open burn waste from Winklepeck Burning Grounds, including flares and booster cups (RVAAP-2.A.9). The landfill is situated on top of a small bluff that overlooks an unnamed stream to the east. Wetlands are associated with the small stream.

Installation personnel have reported that MEC (booster cups and other nondescript items) is present on the slope leading down to the small stream, outside of the current MRS boundary. To capture this potential MEC, the MRS boundary has been adjusted to cover the area between the landfill and the small stream as identified by Installation personnel. In addition, the revised boundary would exclude the landfill area covered under the IRP, which had been identified as the original MRS in the US Army CTT Range/Site Inventory. The IRP will continue to address MC contamination within the known boundaries of the landfill and any MEC discovered incidental during its' continued investigation. **Figure 9** shows the revised boundary (14.05 acres) for the Landfill North of Winklepeck MRS. This figure was taken from Volume I of the Phase I RI Report for the Phase I RI of High Priority AOC at RVAAP by SAIC (RVAAP-3.K.6). This MRS is currently undeveloped (RVAAP-1.A.2).

The MRS is adjacent to the IRP AOC RVAAP-019, which is referred to as the Landfill North of Winklepeck Burning Grounds. The landfill AOC is described as encompassing approximately 10-acres and as having received an unknown quantity of material that included booster cups, aluminum liners, sanitary waste, and possibly explosives and munitions waste and ash. During the HRR, information was uncovered that suggested, based on appearance and location, that the landfill was created using a trench and fill method of operation (RVAAP-14.C.1). Further, it was revealed that debris and garbage protrude through the landfill surface in several areas. As stated previously, the IRP will continue to address MC contamination within the known boundaries of the landfill and any MEC discovered incidental during its' continued investigation. Therefore, the landfill AOC has been removed from consideration under the MMRP. **Photograph 18** shows the current site conditions at the IRP AOC, looking across the landfill unit towards the adjacent stream.

*4.1.7.2 Previous Investigations*

**Phase I RI Report for the Phase I RI of High Priority AOC at RVAAP, Ravenna, Ohio, Volume I, SAIC, February 1998**

Geophysical Survey

A geophysical survey was conducted to locate buried metallic debris and possibly identify disposal trenches. The survey covered approximately four acres believed to be in the vicinity of the landfill. Results from the survey revealed the presence of buried metallic items that purportedly represented trenches (RVAAP-3.K.5).

**Photograph 18: December 2005 photograph of Landfill North of Winklepeck. (RVAAP-8.A.1)**

Soil

A total of nine composite soil samples were collected from depths ranging from 0 to 3 ft bgs at five trench excavation locations. All soil samples were analyzed for metals, cyanide, explosives, VOCs, SVOCs, and polychlorinated biphenyls (PCBs)/pesticides. No explosives were detected in the soil samples collected (RVAAP-3.K.5).

Cadmium (detected in two samples), lead (detected in three samples), and zinc (detected in four samples) were detected in excess of background concentrations. The remaining inorganics (cyanide, antimony, beryllium, cobalt, copper, nickel, thallium, and vanadium) did not have established background concentrations; however, all were "within the range of USGS Ohio reference values with the exception of thallium, which has no published USGS reference value (RVAAP-3.K.5)."

Sediment

Seven sediment samples, two collected from a pond and five from a ditch, were analyzed for metals and explosives. These samples were not collected within the landfill boundary but in the ditch to the east of the landfill. Explosives were not detected in any of the sediment samples (RVAAP-3.K.5). Aluminum, barium, cadmium, chromium, lead, manganese, mercury, selenium, silver, and zinc were all detected above background concentrations (RVAAP-3.K.6).

# LANDFILL NORTH OF WINKLEPECK, BUILDING #F-15 AND F-16, BLOCK D IGLOO, and BLOCK D IGLOO -┬ D MRS LOCATIONS
## Ravenna Army Ammunition Plant, OH

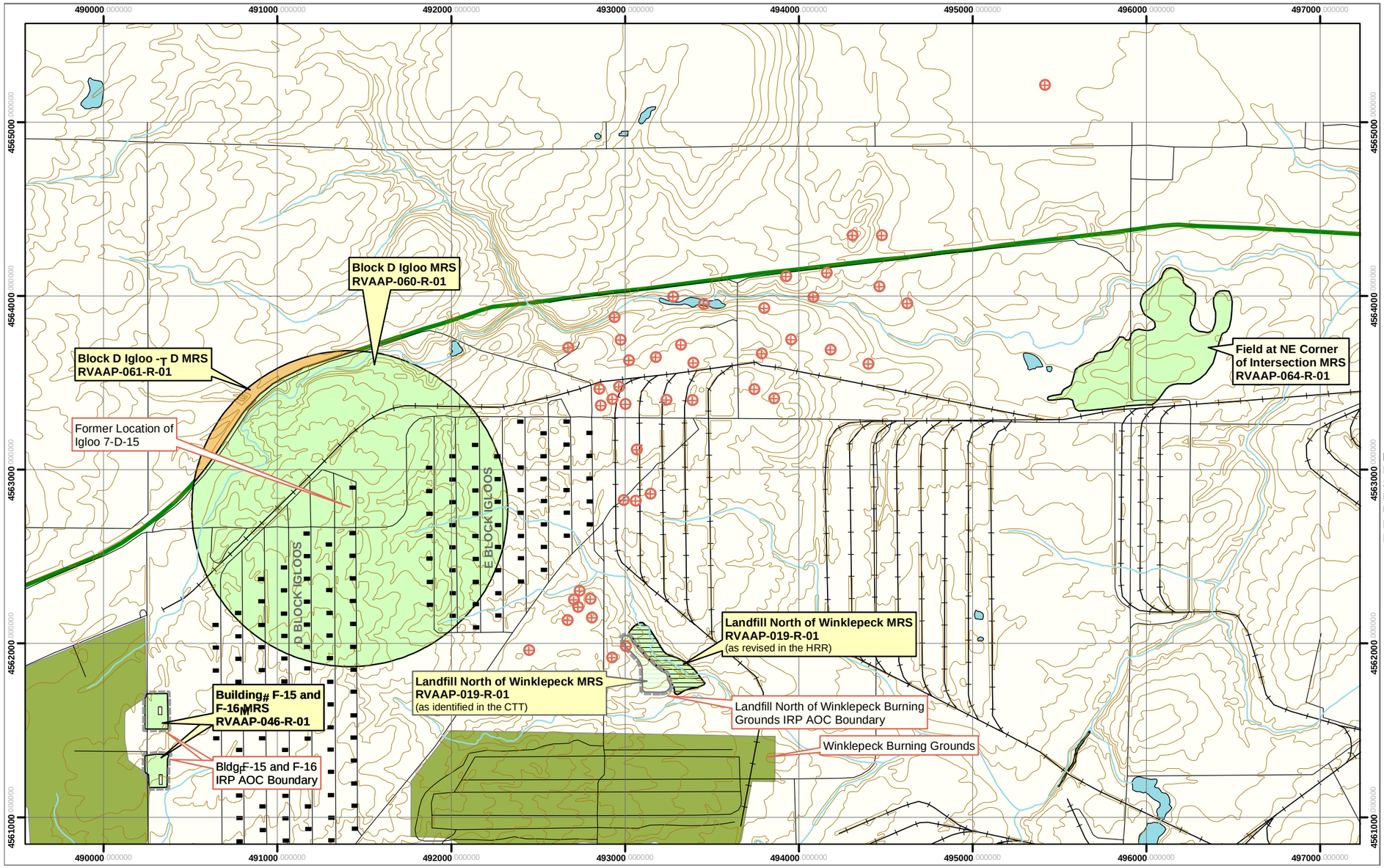


**Figure 9**

N
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- Elevation Contour
- Installation Boundary
- Railroad
- Road
- Stream
- Water
- Building Locations, Demolished
- Igloo Location
- Location of Fragments Found from the 1943 Explosion of Igloo 7-D-15

**Area Status**

- Operational Range
- MRS, Closed
- MRS, Transferred
- MRS, Revised in HRR
- MRS, Identified in CTT
- IRP Area of Concern

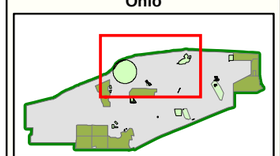
**Data Source:** M KM Engineers, RVAAP Buildings F-15/F-16 Soil Sample Location Exceedance-Organics, Figure F-15/F-16-3, June 30, 2005
USACE, Rock Island IL District, Fragments from 1943 Explosion, Plate 7, June 03, 2004

| | |
|---|---|
| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **1, 000 Meter** |

1:24,000

0 1,000 2,000 3,000 Feet
0 290 580 870 Meters

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. (e²M)

**Date:** January 2007
**Edition:** Final (Revised)

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Groundwater

Four well points were installed and sampled. Three of the well points were located within the AOC boundary, while one was located outside. No explosives were detected in the sampled groundwater (RVAAP-3.K.6). Fourteen metals were detected in groundwater (RVAAP-3.K.5). Background concentrations had not reportedly been established at the site.

#### *4.1.7.3 MEC/MC Analysis*

According to Installation personnel, MEC exists outside the MRS boundary established during the US Army CTT Range/Site Inventory. This newly identified area is located on the hillside between the landfill and the small stream situated adjacent and to the east. The MRS boundary has been revised to include this new area, while concurrently excluding the former MRS boundary covering the land-filled area. Both the potential presence of MEC and MC will have to be further evaluated during the SI process.

The landfill area (IRP AOC RVAAP-019) is currently being addressed under the IRP and will not be evaluated further under the SI process. However, the IRP will continue to address MC contamination within the known boundaries of the landfill and any MEC discovered incidental during its' continued investigation.

## 4.1.8 40mm Firing Range (RVAAP-032-R-01)

*4.1.8.1 Summary of Findings*

This undeveloped MRS encompasses an open field approximately 5.17 acres in size, which is surrounded by forest. A wooden structure (see **Photograph 19**) located at the firing point believed to be the former storage shed, the gun mount foundation, and the chronograph foundation are the only remnants from the operational years still present at the MRS (RVAAP-8.A.1). The firing range was reported by former workers at RVAAP to have been a test firing range for 40mm grenade cartridges fired from a fixed position, which was located in the eastern portion of the site. The impact area was sited in the western portion of the MRS, just uphill from the ponds at the Fuze and Booster Quarry, which included a well defined impact area with a backstop. The backstop has since been removed from the MRS. **Photograph 20** shows the site conditions down range from the firing point. The date of operation for this area was between 1969 and 1971. RVAAP personnel report that UXO is present beyond the impact point, on the slope that leads down to the Fuze and Booster Quarry MRS (RVAAP-2.A.10). **Figure 8** shows the current layout of the 40mm Firing Range MRS.

**Photograph 19: December 2005 photograph of the wooden shack at the firing point on the 40mm Firing Range.**
**(RVAAP-8.A.1)**

**Photograph 20: December 2005 photograph of 40mm Firing Range.**
**(RVAAP-8.A.1)**

Additional information revealed during the HRR found that the range was used during the Viet Nam conflict to test the 40mm cartridge. According to the ASR, the rounds tested may have included both the M407A1 practice round and the M406 HE round. The practice rounds contain yellow marker dye, M9 propellant, and RDX booster pellets, while the M406 HE round contains Composition B and M9 propellant. The purpose of the range was to perform acceptance tests, which included muzzle velocity measurements and impact function tests. Reportedly, an Army Material

Command representative was present during the tests and all of the approximately 2,500 rounds fired on this range were accounted for (RVAAP-4.A.5). This information was obtained from the ASR, which cited a report (Installation Assessment of Ravenna Army Ammunition Plant) prepared by the US Army Toxic and Hazardous Materials Agency in November 1978. However, supporting documentation was not found during the HRR to indicate that all 2,500 rounds were recovered. Therefore, it must be assumed that rounds still remain at the MRS.

The MRS is collocated with the IRP AOC RVAAP-032, which is also referred to as the 40mm Firing Range. The AOC covers the same area as the MRS.

#### *4.1.8.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR indicated that it is unknown whether the 40mm Firing Range has OE present. "This range has either potential ordnance presence or no ordnance presence; good arguments can be made for both cases. Supporting a finding of no ordnance presence are the facts that this range had a small, well-defined impact area, there was only one direction of fire, the firing was done under controlled conditions, a government representative was present during the test and there is no record of OE being found on the range. Supporting a finding of potential ordnance presence are the facts there is no documentation of the range being swept when it was closed and the RDX pellets contained in the M407A1 projectile are often overlooked in a surface sweep (RVAAP-4.A.1)." The ASR also indicates that if the presence of MEC cannot be eliminated, then the area would be considered to have potential MEC presence.

**Final Phase I/Phase II RI of the Fuze and Booster Quarry Landfill/Ponds, SAIC and Spec Pro, Inc., November 2005**

This Phase I/Phase II RI addressed the Fuze and Booster Quarry Landfill/Ponds IRP AOC, as well as the 40mm Firing Range.

Surface Soil

Seven explosive/propellant compounds were detected in samples collected from the 40mm Firing Range at least once in surface soil samples collected during the Phase II RI. The following compounds were detected: nitrocellulose (4 of 4 samples); 2,4,6-TNT (1 of 40 samples); nitrobenzene (4 of 40 samples); 2-amino-4,6-DNT (2 of 40 samples); 4-amino-2,6-DNT (2 of 40 samples); 1,3,5-TNB (1 of 40 samples); 2,4-DNT (1 of 40 samples); tetryl (1 of 30 samples), and HMX and 3-nitrotoluene (each at 1 of 40

samples). Sample FBQ-98 was found to have the greatest number (six) of detected explosive/propellant compounds in surface soil samples at the 40mm Firing Range area (RVAAP-6.B.1).

Thirteen inorganics were detected above background in surface soil samples collected from the 40mm Firing Range area. These compounds were: aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, thallium, vanadium, and zinc. Samples FBQ-066, -078, -079, -086, -087, and -091 had the greatest number of surface soil inorganic SRCs above background in the 40mm Firing Range area. These sample locations were located throughout the central portion of the firing range area (RVAAP-6.B.1).

Subsurface Soil

At the 40mm Firing Range, either 3-nitrotoluene (1 of 26 samples), nitrobenzene (3 of 26 samples), or nitrocellulose (3 of 3 samples) was detected at least once at five sample locations (FBQ-067, -079, -082, -083, and -086) (RVAAP-6.B.1).

Nine inorganics were detected above background in subsurface soil samples collected from the 40mm Firing Range. These compounds were: aluminum, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, and thallium. The following sample locations had four or more subsurface soil inorganic SRCs above background: FBQ-062, -063, -077, and -095 (RVAAP-6.B.1).

#### *4.1.8.3 MEC/MC Analysis*

Installation personnel have reported that MEC is present at the western end of the MRS. However, a description of the type of MEC reportedly present was not provided. Consequently, little is known about the density, condition or extent of MEC, or if a subsurface presence exists.

Metals in excess of background concentrations, and explosives and propellants were detected in surface and subsurface soil at the site. MC is being addressed under the IRP and will not be further evaluated under the SI process.

### 4.1.9 Firestone Test Facility (RVAAP-033-R-01)

*4.1.9.1 Summary of Findings*

The Firestone Test Facility MRS consisted of two buildings and a pond that were situated on the southeastern side of the Load Line 6 Fuze and Booster Area. The buildings were used as a test chamber for TOW and Dragon missiles, while shaped charges were tested under water at the pond. It was also determined that there was an additional building located at the MRS that was used for testing shaped charges. The building, which measured 10 ft high and 10 ft square, was constructed of reinforced concrete and fitted with steel plates, and surround by a barricade constructed of railroad ties. In addition, Installation personnel identified a suspected test range located northeast of the former test facility. Very little is known about the activities that were conducted at the site. However, based on an aerial photograph pre-dating the building demolition (circa 1999), it would appear that the area consisted of a small clearing surrounded by trees and contained one structure. The makeup of the structure was not identifiable, but appears to be a rectangular building. The only remnants left at the site are piles of dirt and large timbers.

**Photograph 21: December 2005 photograph of Firestone Test Facility. (RVAAP-8.A.1)**

Between FY 2003 and 2005 all buildings located at the MRS were demolished. With the exception of Buildings 2F3, 2F7, 2F8, and 2F9, all of the buildings were thermally treated. All that remains on site are piles of demolition debris and the pond formerly used to test underwater shaped charges. In the US Army CTT Range/Site Inventory, the MRS boundary only included the location of the pond and one of the test chambers. The locations of the second missile test chamber and the shaped-charge test chamber were identified during the HRR and have been added to the MRS boundary. Additional investigation of the suspected test range area will have to be conducted during the SI field work. Based on these findings, the area may or may not be included as part of the MRS footprint. The revised MRS boundary is provided in **Figure 8**, which shows the location of the three buildings before they were taken down, and the pond. **Photograph 21** shows the debris piles left over from the demolition of the buildings located at the MRS.

Additional information gathered during the HRR revealed that the Firestone Test Facility was reported by former workers to have been a security classified experimental test facility for munitions. Reportedly, the facility was used to construct and test shaped charges for the DoD, in addition to the missile testing. At one point in time, this facility was also referred to as the Shaped Charge Test Facility. Other than these insignificant facts, very little documentation exists for the site (RVAAP-1.A.1).

The MRS is associated with the IRP AOC RVAAP-033, which is referred to as the Load Line 6 site. Only limited sampling data exists for this site (a preliminary draft RI was due out in March 2006); however, the available analytical data revealed that the soils contained elevated levels of antimony, copper, and lead, which exceeded the Relative Risk Site Evaluation criteria (RRSE). Regardless, the FY 2006 Installation Action Plan (IAP) listed the contaminants of potential concern as lead azide, TNT, RDX, other explosives, and metals.

#### *4.1.9.2 Previous Investigations*

**FY 2006 RVAAP, OH IAP**

The United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) collected soil samples at the site in 1996. Antimony, copper, and lead were all detected above the RRSE screening concentrations (RVAAP-1.A.1).

#### *4.1.9.3 MEC/MC Analysis*

According to the FY 2006 IAP, no UXO investigations have been conducted at the MRS (RVAAP-1.A.2); further, no records were found indicating that MEC had been found at the MRS. The only remnant of former activities left at the MRS is the pond that was used to test shaped charges underwater. Both test chambers where TOW and Dragon missiles were tested have been demolished, as well as the shaped charge test chamber. While the release mechanism for MEC was the intentional testing of these munitions types, the tests were contained limiting any release. As such, the potential for MEC to be located at the MRS is expected to be limited.

Antimony, copper, and lead were all detected above the RRSE screening concentrations for soil at the site (RVAAP-1.A.1). Further, the FY 2006 IAP indicated that lead azide, TNT, RDX, other explosives, and metals are potential contaminants of concern. However, MC is being addressed under the IRP and will not be evaluated further under the SI process (RVAAP-1.A.2).

### 4.1.10 Sand Creek Dump (RVAAP-034-R-01)

*4.1.10.1 Summary of Findings*

The Sand Creek Dump MRS encompasses approximately 0.85 acres of undeveloped land that stretches along the banks of Sand Creek for approximately 1,000 ft. The MRS is split into two sections by a railroad track. The presence of a lift station situated adjacent to the northeastern tip is the only evidence that utilities may be present in the area. During removal activities performed in October of 2003 under the IRP, two demilitarized 75mm projectiles were found at the MRS. The projectiles were removed by MKM Engineers and taken to Building 1501. No other reports of MEC being discovered at the MRS were identified.

**Photograph 22: Photograph of surface debris lying on the bank of Sand Creek, circa 2003. (RVAAP-1.A.1)**

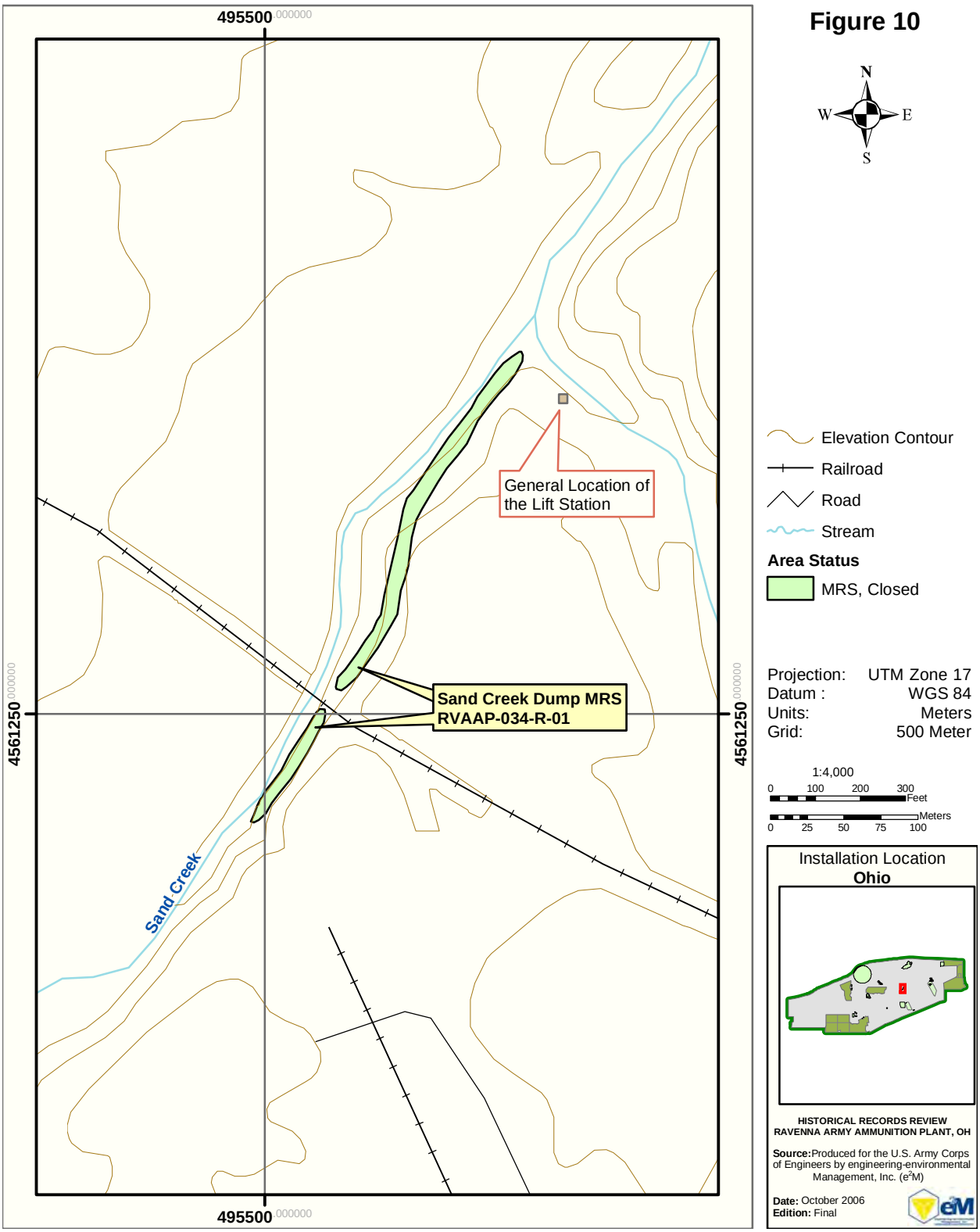
The area is heavily overgrown with trees, shrubs, and ground cover. Debris at the site is reportedly exposed and entering Sand Creek due to erosion (RVAAP-2.A.5). **Photograph 22** shows exposed debris (i.e., drums and containers) lying on the bank of Sand Creek. **Figure 10** shows the layout of the Sand Creek Dump MRS.

Very little original file documentation exists for this MRS (RVAAP-1.A.1); as such, only a modest amount of new information was available during the HRR. One new source of information was contained in an Interim Removal Action (IRA) report from April 2004. The IRA included the removal and disposal of all visible surface debris in order to eliminate the immediate threat to human health and the environment, and consequently remove the potential for future migration of contaminants off-site. The report did not mention the discovery of any MEC or munitions debris at the site.

The MRS is associated with the IRP AOC RVAAP-034, which is referred to as the Sand Creek Disposal Road Landfill site. Available documentation for the AOC provided the same background information that was found while researching the MRS; that is, the AOC was an open dump for concrete, wood, asbestos debris, lab bottles, 55-gallon drums and fluorescent light tubes. One difference is that the AOC encompasses approximately 2.7 acres, rather than the 0.85 acres comprised by the MRS. A figure identifying the IRP AOC boundary could not be located and it is not known where the additional IRP AOC acreage is situated. Further, it was determined that the AOC was transferred to the OHARNG in

# SAND CREEK DUMP MRS
# Ravenna Army Ammunition Plant, OH

**Figure 10**



May 1999. According to the FY 2006 IAP, an Analytical Evaluation Risk Summary and Record of Decision are scheduled for January 2007 for the site (RVAAP-1.A.1).

*4.1.10.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE, Rock Island District, June 2004**

The 2004 ASR indicated that the Sand Creek Dump MRS is "considered to have no OE presence" (RVAAP-4.A.1). The report stated that only inert 75mm projectiles were found at the location and that the discovery of inert metal parts often are found in landfills. Further, the report concluded that other than being examined by a knowledgeable individual, no further action should be required at the site (RVAAP-4.A.1).

**FY 2006, RVAAP, OH IAP**

The IAP report presented analytical sampling results from removal activities conducted under the IRP. The data indicated that arsenic was detected in sediment in the neighboring floodplain at levels above the RRSE screening concentrations. Soil samples were taken by the USACE in September 2001 to further refine the RRSE. Arsenic (87 parts per million [ppm]) and the SVOCs benzo (a) pyrene (0.322ppm), benzo (a) athracene (0.347ppm), benzo (b) fluoranthene (0.446ppm), and indeno (1,2,3-cd) pyrene were detected at significant concentrations (RVAAP-1.A.1). There was no discussion in the IAP of explosives or propellants having been analyzed for or detected during the removal activities.

**Final Report, RD/RA for the Sand Creek Road Dump, 2004**

Confirmation samples collected following the removal action revealed elevated concentrations (i.e., above Installation–specific background and/or EPA Region 9 residential PRGs) of heavy metals, SVOCs, explosives and/or propellants in the underlying soils of the dump site. In addition, the report revealed that some heavy metals, explosives, and propellants were detected above Installation-specific background in the neighboring flood plain sediment, and that propellants were detected above Installation-specific background in surface water samples collected from Sand Creek. Finally, arsenic was detected at concentrations exceeding the EPA Region 9 residential PRGs in the neighboring flood plain sediment.

*4.1.10.3 MEC/MC Analysis*

Only munitions debris (i.e., two demilitarized 75mm projectiles) has been sighted at the MRS. It has been reported by the Installation that the munitions debris were removed by MKM Engineers and taken to Building 1500. The discovery took place during IRP field work; there have not been any incidental

discoveries of MEC reported for this MRS. While there have been no further reports of discovered munitions, an investigation focused on identifying potentially buried items has not been conducted at the MRS. As such, the potential presence of MEC can not be completely dismissed.

Explosives and propellants have been detected at the MRS. Regardless, chemical contamination at the MRS is being addressed under the IRP and will not be evaluated further under the SI process.

### 4.1.11 Building #F-15 and F-16 (RVAAP-046-R-01)

*4.1.11.1 Summary of Findings*

The MRS encompasses approximately 12.23 acres of undeveloped land. Since the completion of the US Army CTT Range/Site Inventory, the buildings at the MRS have been demolished. At Building F-15, the only remaining feature is the raised foundation. Both the foundation and building debris remain at Building F-16. Prior to their demolition, each building measured approximately 60 ft wide by 120 ft long. The area surrounding the buildings is forested land. The remnants of Building F-15 are shown in **Photograph 23**. **Figure 9** provides the layout of the configuration at the MRS.

**Photograph 23: December 2005 photograph of Building F-15. (RVAAP-8.A.1)**

Additional information was found during the HRR describing the activities that were conducted at the MRS. According to interviews with Installation personnel, the facility was used during WWII, the Korean War, and Vietnam War to test miscellaneous explosives and propellants. Buildings F-15 and F-16 were referred to as the Surveillance Work Shop, where large caliber artillery rounds (type not specified) were dismantled and inspected as part of a cyclic inspection procedure. The procedure involved the random selection of completed rounds from storage which were subsequently dismantled for inspection and testing of individual components (i.e., fuzes, primer, propellant, and HE). Information concerning the final disposition of the tested components was not disclosed. It could be surmised that since the projectiles were dismantled and rendered non-operational, the components would have been taken to any one of the burning grounds to be demilitarized.

According to the US Army CTT Range/Site Inventory report, large caliber casings have been found (no date provided) lying on the ground surface somewhere in the vicinity of the buildings. No additional information was uncovered during the HRR concerning the type of ordnance or the exact location where the items were found. However, since the casings were void of HE, they constitute munitions debris and not MEC.

The MRS is associated with the IRP AOC RVAAP-046, which is referred to as the Bldgs. F-15 and F-16 site. Available documentation describing the physical conditions and historic operations for the AOC

duplicated what was found for the MRS; that is, the AOC consisted of two buildings that were used for surveillance testing of ordnance and explosives. The size of the AOC could not be determined, but is assumed to encompass the same area as the MRS. It was determined that the AOC was transferred to the OHARNG in May 1999 (RVAAP-1.A.1).

#### *4.1.11.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE, Rock Island District, June 2004**

While the ASR generally reiterated the information provided in the US Army CTT Range/Site Inventory, there was mention that the surveillance test organization acquired pyrotechnic pistols, presumably for testing aircraft flares. The ASR report stated that "This type of test cannot be conducted inside a building but rather outside the building or at a range". A search of the area adjacent to the buildings during the site visit found no evidence of OE remaining from these tests. Further, the MRS area and buildings were determined to have no OE presence (RVAAP-4.A.1).

As part of the site visit, the inspection team searched an area south of Building F-15 where they discovered some inert metal parts that may have contained explosives at one time. The report described the items as having been modified with threads so that the pieces could be disassembled and reassembled (see **Photographs 24** and **25**).

**Photograph 24: Inert metal item found south of Building F-15 during the June 2004 ASR Site Visit; item split in half.**

**Photograph 25: Inert metal item found south of Building F-15 during the June 2004 ASR Site Visit.**

**FY 2006, RVAAP, OH IAP**

Limited soil sampling has been completed at the site. Four surface soil samples were collected at the site and analyzed for explosives and metals. "Two samples were collected just outside of the foundations of each of the buildings. One sediment sample was collected in a drainage ditch leading to

Sand Creek near Building F-16. Soil samples showed slightly elevated levels of lead (maximum 430 ppm) and arsenic (maximum 28 ppm). Arsenic was also detected in the sediment at a maximum concentration of 9 ppm, approximately 1.5 times the ecological RRSE screening concentration (RVAAP-1.A.1)."

**Characterization of 14 AOCs at Ravenna Army Ammunition Plant, Characterization of Buildings F-15 and F-16, Preliminary Draft, December 2005**

This document, in preliminary draft form, was made available in early January 2006. The purpose of the characterization was to do an initial site characterization prior to submitting the AOCs to another PBC contractor. The preliminary findings revealed that one constituent, other than inorganics, was detected above the screening criteria in the samples collected from the various media. Contaminants detected in surface soil above Installation-specific background and/or EPA Region 9 residential PRG screening values included 22 metals and one SVOC (benzo(a)pyrene). In sediment, fifteen metals were detected above Installation-specific background and/or the EPA Region 9 residential PRG screening values, and in the surface water ten metals were detected above Installation-specific background and/or the EPA Region 9 residential PRG screening values.

#### *4.1.11.3 MEC/MC Analysis*

Munitions debris has been found at the MRS, lying on the ground surface presumably adjacent to the former surveillance test buildings. Reports of MEC found on site were not revealed during the HRR; however, there has not been an investigation conducted specifically to identify whether or not MEC is present at the MRS. MC cleanup for Buildings F-15 and F-16 is included under the IRP and will not be addressed further during the SI process (RVAAP-1.A.2).

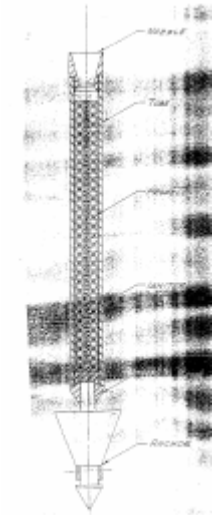
## 4.1.12 Anchor Test Area (RVAAP-048-R-01)

*4.1.12.1 Summary of Findings*

The Anchor Test Area encompasses approximately 2.57 acres of heavily forested land located west and adjacent to Wilcox-Wayland Road. Due to the overgrown conditions, very few remnants of the original facility are visible at the MRS. The only identifiable features at the MRS include several dirt mounds and a nearby sandpit. Little is known about the actual function of the MRS, but available information suggests that it was used to test fire experimental explosively-charged anchors into the ground. RVAAP personnel also believe the experimental munitions were used to drive anchors for ropes or cables into the ground. While some metal debris of unknown origin has been found in the area, the MRS has not been evaluated for the presence of MEC. **Figure 11** provides the layout of the Anchor Test Area MRS. **Photograph 26** shows the current site conditions.

**Photograph 26: December 2005 photograph of the Anchor Test Area. (RVAAP-8.A.1)**

Additional information gathered during the HRR revealed a discrepancy concerning the years of operation at the MRS. The US Army CTT Range/Site Inventory reported that the area was used from approximately 1941 to 1952. However, two reports (ASR and Preliminary Draft Characterization of 14 AOCs at RVAAP) refer to a drawing of the facility dated 1961, inferring that the site was placed into operation some time thereafter. Further, a design figure showing the type of anchor that may have been used at the MRS was found in the ASR report. The ASR stated that it was the only information found in the RVAAP historical files regarding "anchors" or "anchor testing" (RVAAP-4.A.1). The design drawing is shown in **Photograph 27**.

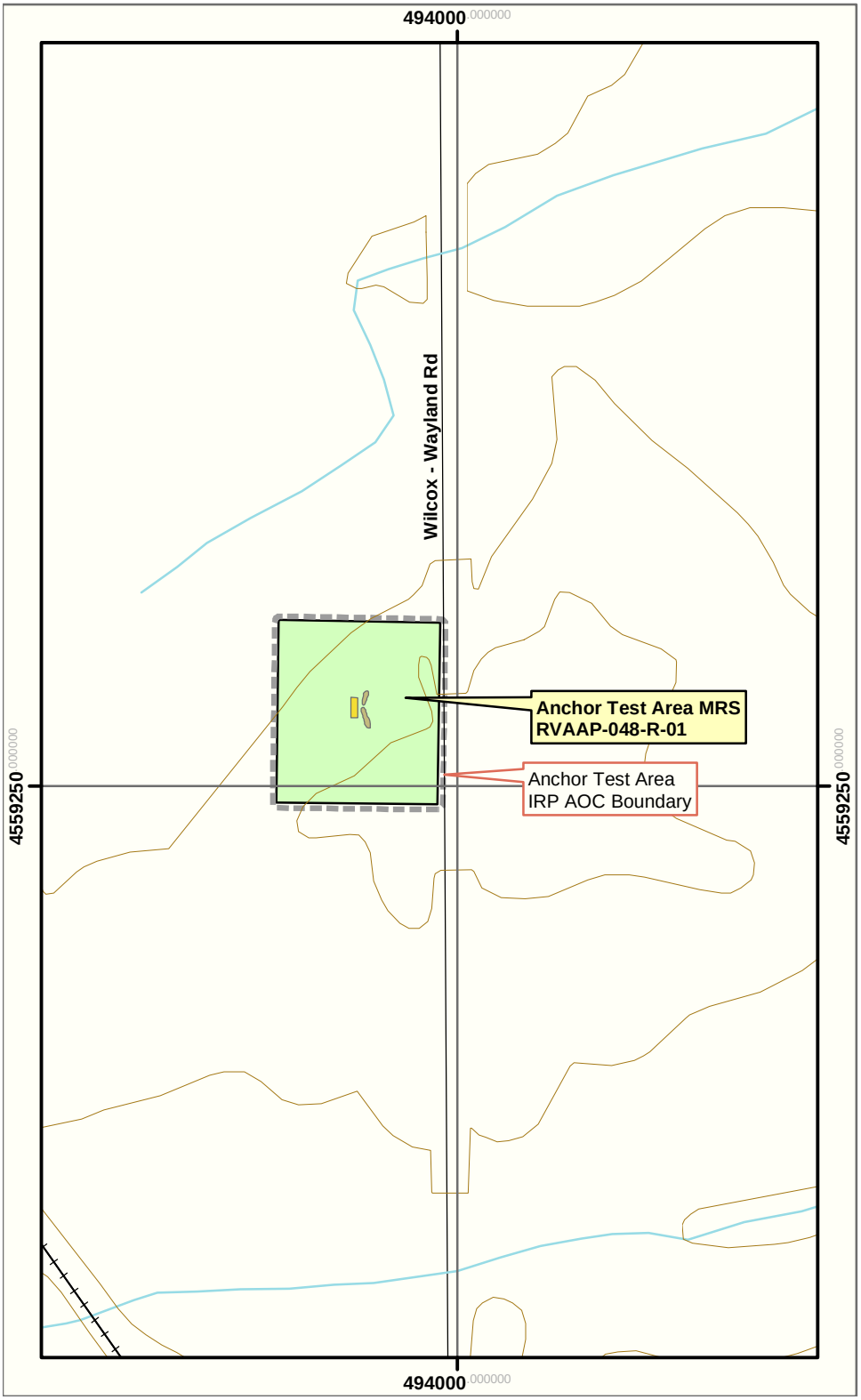


**Photograph 27: Copy of the design drawing contained in the ASR Report, June 2004.**

The MRS is collocated with the IRP AOC RVAAP-048, which is similarly referred to as the Anchor Test Area. Investigations have been conducted under the IRP to evaluate the presence of metals and explosives in the soil and groundwater. Arsenic was detected in the groundwater at a maximum concentration of 14.4 parts per billion (ppb), as well as in the soil. Based on these results, the future

# ANCHOR TEST AREA MRS
# Ravenna Army Ammunition Plant, OH

**Figure 11**




N
W E
S

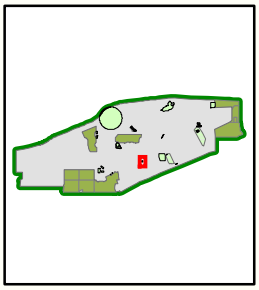
Elevation Contour
Railroad
Road
Stream
Dirt Mounds
Sand Pit

**Area Status**
MRS, Closed
IRP Area of Concern

Projection: UTM Zone 17
Datum : WGS 84
Units: Meters
Grid: 500 Meter

1:4,000
0 100 200 300 Feet
0 25 50 75 100 Meters

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**

**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. ($e^2$M)

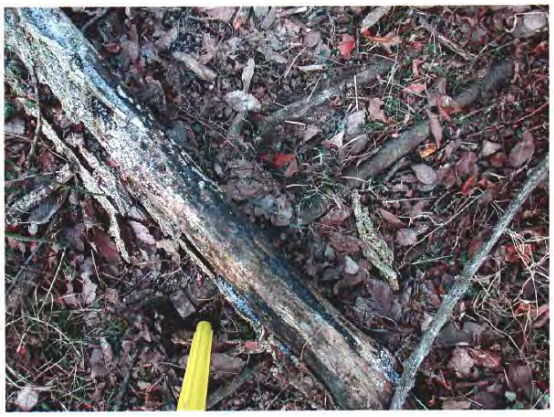
**Date:** October 2006
**Edition:** Final

plan is to release a contract(s) to put a remedy in place. Ultimately, the land will be transferred to the OHARNG who will use the area for mounted training with no digging. Long term monitoring is proposed for the site, which may include ground water monitoring and land use controls.

*4.1.12.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The 2004 ASR indicated that the Anchor Test Area has "potential OE presence", with the most likely location being the former sandpit (RVAAP-4.A.1). It is believed that the pit may contain subsurface metal. The ASR also mentioned a facility drawing that illustrated a propellant storage area, a personnel shelter, a protective earthen barricade, and a sandpit. As previously mentioned, the ASR also contained a design drawing of the non-standard ordnance item believed to be the experimental anchor munitions (**Photograph 27**). The ASR described the munitions as a rocket armed with an anchor instead of a warhead. During the ASR site visit, some metal tubing was found in the location of the former sandpit (see **Photograph 28**). Other than the metal debris, no ordnance related material was found in this area (RVAAP-4.A.1).



**Photograph 28: Metal Debris from Anchor Test Area, June 2004. (RVAAP-4.A.3)**

**Characterization of 14 AOCs at Ravenna Army Ammunition Plant, Characterization of Anchor Test Area, Preliminary Draft, December 2005**

The preliminary draft characterization report also stated that little is known about the historical function of this AOC, other than it is suspected that the site was used to test explosively-charged anchors.

The investigation focused on the nature of contamination in only one media: soil (shallow soil and subsurface soil). The results of the investigation found various metal constituents above screening criteria in all soil samples collected. In shallow and subsurface soils, metals were the only parameter with analytes that were detected above Installation-specific background and/or EPA Region 9 residential PRG screening values. No organic compounds were detected above screening criteria in any of the shallow or subsurface soil samples.

**FY 2006, RVAAP, OH IAP**

One groundwater sample and five soil samples were collected at the site from around the dirt mound and in the sandpit. Arsenic was detected in the soil. Arsenic was also detected in the groundwater at a maximum concentration of 14.4 ppb. These samples are the only known MC samples collected at the site and the date of the sampling is unknown (RVAAP-1.A.1).

#### *4.1.12.3 MEC/MC Analysis*

While metal debris has been found at the MRS, reports of MEC having been found at the site were not revealed during the HRR. However, a UXO evaluation has not been conducted at the sandpit area, which was identified in the ASR as potentially containing MEC (RVAAP-1.A.2).

Metals, which have been detected in the soil and groundwater at elevated concentrations, will be addressed under the IRP. MC will not be evaluated further under the SI process.

### 4.1.13 Atlas Scrap Yard (RVAAP-050-R-01)

*4.1.13.1 Summary of Findings*

The Atlas Scrap Yard MRS encompasses approximately 66.04 acres of mostly open land that contains a network of roads. Originally used as a construction camp, the MRS became a storage area for non-explosive scrap starting in 1969. Currently, the MRS is heavily overgrown with tall grasses, isolated stands of trees, and shrubs. There are scattered piles of debris located throughout the site that appear to be comprised of construction debris, dunnage, and metal scraps. The layout and general location of the MRS is provided in **Figure 7**.

According to interviews with various RVAAP personnel, any of the munitions made or stored at the plant may have been disposed of in this area including: small arms, explosives, pyrotechnics, propellants, mortars, medium and large caliber munitions, landmines, hand grenades, flares, bombs, detonators, or fuzes. The US Army CTT Range/Site Inventory reported that UXO had been uncovered in the southwest corner of the MRS. This disclosure was based on information provided in a removal report funded by the Joint Munitions Command (JMC); however, the name of the reference was not provided and could not be verified. Further, the report stated that the OE, OE scrap, and UXO had been sorted and removed from the site in 2003 (RVAAP-2.A.12). Again, this information could not be verified.

Very few new details describing the use and/or disposal operations for the MRS were found during the HRR. Until the summer of 2005, only one characterization study (i.e., relative risk site evaluation) had been conducted at the MRS. In 2005, a characterization study (see **Section 4.1.13.2**) was conducted at the site that evaluated environmental media contamination. Two points of note reported in the characterization study were:

1. The study focused on areas of concern including stockpiles of debris consisting of pipes, railroad ballast, railroad ties, concrete rubble, and chipped **ammunition boxes**, as well as portions of the AOC where specific operations occurred or where equipment associated with specific operations was located: **munitions storage**, tar cleaning tank, and incinerator.
   (This was the first disclosure found that the MRS had been used to store munitions.)

2. Eight test trenches were excavated near monitoring well locations. The trenching activities provided information about the soil stratification profile, depth to groundwater, and depth to bedrock. Trenching was halted upon encountering saturation, which was encountered between 7.2 and 14 ft bgs. While trenching, no suspect soil or **MEC** was encountered during the operation.

To put the absence of MEC at the trench sites in the proper perspective, it is not apparent that geophysical surveys were performed in conjunction with locating the excavation sites.

The MRS is collocated with the IRP AOC RVAAP-050, which is also referred to as the Atlas Scrap Yard. The AOC is similar in aspect to the MRS (i.e., it covers the old construction camp area) with the exception that it encompasses approximately 150 acres (84 more acres than the MRS). A figure identifying the IRP AOC boundary could not be located and it is not known where the additional IRP AOC acreage is situated; as such, the IRP AOC boundary has not been delineated on **Figure 7**. The IRP is addressing MC concerns at the site.

#### *4.1.13.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE Rock Island District, June 2004**

The USACE assessment team reported that there was some debris in the area, but that the assessment team did not locate any ordnance related debris. The assessment team reported that the area is considered to have potential OE presence until the remaining debris is identified.

**Characterization of 14 AOCs at Ravenna Army Ammunition Plant, Characterization of Atlas Scrap Yard, Preliminary Draft, December 2005**

The characterization study was conducted to collect sufficient data for all applicable media to allow efficient planning and execution of future environmental actions at the site. The study found that contaminants were detected above screening criteria in four media: shallow soil, sediment, surface water and groundwater. Six constituents (all SVOCs) other than inorganics were detected above screening criteria in the samples collected from the various media. SVOCs were detected above screening criteria in all five shallow soil samples analyzed; the only sediment sample analyzed; two out of 17 surface water samples; and one of eleven groundwater samples. Contaminants detected in soil above Installation-specific background and/or EPA Region 9 residential PRG screening values included 22 metals and five SVOCs. Twenty metals and one SVOC were detected at concentrations above Installation-specific background and/or EPA Region 9 residential PRG screening values in sediment samples. In surface water, 12 metals, 3 SVOCs and nitrate were detected above Installation-specific background and/or EPA Region 9 residential PRG screening values. In groundwater, 17 metals and one SVOC were detected above Installation-specific background and/or EPA Region 9 residential PRG screening values. No MEC were found during the course of the investigation, either lying on the ground surface or at the eight trenches installed next to the monitoring well locations.

**FY 2006, RVAAP, OH IAP**

The IAP reports that UXO was discovered in the southwest corner of the site while sampling under the IRP. MEC and munitions debris were partially removed from the site in 2003 (RVAAP-1.A.2). There was no supporting information describing the type and condition of any MEC that had been removed, or what MEC or munitions debris may remain at the site.

This AOC was transferred to OHARNG in May 1999. Future work to be conducted under the IRP includes putting a remedy in place (e.g., soil removal) and completing any response that may be required. Future use by the OHARNG will consist of mounted training without digging. Long term groundwater monitoring, along with land use controls, are anticipated for this AOC.

#### *4.1.13.3 MEC/MC Analysis*

While sampling under the IRP, MEC and munitions debris were discovered and partially removed. The origin, type, and condition of the MEC and munitions debris are unknown. Debris piles still exist at the site and need to be evaluated to determine if MEC still exists at the MRS.

MC is being addressed under the IRP and will not be further evaluated under the SI process (RVAAP-1.A.2).

### 4.1.14 Block D Igloo (RVAAP-060-R-01)

*4.1.14.1 Summary of Findings*

This MRS consists of the area (circle with a 3,000 ft radius) contained within the suspected debris field that resulted when Igloo 7-D-15 ("D" Block) accidentally exploded on 24 March 1943. The MRS boundary was established by the USACE, Huntsville District to capture the probable debris field resulting from the explosion and was based on the type of munitions stored in the bunker at the time of the explosion.

According to an accident report issued by the Office of the Chief of Ordnance, Safety and Security Division, 2,516 clusters (M-1A1) of 20 lb fragmentation bombs (M-41) detonated while being loaded into the storage magazine killing the 10 man work crew and one worker located at an adjacent igloo 800 ft to the side. The igloo, which was 60 ft long and constructed of reinforced concrete, was filled to 95 percent capacity at the time of the detonation while a few of the bomb crates remained on the semi-trailer from which the bombs were being off loaded. The trailer completely disintegrated in the blast while remnants of the associated truck were hurled forward 500 to 600 feet. Other items found and the distances recorded included the igloo's steel door, which was propelled forward approximately 1,800 ft; a concrete fragment that was propelled 1,800 ft to the north striking a small sawmill; and a concrete fragment that hit igloo 2-E-6 located approximately 2,100 ft forward of igloo 7-D-15 (RVAAP-4.A.4).

Based on the investigation conducted by the Chief of Ordnance to establish the circumstances behind the explosion, it was determined that the cause of the detonation was due to a combination of rough handling and a faulty design of the M-110 fuze which left the fuze in the armed position. It was determined that the 2,516 clusters contained approximately 41,000 pounds of explosive; based on a computation of the usual weight of TNT per bomb. Observations made at the scene determined that the earthen embankments held the force of the explosion at the base so that the side-walls of the igloo sheared off at the footings. It was reported that the blast formed two fans: the first and smaller fan was roughly circular in shape and extended to the right, to the rear, and to the left of the igloo, while the larger fan extended forward from the igloo in an easterly direction toward the "E" block of igloos. The major force was directed along a median line in conjunction with the long axis of the igloo. Large sections of concrete were lifted up and over the earthen embankments, while smaller sections traveled in the fan shaped blast to the right and left of the median line on an approximate sixty to eighty degree angle. Some of the concrete fragments were propelled forward in the larger of the two fans up to 3,800 ft. There was no mention of the distance that the smaller fan stretched.

The investigation further stated that, based on the examination of the debris, the blast was definitely directional. "The shock was scarcely felt in the office approximately two and one-half miles to the southwest although other statements indicated that it was felt in the city of Youngstown, thirty miles east. A twenty to twenty-five mile per hour wind was blowing in an easterly direction so small fragments blown to great heights traveled easterly and fell over the boundary of the Depot into the Ravenna Ordnance Plant igloo area. Dirt from the explosion blown skyward in a similar manner traveled with the wind and contaminated freshly painted houses some six miles away. A circuit of the area adjacent to the Ravenna Ordnance Plant line at the eastern end of block E along Greenleaf Road produced fragments of rubble with diameters of about one inch or less (RVAAP-4.A.4)." One additional piece of information of note was that personnel at the plant at the time of the explosion reported hearing two explosions. This was dismissed by the investigation, attributing the effect to the difference between sight and sound, and ground shock and sound.

The US Army CTT Range/Site Inventory described the MRS as the area encompassed within a circle with a diameter of 3,000 ft and that the total area was approximately 622.24 acres (RVAAP-2.A.12). However, it was determined that the radius is 3,000 feet and not the diameter. The MRS boundary was developed by the USACE, Huntsville District and was based on the type of munitions stored at the igloo when it detonated.

The D block of igloos is now inactive (RVAAP-1.A.2). The MRS is not associated with an IRP AOC. **Figure 9** provides the layout of the Block D Igloo MRS. The figure also shows the location of fragments that were found by Installation personnel after the explosion which are located outside of the MRS boundary. **Photograph 29** provides a view of the interior of a typical igloo, and **Photograph 30** shows a view of the D Block Igloos.

**Photograph 29: View of the interior of an igloo within the "D" Block, undated photograph from RVAAP archives. (RVAAP-4.A.3)**

**Photograph 30: View of the "D" Block igloos, undated photograph from the RVAAP archives. (RVAAP-4.A.3)**

*4.1.14.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE, Rock Island District, June 2004**

The 2004 ASR indicated that the site "is considered to have potential OE presence (RVAAP-4.A.1)." It is believed fragmentation bombs that were not destroyed in the explosion may be scattered in a large area at the site (RVAAP-4.A.1). In addition, the ASR stated that some witnesses to the explosion believed that there were two distinct explosions, increasing the likelihood that some bombs were not completely destroyed.

During the site visit, the assessment team concentrated a search at the MRS in the area forward of the former headwall, since it was the most likely place to find debris. It was reported that the team only found what might have been part of the truck that was parked in front of the magazine at the time of the explosion, and did not find any OE related debris.

*4.1.14.3 MEC/MC Analysis*

Cluster bombs may have been propelled from the igloo or may have been scattered from the munitions crates that remained on the semi-trailer over a large area during the explosion. RVAAP personnel have indicated that the site was considered clean of UXO some time after the explosion. No documentation to support this statement was identified (RVAAP-1.A.2). Further, it is likely that remote, wooded or densely vegetated areas of the MRS were not thoroughly searched for debris (including MEC and munitions debris) after the detonation.

No known previous investigations for MC have been conducted at the site.

## 4.1.15 Block D Igloo–TD (RVAAP-061-R-01)

### *4.1.15.1 Summary of Findings*

The Block D Igloo–TD consists of the portion of the circle centered on Igloo 7-D-15 (MRS RVAAP-060-R-01) that exploded on 24 March 1943 that extends beyond the Installation boundary. This property, which encompasses 19.25 acres, is considered separately as a transferred site (RVAAP-2.A.12). The MRS is located to the northwest of Igloo 7-D-15 and consists of farm fields that are separated by stands of woodlands, railroad tracks, and a right-of-way. The right-of-way runs adjacent to the RVAAP property boundary, separating the wooded areas and farm fields from the Installation. There are no structures located at this MRS and access to the area is not restricted. Additional details on the history of this site can be found in **Section 4.1.14**. **Figure 9** shows the layout of the Block D Igloo–TD MRS.

Few additional details were disclosed concerning the nature of this MRS during the HRR. This site is not associated with an IRP AOC; as such, no investigations have been conducted. Further, no information was found that reported finding MEC or munitions debris at the MRS.

### *4.1.15.2 Previous Investigations*

No previous investigations have been conducted at the MRS to evaluate MEC or MC.

### *4.1.15.3 MEC/MC Analysis*

MEC has not been confirmed at the site. No known MC analysis has been conducted at the site (RVAAP-1.A.2).

## 4.1.16 Water Works #4 Dump (RVAAP-062-R-01)

*4.1.16.1 Summary of Findings*

The Water Works #4 Dump is an approximate 6.15 acre wooded area immediately west of Water Works #4 and Load Line 7, in the southwestern portion of RVAAP. Large caliber casings were found scattered throughout the MRS lying on the ground surface and partially buried, as were metal parts defined as ogives from WWI 155mm shrapnel projectiles. According to RVAAP personnel, the dates of disposal are estimated to be between 1941 and 1949. The type and origin of the casings is unknown. No MEC investigations have been performed on the site (RVAAP-2.A.5).

There are no known structures at the site. The presence of utilities at the site is unknown. The site is located north of the Fuze and Booster Quarry and the 40mm Firing Range. See **Figure 8** for the layout of the Water Works #4 Dump MRS. The MRS is controlled by an Installation perimeter fence which is patrolled intermittently (RVAAP-2.A.5). **Photograph 31** shows the current site conditions looking across the dump area.

**Photograph 31: December 2005 photograph of the Water Works #4 Dump. (RVAAP-8.A.1)**

*4.1.16.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE, Rock Island District, June 2004**

The 2004 ASR indicates the munitions debris found at the site was inert and the area "is considered to have no OE presence (RVAAP-4.A.1)." Metal parts found in the area were all inert.

*4.1.16.3 MEC/MC Analysis*

Munitions debris has been confirmed at the site. No known investigations for MEC or MC have been conducted at the site (RVAAP-1.A.2).

### 4.1.17 Area Between Buildings 846 and 849 (RVAAP-063-R-01)

*4.1.17.1 Summary of Findings*

The MRS is approximately 2.65 acres and consists of most of the area between buildings 846 and 849. This area is disturbed land currently being used as an OHARNG vehicle staging area. The land between the buildings may have been used for burning of construction debris and rubbish in the past. In 1996, one anti-personnel fragmentation bomb (referred to as a "hammerhead" anti-personnel bomb) loaded with HE was found at the MRS. The bomb was taken to Demolition Area #2 and detonated at the RCRA unit by an Ordnance Company that had been dispatched from Wright-Patterson Air Force Base. OHARNG personnel discovered the bomb. In addition, one demilitarized (i.e., cut into two halves) 175mm projectile was found on the ground surface at the MRS. The demilitarized projectile was removed and taken to Building 1501. The site has not been evaluated for presence of MEC and no site investigations have been performed at the site (RVAAP-2.A.10).

There are buildings in close proximity to the site used for the storage of equipment and vehicles by OHARNG (RVAAP-1.A.2). It is unknown if there are utilities present at the site. The site is located southeast of Load Line #12 and just north of the Installation boundary. See **Figure 7** for the layout of the Area Between Buildings 846 and 849 MRS.

*4.1.17.2 Previous Investigations*

No previous investigations of the site were discovered during the course of the HRR.

*4.1.17.3 MEC/MC Analysis*

MEC has been confirmed at the site. In 1996, one "hammerhead" anti-personnel bomb was found on the ground surface at the site. The bomb, which was loaded with HE, was removed and detonated at the interim RCRA unit at Demolition Area #2. One inert 175mm projectile was also found at the site. This munitions debris was removed and stored at Building 1501 (RVAAP-1.A.2 and RVAAP-2.A.10).

### 4.1.18 Field at the NE Corner of Intersection (RVAAP-064-R-01)

*4.1.18.1 Summary of Findings*

The MRS consists of an open field that encompasses approximately 91.86 acres. The open field is bisected by Paris-Windham Road, which runs north-south through the MRS. The MRS is mostly surrounded by fairly dense woodlands. The field lay fallow from the early 1970s to mid-1980s. The trees and shrubs were cleared with a bull dozer in 1985 and the field tilled and planted into grasses for hay production. The field was leased from 1986 through the 2000 growing season. On 6 May 1999, the land was transferred to the NGB and reassigned to RTLS. The MRS boundary was based, in large part, on input from Installation personnel, who identified that all open areas could have possibly been used for training or the inadvertent disposal of munitions during the course of the Installations history. **Figure 12** provides the layout of the MRS, while the current site conditions are provided in **Photograph 32**.

**Photograph 32: December 2005 photograph of Field at the NE Corner of Intersection MRS. (RVAAP-8.A.1)**

One inert anti-tank landmine (14 to 16 inches in diameter, pressure detonated) was discovered in 1996, by OHARNG personnel, lying on the ground surface of the forested area adjacent to the open field in the north-central portion of the MRS, approximately 100 feet to the east of Paris-Windham Road (see **Figure 12**). The inert practice mine was removed by the OHARNG from the MRS; the inert practice landmine is now a show-piece at Building 1037. No other reports of MEC or munitions debris findings at the MRS have been discovered. According to input from the OHARNG and Installation personnel, it is believed that the discovery of the inert land mine was a one- time occurrence that probably resulted from the accidental dropping by a guardsman.

The MRS is undeveloped and is used to practice airlifts of heavy objects (pre-weighted concrete blocks) by rotary-wing aircraft. There are no known structures or utilities located at the MRS.

The MRS is not associated with an IRP AOC; as such, characterization studies have not been conducted at the site.

# FIELD AT NE CORNER OF INTERSECTION MRS
# Ravenna Army Ammunition Plant, OH

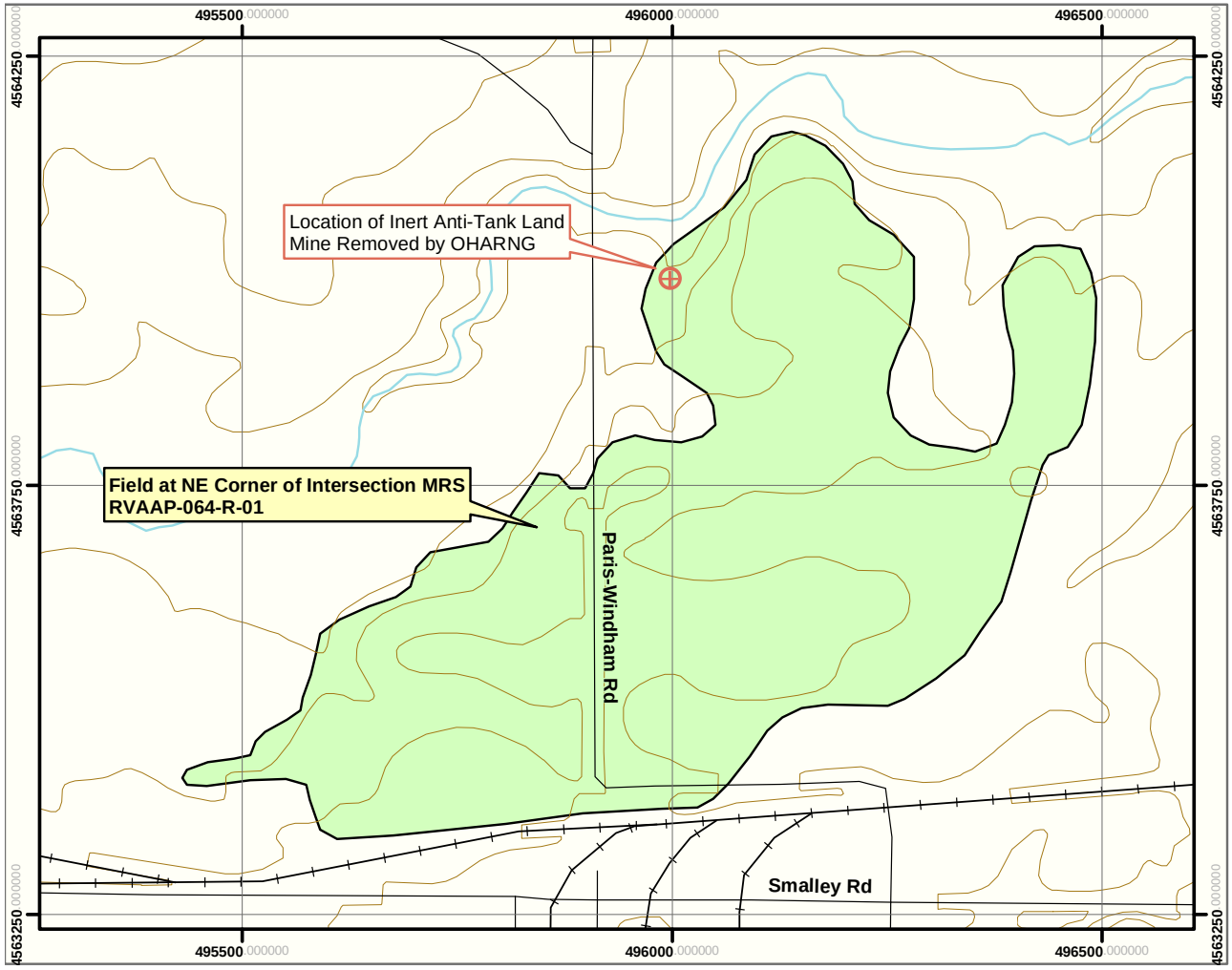



**Figure 12**

N
W E
S

Elevation Contour
Railroad
Road
Stream

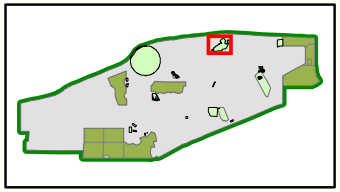
**Area Status**
MRS, Closed

| | |
|---|---|
| **Projection:** | **UTM Zone 17** |
| **Datum :** | **WGS 84** |
| **Units:** | **Meters** |
| **Grid:** | **500 Meter** |

1:8,000

0 200 400 600 800 1,000 Feet
0 100 200 300 Meters

Installation Location
**Ohio**



**HISTORICAL RECORDS REVIEW**
**RAVENNA ARMY AMMUNITION PLANT, OH**
**Source:** Produced for the U.S. Army Corps of Engineers by engineering-environmental Management, Inc. ($e^2M$)

**Date:** January 2007
**Edition:** Final (Revised)

*4.1.18.2 Previous Investigations*

**OE ASR for RVAAP, OH, USACE, Rock Island District, June 2004**

The ASR assessment team determined that the area is "considered to have no OE presence" (RVAAP-4.A.1). The assessment team evaluated the historic information and found that the "OE found in this area was located on the surface and there is no evidence of other items remaining in the area" (RVAAP-4.A.1).

*4.1.18.3 MEC/MC Analysis*

MEC has not been found at the MRS and is not suspected of being present, however its presence or absence is unknown. Munitions debris (inert practice mine) was found and removed by the OHARNG.

There have been no investigations conducted at the site to evaluate the presence of MC; however, the likelihood that MC is present is low given the agricultural activities that were conducted at the site and due to the low probability of MEC being present.

# 5.0 CONCEPTUAL SITE MODEL

## 5.1 Introduction

The primary purpose of the CSM is to identify current or reasonably anticipated human and environmental exposure to MEC and MC by identifying potential human and ecological receptors and pathways. As such, this document provides a conceptualization of the following site conditions:

- Actual or reasonably anticipated presence of MEC and MC;
- Actual or reasonably anticipated points of exposure and exposure pathways; and
- Actual or reasonably anticipated future human and ecological receptors.

The assessment of these site conditions are presented in MEC and MC Exposure Pathway Analysis flow charts, which are provided at the end of each MRS site-specific discussion that follows (**Figures 13 – 39**). Exposure Pathway Analysis flow charts are developed to provide an illustration of the interaction between a source (i.e., MEC or MC) and a receptor(s); that is, the course and activity that a receptor may take to expose them to MEC or conversely, the course (i.e., release mechanism and exposure media) that MC may take to reach receptors. The objective of the flow charts is to determine if a complete, potentially complete, or incomplete exposure pathway exists at a particular MRS. The evaluation of these site-specific conditions will assist in determining effective and achievable future actions that are protective of human health and the environment.

When assessing MEC, each pathway must include a source, access, MEC location/release mechanism, activity, and a receptor, whereas an assessment of MC must include a source, source media, release mechanism, exposure media, exposure routes, and a receptor. The following is a brief discussion of the assessment components.

**MEC**

- *Source*. Sources are those areas where MEC has entered the environment. For MEC, examples include burial sites, landfills, open burn/open detonation areas, demolition ranges, and impact ranges
- *Access*. Access is the ease in which a receptor can come into contact with a source. The presence of access controls help determine whether an exposure pathway to a receptor is complete, as fences or natural barriers can limit human access to a source area. Furthermore, the depth of MEC items in subsurface soils may also limit access by a receptor. Ease of entry for

adjacent populations (e.g., lack of fencing) can facilitate trespassing at the site, either intentional or accidental.

- *MEC Location/Release Mechanism*. This component describes the physical location of the MEC; that is, MEC lying on the ground surface or present in the subsurface soil (i.e., greater than two ft bgs). Typically, movement of MEC is not significant. However, there can be some movement through natural processes, such as frost heave, tidal action, and erosion, or from human activity, such as digging or excavation.
- *Activity*. Activity can be described as the action that a receptor takes which introduces them to MEC. Human exposure to MEC can include handling or stepping on munitions that may be lying on the ground surface or coming into contact with buried munitions while digging or excavating. Ecological exposure can include coming into contact with MEC lying on the ground surface or through disturbing buried MEC while burrowing.

*Receptors*. A receptor is an organism (human or ecological) that can come into contact with MEC or MC. Pertinent human and ecological receptors are identified when assessing the land use and ecological biome for the surrounding area at the MRS. Human receptor categories can include residents, site workers, construction workers, recreational users, and trespassers. Ecological receptors include flora and fauna native to the region.

**MC**

- *Source*. Sources are those areas where MC has entered the environment. Examples of MC sources include any location where materials originating from UXO, DMM, or other military munitions, and emission, degradation, or breakdown elements have collected. This would also include constituents from small arms ranges. Identifying munitions types and MC potentially associated with a source area is a principal goal early in the process.
- *Source Media*. The source media is the environmental media (i.e., soil, surface water, sediment, ground water) from where the MC originated; that is, the media that contains the source. For the HRR, only soil is evaluated.
- *Release Mechanisms/Exposure Media*. Environmental contaminants, such as MC, often undergo various processes (e.g., volatilization, migration) such that media other than the source area can become contaminated. Therefore, all potentially contaminated media (exposure media) must be evaluated when considering MC at an MRS. Release mechanisms are the transport processes that spread the MC to other media. Under the HRR, the release mechanisms evaluated include runoff and leaching.

- *Exposure Routes.* The exposure routes are described as the course which MC is introduced to receptors, which includes ingestion, inhalation, and dermal contact.
- *Receptors.* A receptor is an organism (human or ecological) that can come into contact with MEC or MC. Pertinent human and ecological receptors are identified when assessing the land use and ecological biome for the surrounding area at the MRS. Human receptor categories can include residents, site workers, construction workers, recreational users, and trespassers. Ecological receptors include flora and fauna native to the region.

This section begins with a general description of the RVAAP facility (**Section 5.2**) and continues with site-specific discussions of each RVAAP MRS.

## 5.2 Installation Setting

### 5.2.1 Physical Setting

RVAAP is located within the Southern New York Section of the Appalachian Plateau physiographic province. This province is characterized by elevated uplands, rolling topography, and incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which rounded ridges, filled major valleys, and blanketed many areas with glacially derived unconsolidated deposits (e.g., sand, gravel, and finer-grained outwash deposits). As a result of glacial activity in this section, old stream drainage patterns were disrupted in many locales, and extensive wetland areas developed. The area is marked by tracts of forests, ranging from a few acres to hundreds of acres (RVAAP-3.G.7).

#### *5.2.1.1 Climate*

RVAAP has a humid continental climate characterized by warm, humid summers and cold winters. Precipitation varies widely throughout the year. The average driest month is February, and the wettest month is July. Data from the National Weather Service compiled over the past 47 years indicate that the average annual rainfall for the area is 0.98 meters (m) (38.72 inches). The average annual snowfall is 1.1 m (43.4 inches). Severe weather, in the form of thunder, hail, or snow storms, is common during the summer and winter. Tornadoes are infrequent (RVAAP-3.G.8).

#### *5.2.1.2 Geology*

The regional geology at RVAAP consists of horizontal to gently dipping bedrock strata of Mississippian and Pennsylvanian age. These Mississippian and Pennsylvanian aged formations dip to the south at a rate of approximately 5 to 10 ft/mile and are overlain by varying thicknesses of unconsolidated glacial deposits.

Bedrock at RVAAP is overlain by deposits of the Wisconsin-aged Lavery Till in the western portion of the facility and the younger Hiram Till and associated outwash deposits in the eastern portion. Unconsolidated glacial deposits vary considerably in their character and thickness across RVAAP, from zero m or ft in some of the eastern portion of the facility to an estimated 46 m (150 ft) in the south-central portion.

Thin coverings of glacial materials have been completely removed as a consequence of human activities at locations such as the Ramsdell Quarry Landfill, and bedrock is present at or near the ground surface in many locations, such as Load Lines 1 and 2. At locations across the Installation where glacial materials are still present, their distribution and character indicate their origin as ground moraine. These tills consist of laterally discontinuous assemblages of yellow-brown, brown, and gray silty clays to clayey silts, with sand and rock fragments. Deposits from bodies of glacial-age standing water may also have been encountered, in the form of over 15 m (50 ft)-thick deposits of uniform light gray silt.

The Mississippian Cuyahoga Group is present at depths of approximately 200 ft bgs throughout the majority of the site. However, the Meadville Shale Member of the Cuyahoga Group, a blue-gray silty shale characterized by alternating thin beds of sandstone and siltstone, is present at or near the surface in the very northeastern corner of RVAAP.

The Sharon Member of the Pennsylvanian Pottsville Formation unconformably overlies the Meadville Shale Member of the Mississippian Cuyahoga Group. The unconformity has a relief of as much as 200 ft in Portage County, and this is reflected in the variation of thickness of the Sharon Member. The Sharon Member consists of two units: a shale and a conglomerate.

The conglomerate unit of the Sharon Member (informally referred to as the Sharon Conglomerate) is a highly porous, permeable, cross-bedded, frequently fractured and weathered quartzite sandstone, which is locally conglomeratic and exhibits an average thickness of 100 ft. The Sharon Conglomerate has a thickness of as much as 250 ft where it was deposited in a broad channel cut into Mississippian rocks. In marginal areas of the channel, the conglomerate unit thins to about 20 ft and in places may be missing, owing to non-deposition on the uplands of the early Pennsylvanian erosional surface. Thin shale lenses occur sporadically within the upper part of the conglomerate unit.

The shale unit of the Sharon Member (informally referred to as the Sharon Shale) is a light to dark-gray fissile shale, which overlies the conglomerate in some locations, but has been eroded in most areas of RVAAP. The Sharon Member outcrops in many locations in the eastern half of RVAAP.

In the western half of RVAAP, the remaining members of the Pottsville Formation found in the local area overlie the Sharon Member. These remaining members of the Pottsville Formation are not found in the eastern half of the site either because the land surface was above the level of deposition or they were eroded. The Connoquenessing Sandstone Member, which unconformably overlies the Sharon Member, is a sporadic, relatively thin channel sandstone comprised of gray to white, coarse-grained quartz with a higher percentage of feldspar and clay than the Sharon Conglomerate. The Mercer Member is found above the Connoquenessing Sandstone and consists of silty to carbonaceous shale with many thin and discontinuous lenses of sandstone in its upper part. The Homewood Sandstone Member unconformably overlies the Mercer and is the uppermost unit of the Pottsville Formation. The Homewood occurs as a caprock on bedrock highs in the subsurface and ranges from a well-sorted, coarse-grained, white quartz sandstone to a tan, poorly sorted, clay-bonded, micaceous, medium- to fine-grained sandstone (RVAAP-3.C.5).

#### *5.2.1.3 Topography*

The province is characterized by its rolling topography with incised streams having dendritic drainage patterns. The Southern New York Section has been modified by glaciation, which rounded ridges, filled major valleys, and blanketed many areas with glacially derived unconsolidated deposits (e.g., sand, gravel, and finer-grained outwash deposits). Evidence of the region's glacial past includes bogs, kettle lakes, and a landscape marked by small upland hills of sand and gravel called "kames". As a result of glacial activity in this section, old stream drainage patterns were disrupted in many locales, and extensive wetland areas developed. These flat land areas to a considerable extent, contain the glacially derived finer-grained outwash deposits of clay (RVAAP-3.G.7).

#### *5.2.1.4 Soils*

Soils at RVAAP are generally derived from the Wisconsin-age silty clay glacial till. Distributions of soil types are discussed and mapped in the Soil Survey of Portage County, Ohio. Much of the native soil at RVAAP was reworked or removed during construction activities in operational areas of the Installation. According to the Portage County soil survey, the major soil types found in the high-priority AOCs are silt or clay loams with permeabilities ranging from $6.0 \times 10^{-7}$ to $1.4 \times 10^{-3}$ centimeter/second (RVAAP-3.C.5).

*5.2.1.5 Hydrogeology*

Sand and gravel aquifers are present in the buried-valley and outwash deposits in Portage County. Generally, these saturated zones are too thin and localized to provide large quantities of water for industrial or public water supplies; however, yields are sufficient for residential water supplies. Lateral continuity of these aquifers is not known. Recharge of these units comes from surface water infiltration of precipitation and surface streams. Specific groundwater recharge and discharge areas at RVAAP have not been delineated. However, extensive upland areas, such as north of the Winklepeck Burning Grounds and in the western portion of the facility, are presumed to be regional recharge zones. The major perennial surface water drainages (e.g., Sand Creek, Hinkley Creek, and Eagle Creek) are presumed to be the major groundwater discharge areas.

The sandstone facies of the Sharon Member, and in particular the Sharon Conglomerate, were the primary sources of groundwater during RVAAP's active phase, although some wells were completed in the Sharon Shale. Past studies of the Sharon Sandstone indicate that the highest yields come from the quartzite-pebble conglomerate facies and from jointed and fractured zones. Where it is present, the overlying Sharon Shale acts as a relatively impermeable confining layer for the sandstone. Hydraulic conductivities in wells completed in the Sharon Shale generally are much lower than those in the sandstone.

At the watershed scale (i.e., Sand Creek, Hinkley Creek, South Fork of Eagle Creek), groundwater flow generally mirrors surface drainage patterns. Regional drainage patterns along Sand Creek in the northeast portion of RVAAP result in a localized perturbation in the overall flow direction to the north-northeast. In several locations along the southern boundary of RVAAP, south-southeast perturbations in the overall observed groundwater flow patterns are observed as follows:

- A localized south-southeasterly flow component from the potentiometric high area centered around Load Lines 1, 2, and 3 toward the facility boundary;
- A localized southerly flow component toward the facility boundary from the southernmost portion of Load Line #12;
- A localized southerly flow component toward the facility boundary from Load Line 4, which mirrors the direction of surface water flow in the unnamed tributary that drains this load line; and
- Groundwater flow to the south in association with Hinkley Creek in the southwest portion of the site (e.g., Demolition Area 1 vicinity) (RVAAP-3.C.5).

*5.2.1.6 Hydrology*

The entire RVAAP facility is situated within the Ohio River Basin, with the West Branch of the Mahoning River representing the major surface stream in the area. This stream flows adjacent to the western end of the facility, generally from north to south, before flowing into the M. J. Kirwan Reservoir that is located to the south of State Route 5. The West Branch flows out of the reservoir along the southern facility boundary before joining the Mahoning River east of RVAAP.

The western and northern portions of RVAAP are characterized by low hills and dendritic surface drainage. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection by surface drainage. The facility is marked with marshy areas and flowing and intermittent streams, with headwaters located in the higher regions of the site. Three primary watercourses drain RVAAP: the South Fork of Eagle Creek, Sand Creek, and Hinkley Creek.

Sand Creek, with a drainage area of 36 square kilometers ($km^2$)(13.9 $miles^2$), flows generally northeast to its confluence with the South Fork of Eagle Creek. In turn, the South Fork of Eagle Creek then continues in a northerly direction for 7 kilometers (2.7 miles) to its confluence with Eagle Creek. The drainage area of the South Fork of Eagle Creek is 67.9 $km^2$ (26.2 $miles^2$), including the area drained by Sand Creek. Hinkley Creek, which has a drainage area of 28.5 $km^2$ (11.0 $miles^2$), flows in a southerly direction through the Installation to its confluence with the West Branch of the Mahoning River south of the facility.

Approximately 50 ponds are scattered throughout the Installation. Many were built within natural drainageways to function as settling ponds or basins for process effluent and runoff. Others are natural glacial depressions or result from beaver activity. All water bodies at RVAAP support an abundance of aquatic vegetation and fish. None of the ponds within the Installation are used as water supply sources.

Storm water runoff is controlled primarily by natural drainage, except in facility operations areas where extensive storm sewer networks and surface ditches help to direct runoff to drainage ditches and settling ponds. In addition, the storm sewer and drainage ditch systems were one of the primary drainage mechanisms for process effluent during the period that production facilities were in operation (RVAAP-3.C.5).

#### *5.2.1.7 Vegetation*

Dominant vegetative cover types are forest and old fields of various ages. Over 80 percent of RVAAP is now forest (RVAAP-3.G.8). See **Section 5.2.2.2** below.

### 5.2.2 Ecological Setting

#### *5.2.2.1 Habitat Type*

Portions of the Installation satisfy the regulatory definition of jurisdictional wetland. Wetland areas at RVAAP include seasonally saturated wetlands, wet fields, and forested wetlands. Most of these wetland areas exist because of poorly drained and hydric soil. Beaver impoundments contribute to wetland diversification on the Installation.

Overall, the trend towards forest cover enhances the area for use by forest species, both plant and animal. Future IRP activities will require consideration of these species to ensure detrimental effects on threatened or endangered RVAAP flora and fauna do not occur. There are no federal, state, or local parks or protected areas on RVAAP facility property (RVAAP-11.A.1). See **Section 5.2.2.2** below.

#### *5.2.2.2 Degree of Disturbance*

Before the government acquired the property in the 1940's, much of the land at RVAAP was cleared for agricultural use. Over 80 percent of RVAAP is now forest. The limited field cover growth is the result of earlier agricultural practices that left these sites with poor top soil that still limits forest regeneration. Several thousand acres of agricultural fields were planted with trees during the 1950s and 1960s, but these plantings did not take well in areas with poor topsoil. Some fields, leased for cattle grazing during the same period, were subsequently delayed in their reversion to forest. A few fields have been brush hogged, maintaining them as old field (RVAAP-11.A.1).

Restricted land use and sound forest management practices have preserved and enabled large forest tracts to mature. Habitat conversion at RVAAP has focused on restoration of the forests that covered the area prior to its being cleared for agriculture. The reversion of these agricultural fields to mature forest provides a diversity of habitats from old field through several successive stages.

In general, the current degree of disturbance of the RVAAP facility is very limited. An evaluation of the degree of disturbance of each MRS is included in the site specific descriptions later in this section.

*5.2.2.3 Ecological Receptors*

The flora and fauna presented at RVAAP are varied and widespread. A total of 18 plant communities have been identified on facility property including marsh, swamp, and forest communities. Below is a listing of all state species confirmed to be present on the Installation either by biological inventories and/or confirmed sightings.

**State Endangered**

- American bittern, *Botaurus lentiginosus* (migrant)
- Northern harrier, *Circus cyaneus*
- Yellow-bellied Sapsucker, *Sphyrapicus varius*
- Golden-winged warbler, *Vermivora chrysoptera*
- Osprey, *Pandion haliaetus* (migrant)
- Trumpeter swan, *Cygnus buccinator* (migrant)
- Mountain Brook Lamprey, *Ichthyomyzon greeleyi*
- Graceful Underwing, *Catocala gracilis*
- Ovate Spikerush, *Eleocharis ovata* (Blunt spike-rush)
- Tufted Moisture-loving Moss, *Philonotis fontana* var. *caespitosa*
- Bobcat, *Felis rufus*
- Narrow-necked Pohl's Moss, *Pohlia elongata* var. *elongata*

**State Threatened**

- Barn owl, *Tyto alba*
- Dark-eyed junco, *Junco hyemalis* (migrant)
- Hermit thrush, *Catharus guttatus* (migrant)
- Least bittern, *Ixobrychus exilis*
- Lest flycatcher, *Empidonax minimus*
- *Psilotreta indecisa* (caddisfly)
- Simple willow-herb, *Epilobium strictum*
- Woodland Horsetail, *Equisetum sylvaticum*
- Lurking leskea, *Plagiothecium latebricola*
- Pale sedge, *Carex pallescens*

**State Potentially Threatened Plants**

- Gray Birch, *Betula populifolia*
- Butternut, *Juglans cinerea*

- Northern rose azalea, *Rhododendron nudiflorum* var. *roseum*
- Hobblebush, *Viburnum alnifolium*
- Long Beech Fern, *Phegopteris connectilis* (*Thelypteris phegopteris*)
- Straw sedge, *Carex straminea*
- Water avens, *Geum rivale*
- Tall St. John's wort, *Hypercium majus*
- Swamp oats, *Sphenopholis pensylvanica*
- Shinning ladies'-tresses, *Spiranthes lucida*
- Arbor Vitae, *Thuja occidentalis*
- American Chestnut, *Castanea dentata*

**State Species of Concern**

- Pygmy shrew, *Sorex hovi*
- Star-nosed mole, *Condylura cristata*
- Woodland jumping mouse, *Napaeozapus insignis*
- Sharp-shinned hawk, *Accipiter striatus*
- Marsh wren, *Cistothorus palustris*
- Henslow's sparrow, *Ammodramus henslowii*
- Cerulean warbler, *Dendroica cerulea*
- Prothonotary warbler, *Protonotaria citrea*
- Bobolink, *Dolichonyx oryzivorus*
- Northern bobwhite, *Colinus virginianus*
- Common moorhen, *Gallinula chloropus*
- Great egret, *Casmerodius albus*
- Sora, *Porzana carolina*
- Virginia Rail, *Rallus limicola*
- Creek heelsplitter, *Lasmigona compressa*
- Eastern box turtle, *Terrapene carolina*
- Four-toed Salamander, *Hemidactylium scutatum*
- *Stenonema ithica* (mayfly)
- *Apamea mixta* (moth)
- *Brachylomia algens* (moth)

**State Special Interest**

- Canada warbler, *Wilsonia canadensis*
- Little blue heron, *Egretta caerula*
- Magnolia warbler, *Dendroica magnolia*
- Northern waterthrush, *Seiurus noveboracensis*
- Winter wren, *Troglodytes troglodytes*
- Back-throated blue warbler, *Dendroica caerulescens*
- Brown creeper, *Certhia americana*
- Mourning warbler, *Oporornis philadelphia*
- Pine siskin, *Carduelis pinus*
- Purple finch, *Carpodacus purpureus*
- Red-breasted nuthatch, *Sitta canadensis*
- Golden-crowned kinglet, *Regulus satrapa*
- Blackburnian warbler, *Dendroica fusca*
- Blue grosbeak, *Guiraca caerulea*
- Common snipe, *Gallinago gallinago*
- American wigeon, *Anas americana*
- Gadwall, *Anas strepera*
- Green-winged teal, *Anas crecca*
- Northern shoveler, *Anas clypeata*
- Redhead duck, *Aythya americana*
- Ruddy duck, *Oxyura jamaicensis*

There are currently no federally listed species or critical habitat on the RTLS property. There are a few species currently under federal observation for listing, but none listed. Below is a list of species documented by the US Fish and Wildlife Service or the Ohio Division of Natural Areas Preserves known to exist within the vicinity of the RTLS or within ranges that include the RTLS, but not known to be on the RTLS/RVAAP property.

**Federal Endangered**

- Indiana Bat, *Myotis sodalis* (Portage and Trumbull Counties)
- Mitchell's satyr, *Neonympha mitchellii* (Portage County)
- Clubshell mussel, *Pleurobema clava* (Trumbull County)

**Federal Threatened**

- Northern Monkshood, *Aconitum noveboracense* (Portage County)
- Bald Eagle, *Haliaetus leucocephalus* (Portage and Trumbull Counties)

**Federal Candidate Species**

- Eastern Massasauga, *Sistrurus catenatus catenatus* (Portage and Trumbull Counties)

**State Endangered**

- Bald Eagle, *Haliaetus leucocephalus* (Portage County)
- Northern Monkshood, *Aconitum noveboracense* (Nearby)
- Indiana Bat, *Myotis sodalis* (RVAAP is within historic range)
- Mountain Brook Lamprey, *Ichthyomyzon greeleyi* (within 1 mile)

**State Threatened**

- Upland Sandpiper, *Bartamia longicauda* (Nearby/Nest)

**State Potentially Threatened**

- Richardson's Pondweed, *Potamogeton richardisonii* (Nearby)
- Flat-Stem Pondweed, *Potamogeton zosteriformis* (Nearby)

**State Species of Concern (ODOW)**

- Iowa Darter, *Etheostoma exile* (1991, Nearby)

**Rare Plant Communities**

- Floodplain Forest (within 1 mile, Windham Quad.)

### 5.2.3 Cultural Setting

*5.2.3.1 Beneficial Resources*

As stated previously, RVAAP encompasses various vegetative site conditions ranging from open fields, wetlands, and forests. Actions at RVAAP, since its closure, have focused on returning the property to its original condition prior to when the land was farmed and the Installation was constructed, either by active methods or natural progression. This effort has allowed the facility to become the home to various species of plants and animals, including those which are state listed as threatened, endangered, or of concern. The forest which covers approximately 80 percent of the facility is used for some limited timbering. Also, hunting, including fishing and trapping, is permitted on the facility to help control population levels of resident wildlife and for proper land management. Hunting by the general public is permitted in designated areas on the Installation and is conducted under a controlled access program.

The Sharon Conglomerate bedrock was the primary source of potable groundwater at RVAAP during its operational phase. Most facility production wells were completed in this unit, although some wells were completed in the overlying Sharon Shale (RVAAP-11.A.1). Residential groundwater use occurs outside of the facility. Residential wells in the vicinity of the RVAAP are completed in both the unconsolidated unit and bedrock, with the Sharon Conglomerate acting as the major producing aquifer in the area (RVAAP-3.B.3).

Eight Phase I Archaeological Surveys have been completed by the RVAAP and the OHARNG at various locations throughout the facility since 1993. These eight surveys have identified 95 archaeological sites. One Phase II Investigation was completed on ten sites in 2006. None of the archaeological sites identified in these surveys meet the eligibility requirements for listing on the National Register of Historic Places (NRHP). To date, the total acreage surveyed on the facility is approximately 6,830 acres. Only one historic property eligible for listing on the NRHP exists on the facility, the Stone Arch Bridge. It is not known if the MRSs identified in this document have been surveyed for cultural resources. Further information regarding the completed surveys and archaeological sites is located and can be obtained at the RTLS-Environmental Office.

#### *5.2.3.2 Demographics*

RVAAP is in northeastern Ohio within Portage and Trumbull counties. The US Census Bureau population estimates for 2004 indicate that the population of Portage County is 154,764, and 220,486 for Trumbull County. Population centers closest to RVAAP are Ravenna, with an estimated population of 11,503, and Newton Falls, with an estimated population of 4,865 (RVAAP-12.A.1). The RVAAP facility is located in a rural area and is not close to any major industrial or developed areas. Approximately 55 percent of Portage County, in which the majority of RVAAP is located, consists of either woodland or farmland acreage. The Michael J. Kirwan Reservoir (also known as West Branch Reservoir) is the closest major recreational area and is located adjacent to the western half of RVAAP, south of State Route 5 (RVAAP-3.C.4).

#### *5.2.3.3 Land Use Activities*

During the operational history, industrial operations at RVAAP consisted of 12 load lines. Load Lines 1 through 4 were used to melt and load TNT and Composition B into large caliber shells and bombs, while Load Lines 5 through 11 were used to manufacture fuzes, primers, and boosters. Load Line 12 was originally used to produce ammonium nitrate for explosives and fertilizers, and was later used as a weapons demilitarization facility (i.e., TNT recovery facility).

Along with the production activities, the facility also operated several landfills and OB/OD areas which received a variety of explosives wastes, ash, dunnage, and munitions. At some of the landfills, the explosive wastes were thermally treated. The OB/OD operations were conducted to desensitize and/or destroy waste materials ranging from raw explosives to explosives contaminated wastes (e.g., rags, cardboard, etc.). Prior to 1980, these items were typically burned directly on the ground surface. Thereafter, waste explosives and munitions were either burned in metal refractory-lined trays or a deactivation furnace located at the Winklepeck Burning Grounds.

As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP has been transferred to the NGB and subsequently licensed to the OHARNG for use as a military training site. This portion of the facility is identified as the RTLS. The current RVAAP consists of 1,280 acres that are scattered throughout the RTLS which consist mostly of IRP sites. Once this remaining acreage has been remediated, it will be transferred to the NGB for use by the OHARNG.

Current OHARNG training operations and assets within RTLS include: field operations and bivouac training, convoy training, equipment maintenance, storage of heavy equipment, rotary and fixed-wing aircraft training, tracked vehicle maneuver training, engineer training, MK-19 Range, Gunnery Table IV MILES Range, hand grenade qualification range, and field support and cantonment facilities. Thirteen of the MRSs are collocated with IRP sites, while four of the remaining five (i.e., Block D Igloo, Water Works #4, Area Between Buildings 846 and 849, Field at the NE Corner of Intersection) are located on RTLS. The fifth MRS, Block D Igloo-TD, is located off the Installation to the northwest.

## 5.3 Ramsdell Quarry Landfill (RVAAP-001-R-01)

### 5.3.1 Human Exposure Profile

*5.3.1.1 Current Land Use*

The MRS consists of two distinct areas: an undeveloped partially flooded quarry and an undeveloped open field. The MRS is fairly isolated in the central portion of the Installation and is surrounded by woodlands. Current site activities include maintenance of the grounds, stakes, and signs; long term monitoring of the groundwater; and landfill cap inspections. The property is scheduled to be transferred to the OHARNG in 2007. Land use controls for this facility established by the OHARNG will continue indefinitely, whereby the OHARNG will preserve restricted access and prohibit training at the MRS (RVAAP-1.A.2).

*5.3.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel, contract workers (including maintenance personnel charged with mowing), and regulatory personnel conducting periodic monitoring. Although site visits are limited, they are necessary to perform semi-annual sampling of the monitoring wells, to conduct security patrols, and to perform grounds keeping and maintenance tasks. The OHARNG does not use the area for training activities (RVAAP-1.A.2).

*5.3.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. However, the OHARNG has a "restricted access, no training," use restriction due to concerns over the presence of MEC and the requirement to preserve the integrity of the landfill cap (RVAAP-1.A.2).

*5.3.1.4 Beneficial Resources*

The former quarry is intermittently flooded and contains wetlands. Although rare, the quarry has been observed to be completely dry. The immediate surrounding area encompasses mature forest and open fields. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

### 5.3.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 4**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 4: Ramsdell Quarry Landfill Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Ramsdell Quarry Landfill | Isolated wetlands associated with surface water. | Disturbed. MRS excavated to recover unconsolidated glacial material. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.3.3 MEC and MC Release Profile

*5.3.3.1 Release Mechanisms*

For approximately four years, the MRS was used to thermally treat (i.e., open burn) explosives waste and munitions, as well as napalm bombs. MEC (e.g., 81mm mortar rounds) and munitions debris have been observed in this area. Although unlikely, MEC and munitions debris may be potentially present lying on the ground surface at the former quarry area. Analytical data from IRP investigations have confirmed the presence of explosives and metals. As such, the entire quarry area is considered to contain MC. Very little information exists concerning the presence or absence of MEC or MC at the undeveloped open field. Therefore, it is assumed that MEC could be potentially buried or lying on the ground surface in this area, and MC may be present.

The release mechanisms for MEC and MC are the intentional disposal/demilitarization of munitions and related items. MC at the undeveloped open field will require further evaluation under the SI process. **Table 5** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 5: Summary of Potential MEC and MC Present at the Ramsdell Quarry Landfill**

| Potential MEC | Potential MC | Primary Release Mechanism |
|---|---|---|
| Bombs | White phosphorus, smoke, photoflash | Open burn on ground surface; uncontained. |
| Mortars | White Phosphorus, Smoke, Illumination, HE, practice (inert) | Open burn on ground surface; uncontained. |
| Low Sensitivity Explosives | Ammonium Nitrate, Explosive D | Open burn on ground surface; uncontained. |
| Primary/Initiating Explosives | Lead azide diazodinitrophenol, mercury fulminate | Open burn on ground surface; uncontained. |
| Secondary Explosives | PETN, Composition B, Tetryl, TNT, RDX, HMX, Black Powder | Open burn on ground surface; uncontained. |

HMX - High Melting Explosive (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)

PETN - Pentaerythritol tetranitrate

RDX - Royal Demolition (or Research Department) explosive (hexahydro-1,3,5-trinitro-1,3,5-triazine) also known as Cyclonite

PETN - Pentaerythritol tetranitrate

Tetryl - N-methyl-N-2,4,6-tetranitroaniline

TNT – Trinitrotoluene

#### *5.3.3.2 Maximum Penetration Depth*

Munitions were burned on the ground surface at the MRS. Further, penetration is unlikely due to the thin cover of sediments that currently covers the bedrock. As such, MEC would not be expected in the subsurface soil within the former quarry area. Information concerning the types of operations conducted at the open field south of the quarry area was not found. As such, there is no supporting documentation to determine whether or not MEC was buried in this area. Without definitive information documenting that MEC is not buried within the open field, it has to be expected that MEC may be present in the subsurface soil.

#### *5.3.3.3 MEC Density*

An exact location of the open burn operation within the quarry has not been identified. Rather, it is likely that these activities were rotated throughout the entire area. Therefore, the entire MRS has the potential to contain MEC. Concerning the open field to the south, very little information is known about the operations conducted in this area or concerning the presence of MEC or its potential density.

#### *5.3.3.4 Munitions Debris*

Spent 81mm mortar rounds have been observed at the MRS. Evidence of recent discoveries (i.e., last 10 years) of munitions debris was not identified during this records search.

#### *5.3.3.5 MEC Exposure and Transport Pathway Analysis*

After cessation of the open burn activities, a portion (southern and western rim of the quarry) of the MRS was used as a solid waste landfill, which was subsequently closed and capped in accordance with Ohio solid waste regulations. It is likely that the waste cell and cap overlay any remaining MEC that was left on site. This portion of the site is not MMRP-eligible, since it is considered to be a "Response Complete". At the quarry area, only a surface exposure pathway for human and ecological receptors would be anticipated, although unlikely.

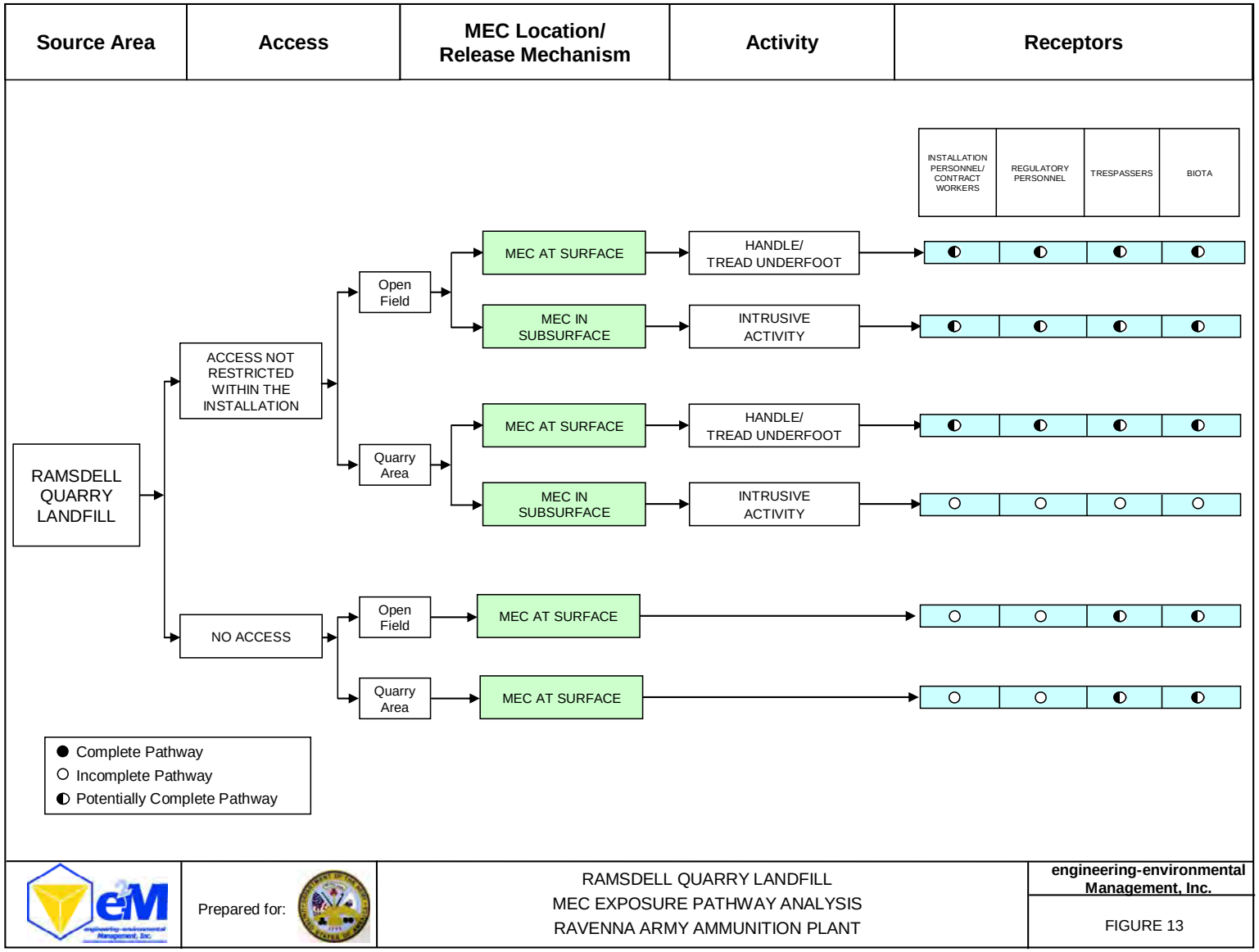
Since very little is known about the open field south of the quarry area, the primary exposure pathway for human and ecological receptors would be through handling or treading under foot or by disturbance of subsurface soil. **Figure 13** provides the pathways evaluated and the findings of the assessment.

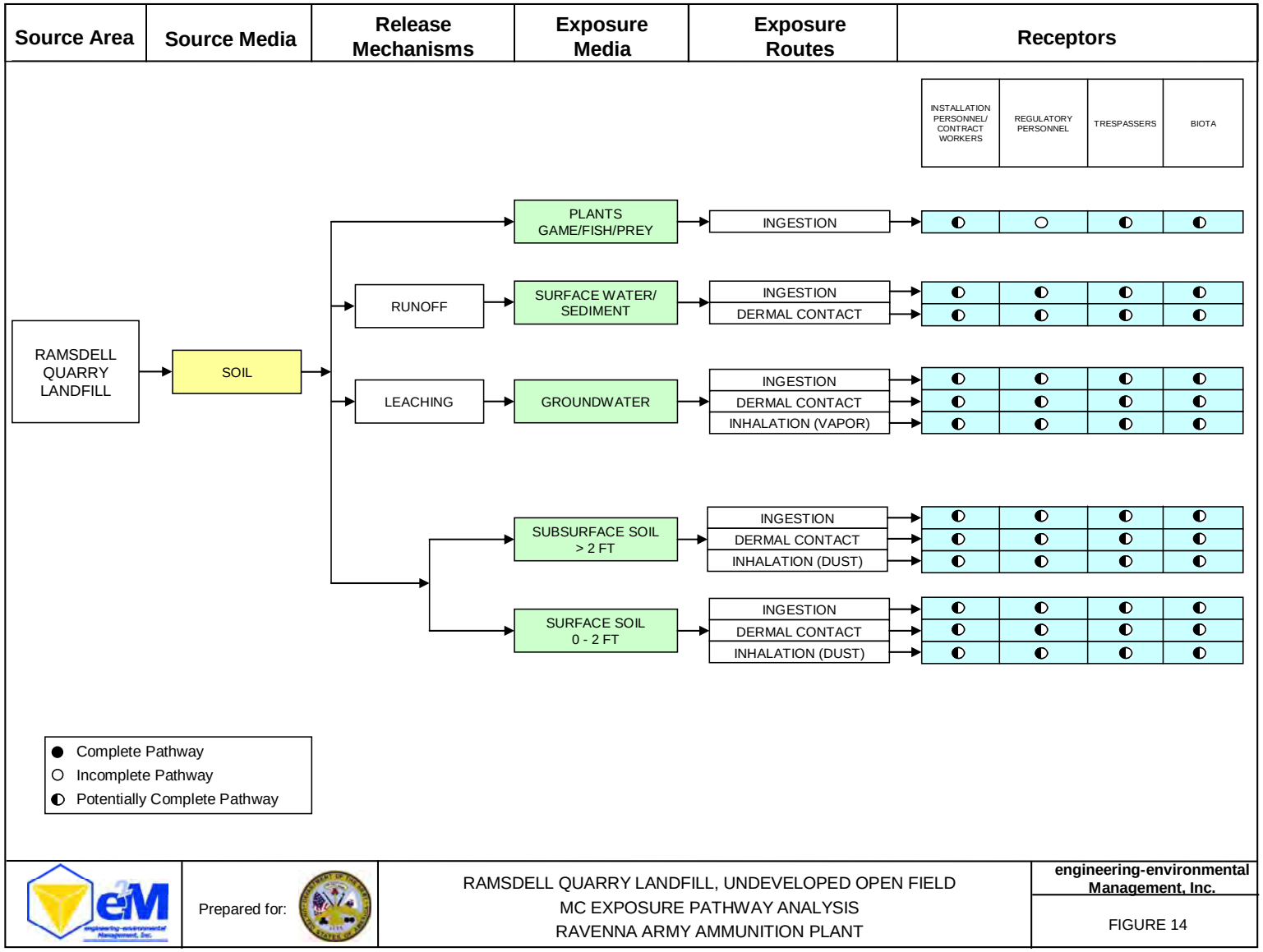
#### *5.3.3.6 MC Exposure and Transport Pathway Analysis*

The presence of MC at the former quarry areas has been established and will not require further evaluation under the SI process; however, no analytical data exists for the undeveloped open field. Therefore, additional characterization will be required at the undeveloped open field under the SI process. **Figure 14** provides the exposure pathways for the undeveloped open field south of the former quarry.

### 5.3.4 MRS Data Gaps

Adequate historic data determining the presence of MEC at the former quarry area exists; however, little information is known concerning the activities that were conducted in the open field south of the former quarry or whether or not MEC or munitions debris are present. The presence of MC in the former quarry has been confirmed; however, presence of MC at the area south of the quarry is not fully known and requires further investigation during this SI. MC contamination within the quarry area that is outside of the landfill will require further investigation under the MMRP.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
RAMSDELL QUARRY LANDFILL
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
Open Field
Quarry Area
MEC AT SURFACE
MEC IN SUBSURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
RAMSDELL QUARRY LANDFILL
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 13


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
RAMSDELL QUARRY LANDFILL
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
RAMSDELL QUARRY LANDFILL, UNDEVELOPED OPEN FIELD
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 14

## 5.4 Erie Burning Grounds (RVAAP-002-R-01)

### 5.4.1 Human Exposure Profile

*5.4.1.1 Current Land Use*

The former burning grounds is composed of forests, shrub lands, grasslands, wetlands, open water, and unpaved roads. Current site activities include surveying, environmental media sampling, security, safety, natural resources management, and other directed maintenance activities as required. Land use restrictions established by the OHARNG are currently in place at the MRS, which prohibits general training activities by the OHARNG (RVAAP-1.A.2). The site is also permitted for waterfowl hunting and trapping.

*5.4.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel, contract workers (including maintenance personnel), and hunters/trappers. Although site visits are limited, they are necessary to conduct intermittent security patrols and to perform grounds keeping and maintenance tasks. The OHARNG does not use the area for training activities (RVAAP-1.A.2).

*5.4.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. However, the OHARNG has a "restricted access, digging prohibited," use restriction due to concerns over the presence of MEC (RVAAP-1.A.2).

*5.4.1.4 Beneficial Resources*

The former burning ground is predominantly flooded and contains wetlands. The immediate surrounding area encompasses mature forest. Specific details of the beneficial resources present at the Installation are provided in **Section 5.2.3**.

### 5.4.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 6.** Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 6: Erie Burning Grounds Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Erie Burning Grounds | Wetlands associated with surface water. | Minimally disturbed. MRS transformed into pond and wetlands. | No federal threatened or endangered species |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.4.3 MEC and MC Release Profile

*5.4.3.1 Release Mechanisms*

For approximately ten years the MRS was used to thermally treat (i.e., open burn) bulk, obsolete, non-specification explosives, as well as propellants, rags, and Army railcars used for transporting explosives. Prior to its acquisition by the Army in 1940, the area may have been used for brick manufacturing. Aerial photos of the site from the 1940s and 1950s depict open boxcars staged at the end of the rail spur, known as Track 49. Presumably, materials were tipped out of the cars on either side of the embankment to be burned. Ash residue was left on site after the burn. Engineering drawings from 1941 also identify two additional burning areas: the first is located 200 ft to the north that was fed by a chute, and the second (known as the "T-Area") located to the south of the rail spur. MEC has been observed on site and analytical data from IRP investigations have confirmed the presence of explosives and metals in the soil, surface water, and dry sediment. As such, the entire MRS (approximately 33.93 acres) is considered to contain MEC and MC.

The release mechanisms for MEC and MC are the intentional disposal of explosives and related items. MC in soils and dry sediments (only) will be addressed under the IRP and will not be evaluated further under the MMRP SI process; however, a decision concerning MC in wet sediments, surface water, or ground water has not been made. As such, MC will be further investigated under the MMRP. **Table 7** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 7: Summary of Potential MEC and MC Present at the Erie Burning Grounds**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Low Sensitivity Explosives | Ammonium Nitrate, Explosive D | Open burn on ground surface; uncontained. |
| Primary/Initiating Explosives | Lead azide diazodinitrophenol, mercury fulminate, | Open burn on ground surface; uncontained. |
| Secondary Explosives | PETN, Composition B, Tetryl, TNT, RDX, HMX, Black Powder | Open burn on ground surface; uncontained. |

HMX - High Melting Explosive (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)

PETN - Pentaerythritol tetranitrate

RDX - Royal Demolition (or Research Department) explosive (hexahydro-1,3,5-trinitro-1,3,5-triazine) also known as Cyclonite

PETN - Pentaerythritol tetranitrate

Tetryl - N-methyl-N-2,4,6-tetranitroaniline

TNT – Trinitrotoluene

#### *5.4.3.2 Maximum Penetration Depth*

Munitions were burned on the ground surface at the MRS. As such, MEC and MC would not be expected to be in the subsurface soil. However, a large portion of the MRS is submerged limiting surface contact. While the penetration of MEC items are anticipated to be static (i.e., horizontally), MC have been detected in the groundwater suggesting their mobility. In addition, MC has been documented in surface and subsurface soil, surface water, and sediment (RVAAP-3.F.4).

#### *5.4.3.3 MEC/MC Density*

The density of MEC is unknown. A UXO avoidance sweep was performed in conjunction with the Phase II RI field work and although anomalies were identified, MEC items were not discovered (RVAAP-3.F.6). Burning operations were conducted along the Track 49 rail spur, the burn area situated at the terminus and to the north of the spur, and at the "T-Area". Therefore, MC is anticipated to be located throughout these areas (RVAAP-3.F.5).

#### *5.4.3.4 Munitions Debris*

The presence of munitions debris is unknown. Although photographic evidence presented in the ASR documented the presence of MEC, MEC items or munitions debris were not discovered during the Phase II RI field work (RVAAP-4.A.2).

#### *5.4.3.5 MEC Exposure and Transport Pathway Analysis*

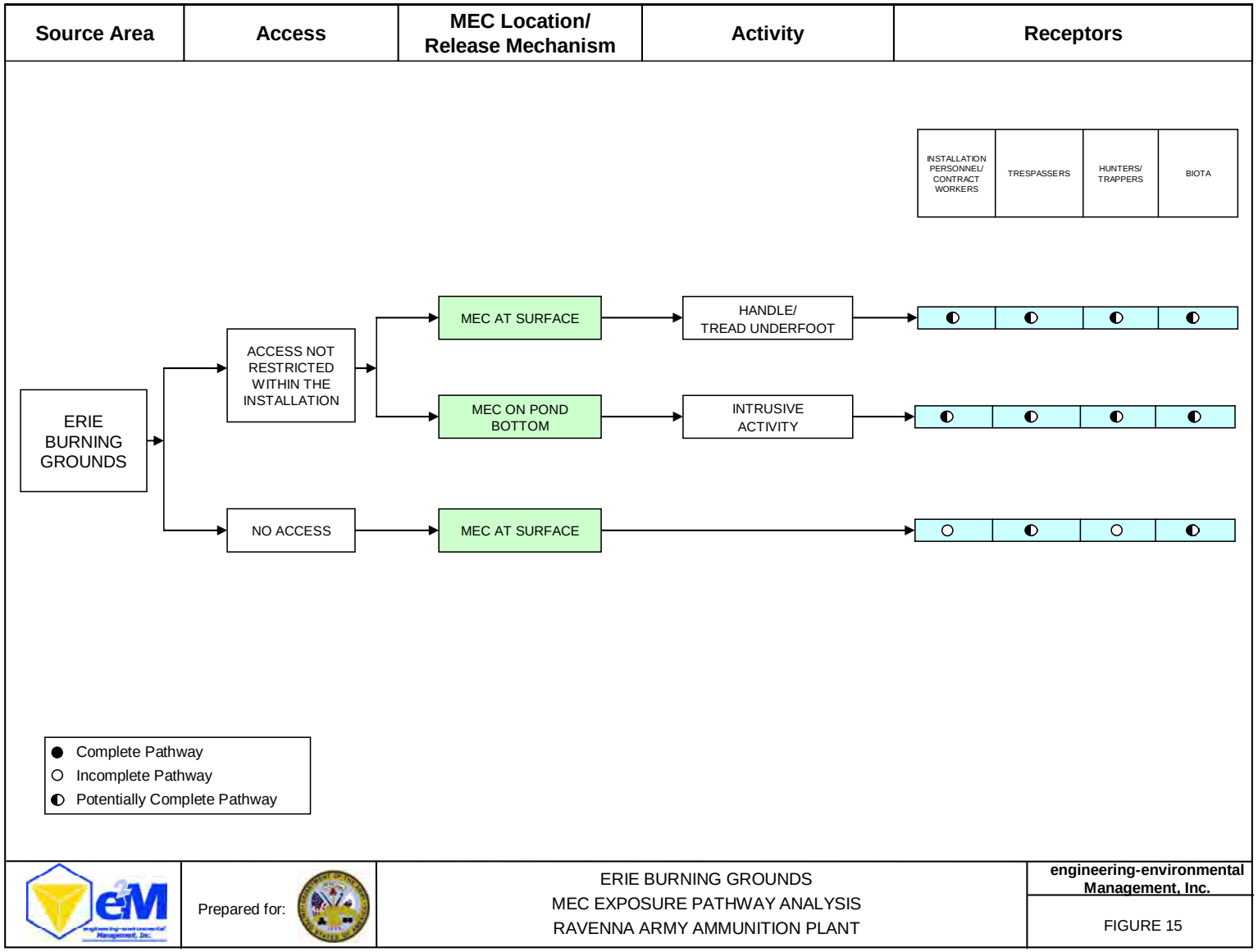
In the early 1990s, the majority of the MRS became flooded due to a combination of sedimentation, vegetative growth, and beaver damming, leaving only the railroad embankment and a portion of the T-Area exposed. Within these areas, the primary exposure pathway for human and ecological receptors would be contact with MEC lying on the ground surface. Periodically, the open water body north of the rail spur has drained on its own. During these episodes, contact with submerged MEC items could be possible. Since any MEC that is likely to be on site is submerged (i.e., no visual observations reported), transport and migration are not likely, unless disturbed. **Figure 15** provides the pathways evaluated and the findings of the assessment.

#### *5.4.3.6 MC Exposure and Transport Pathway Analysis*

The presence of explosives and metals in the surface and subsurface soil, surface water, and sediments has been established by investigations conducted under the IRP. Contact with MC is considered to be likely since there are no access restrictions at the MRS. Transport of MC via groundwater, surface water, and sediments is possible. **Figure 16** provides the pathways evaluated and the findings of the assessment.

### 5.4.4 MRS Data Gaps

Adequate historic data determining the presence and density of MEC items has not fully been determined and will require further evaluation during the SI process. MC in soils and dry sediments has been addressed under the IRP, with a likely decision (based on the risk assessment) of NFA. However, a decision concerning MC in wet sediments, surface water, or ground water has not been made. As such, MC will be further investigated under the MMRP.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
TRESPASSERS
HUNTERS/ TRAPPERS
BIOTA
ERIE BURNING GROUNDS
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC ON POND BOTTOM
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
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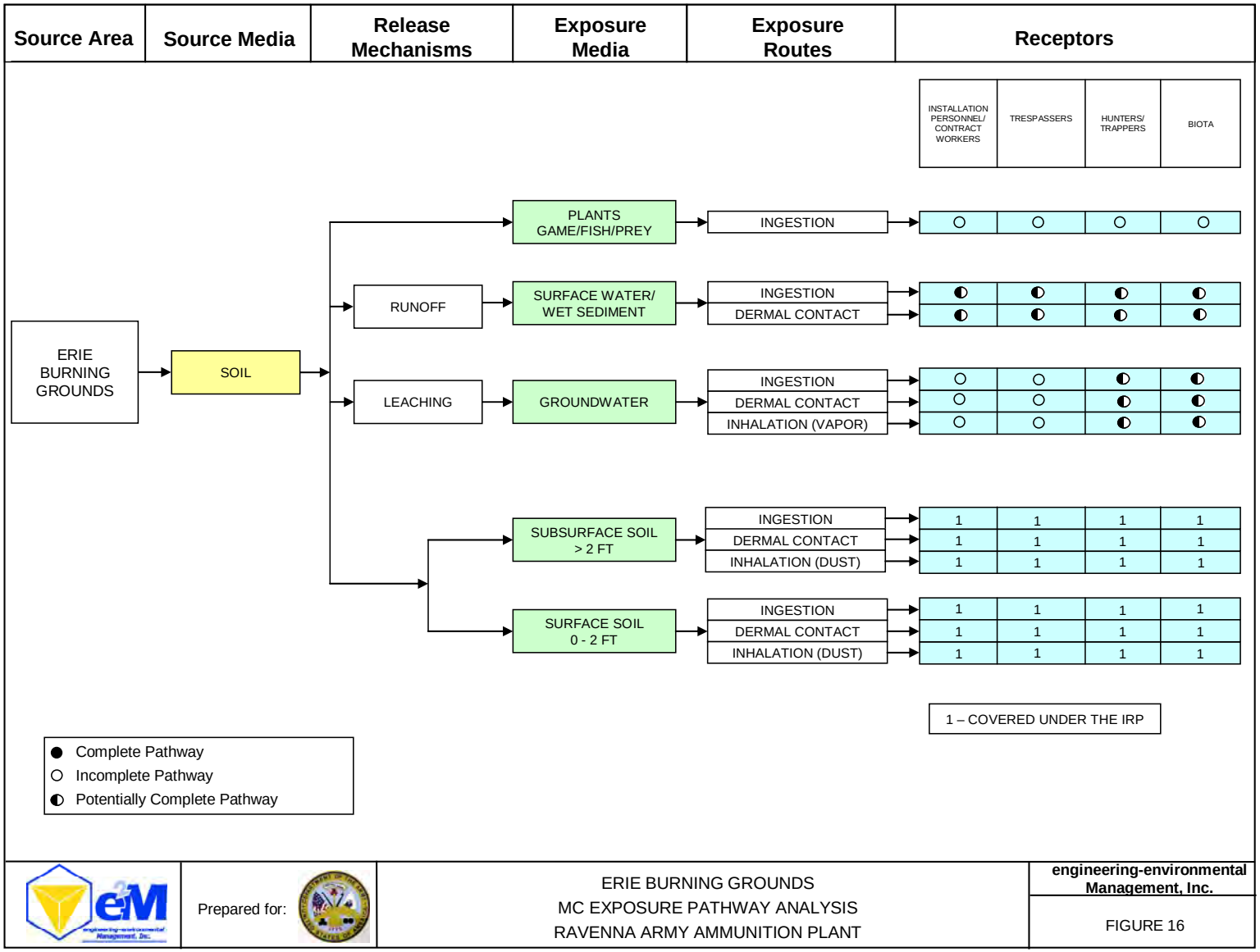
ERIE BURNING GROUNDS
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 15


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
TRESPASSERS
HUNTERS/ TRAPPERS
BIOTA
ERIE BURNING GROUNDS
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ WET SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
1 – COVERED UNDER THE IRP
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
ERIE BURNING GROUNDS
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 16

## 5.5 Demolition Area #2 (RVAAP-004-R-01)

### 5.5.1 Human Exposure Profile

*5.5.1.1 Current Land Use*

The former detonation area is remotely located and not developed. Current site activities include intermittent security patrols, maintenance (i.e., of the gate, stakes, and signs), environmental media sampling, surveying, and natural resource management. Land use restrictions established by the OHARNG are currently in place at the MRS for guard personnel (RVAAP-1.A.2). Visitors must be briefed on the inherent dangers located at the site before entrance is allowed.

*5.5.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel (e.g., security guards) and contract workers (e.g., maintenance and natural resource management personnel). Although site visits are limited, they are necessary to conduct security/inspection patrols, perform maintenance, and evaluate natural resources.

*5.5.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. However, the OHARNG has a "restricted access, digging prohibited," use restriction for guard personnel due to concerns over the presence of MEC (RVAAP-1.A.2).

*5.5.1.4 Beneficial Resources*

The former burning ground is comprised of grasslands, mature forest, wetlands, and open water (i.e., Sand Creek). Specific details of the beneficial resources present at the Installation are provided in **Section 5.2.3**.

### 5.5.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 8**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 8: Demolition Area #2 Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Demolition Area #2 | Wetlands associated with the Sand Creek flood plain. | Moderately disturbed. Detonation area cleared and pits excavated. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.5.3 MEC and MC Release Profile

*5.5.3.1 Release Mechanisms*

For approximately 43 years the MRS was used to dispose of large caliber munitions and bulk explosives, in addition to the burial of bombs and white phosphorus (Burial Areas 1 and 2). MEC has been observed on site, and in 1999 over 100,000 munitions items and munitions debris were removed from the RCRA unit (RVAAP-6.A.5). Munitions debris and possible MEC is present lying on the ground surface, partially buried, and in Sand Creek at the Rocket Ridge area. Installation personnel stated a bomb disposal area is located near the northwestern portion of the MRS; however, no corroborating evidence was located, thus this area will require further investigation during the SI. No other removal actions involving MEC have been conducted.

Analytical data from IRP investigations have confirmed the presence of explosives and metals in the surface and subsurface soil and groundwater in two distinct areas along Sand Creek (RVAAP-6.A.6). Excluding the RCRA unit (which is not MMRP-eligible), MEC should be anticipated across the remainder of the site. Analytical data collected during IRP investigations have identified MC in groundwater and soil, north of, and within, a portion of the Sand Creek floodplain.

The release mechanisms for MEC and MC are the intentional detonation and burial of munitions and bulk explosives. MC is partially being addressed under the IRP, but further characterization is anticipated under the SI. **Table 9** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 9: Summary of Potential MEC and MC Present at Demolition Area #2**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Blasting Caps and Fuzes | Lead azide diazodinitrophenol, mercury fulminate, silver azide | Open Detonation |
| Boosters | TNT, C4, Composition A, B, or C, RDX, PETN | Open Detonation |
| Bursters | TNT, RDX,HMX, Explosive D | Open Detonation |
| Bombs (up to 500 lbs) | Smoke, white phosphorus, HE, incendiary, and practice (inert) | Open Detonation |
| Demolition Materials | TNT | Open Detonation |
| Large Caliber Rounds (37mm or greater) | Smoke, white phosphorus, HE, incendiary, and practice (inert) | Open Detonation |

HMX – High Melting Explosive (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)

PETN – Pentaerythritol tetranitrate

RDX – Royal Demolition (or Research Department) explosive (hexahydro-1,3,5-trinitro-1,3,5-triazine) also known as Cyclonite

TNT – Trinitrotoluene

(RVAAP-2.A.7)

#### *5.5.3.2 Maximum Penetration Depth*

At the detonation area, munitions were detonated in pits that were excavated with a backhoe to a maximum depth of four ft bgs. Based on the location and conditions at the Rocket Ridge area, munitions and munitions debris are only partially buried as a result of slumping soils and erosion. The depth of potentially buried MEC at the bomb disposal area located near the northwestern portion of the MRS is not known, but items have been observed lying on the ground surface and partially buried. Likewise, little is known about the depth that items were buried at the two burial sites, but it is anticipated not to exceed 15 ft, or the average digging depth of a backhoe.

#### *5.5.3.3 MEC/MC Density*

MEC and munitions debris have been removed from the RCRA unit. However, the density of MEC at the remaining part of the detonation area is not fully known. Records indicate that after detonation of munitions, the area was policed to remove any munitions debris then backfilled, mulched, and seeded. New pits were subsequently dug for each detonation activity (RVAAP-2.A.6); therefore, increasing the area of operations. As such, it is expected that MEC is located throughout the former detonation area. At the two burial sites and Rocket Ridge area, MEC is expected throughout.

*5.5.3.4 Munitions Debris*

Due to possible kick-out, munitions debris is expected to be present across the entire MRS, including Rocket Ridge. Fragments of exploded or unexploded ordnance items forcefully propelled away from the detonation pits during detonation activities can be found several thousand ft away from the detonation site. Default distances for fragment protection range from 1,250 ft for non-fragmenting explosives materials to 4,000 ft for munitions 5-inch caliber or larger (RVAAP-6.A.7).

*5.5.3.5 MEC Exposure and Transport Pathway Analysis*

The presence of MEC is expected in the subsurface soil and lying on the ground surface. Human and ecological exposure pathways include contact with MEC during disturbance of subsurface soil and contact with MEC lying on the ground surface. Since MEC is expected to be buried, transport and migration are not likely, unless disturbed. MEC lying on the ground surface can be transported by surface water flow (i.e., via Sand Creek, especially during flood events) and by biota (animals). **Figure 17** provides the pathways evaluated and the findings of the assessment.

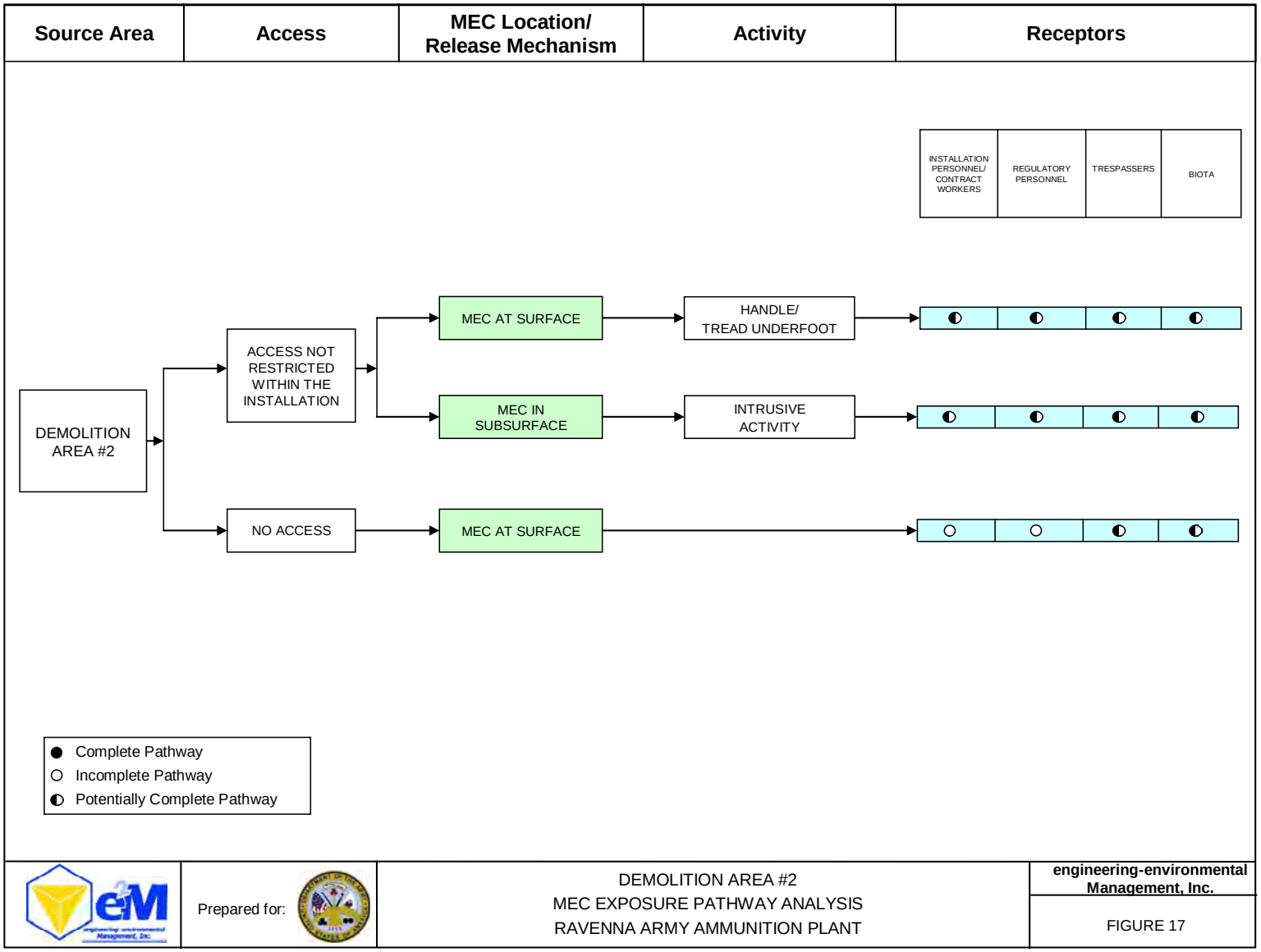
*5.5.3.6 MC Exposure and Transport Pathway Analysis*

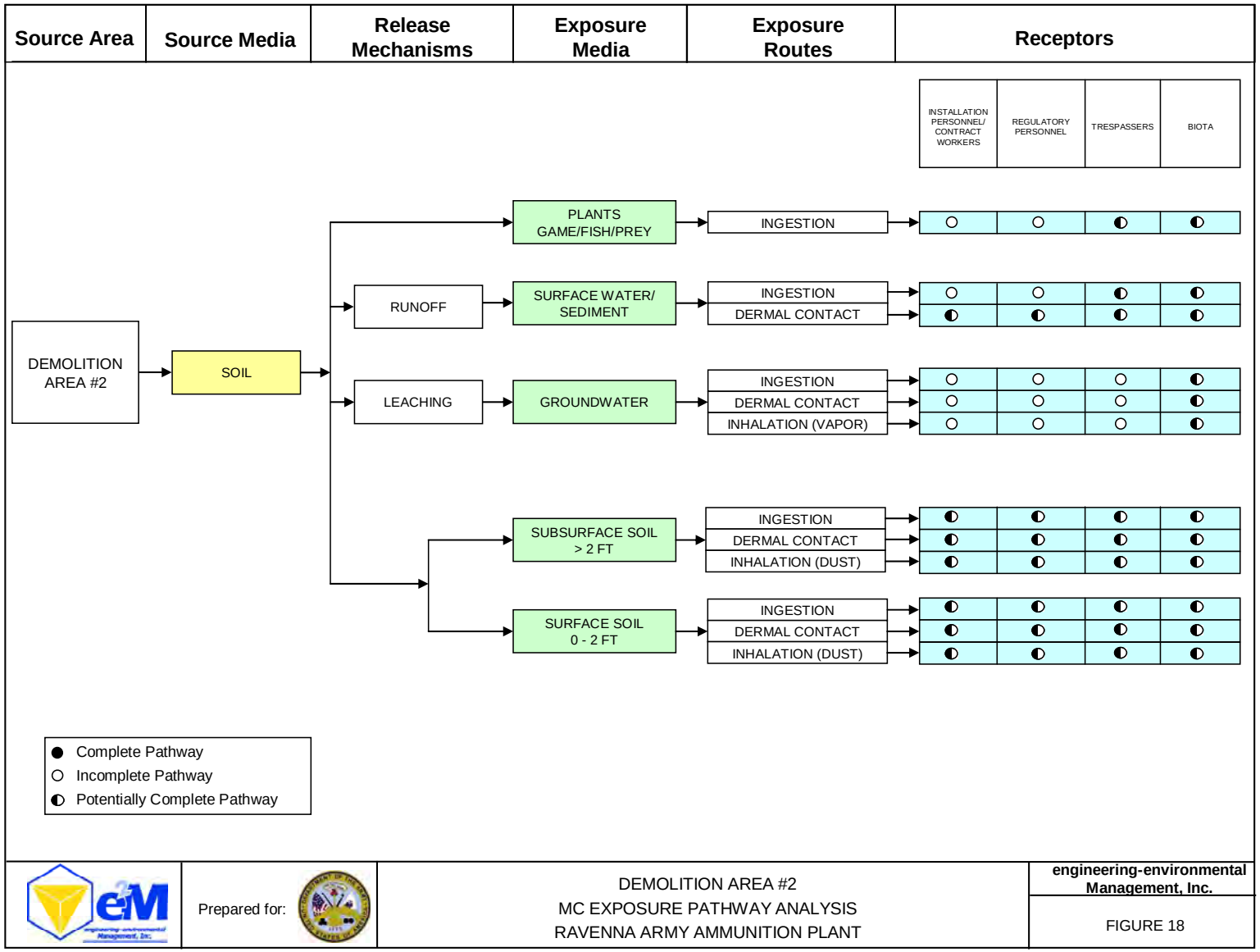
The presence of explosives and metals (MC) in groundwater, surface soil, and subsurface soil has been established and will partially be addressed under the IRP. Further characterization of the nature of MC will be required under the MMRP SI process. There are no formal land use restrictions that have been ratified under CERCLA, and access to the site is only partially limited by a locked gate. Therefore, potential contact with MC contaminated surface and subsurface soils is considered possible. Transport of MC via groundwater, surface water, and sediments is possible. **Figure 18** provides the pathways evaluated and the findings of the assessment.

### 5.5.4 MRS Data Gaps

The extent and density of MEC items has not fully been determined. MEC is expected to be present at the former detonation area, burial sites, northwestern disposal area, and Rocket Ridge.

The nature and extent of MC contamination at the MRS has not fully been determined.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
DEMOLITION AREA #2
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
DEMOLITION AREA #2
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 17


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
DEMOLITION AREA #2
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
DEMOLITION AREA #2
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 18

## 5.6 Load Line #1 (RVAAP-008-R-01)

### 5.6.1 Human Exposure Profile

*5.6.1.1 Current Land Use*

All buildings associated with the former load line have been demolished, with only the subsurface infrastructure (e.g., sewers and utilities), foundations, and walkways remaining. The MRS is fenced, but has a missing section located behind the guard building. Current site activities are limited to security patrols and maintenance activities (i.e., grounds and wildlife management).

*5.6.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel, contract workers (including maintenance personnel), and trespassers. Although site visits are limited, they are necessary to conduct security patrols and to perform grounds keeping and maintenance tasks. The OHARNG does not use the area for training activities (RVAAP-1.A.2).

*5.6.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. This area is restricted because remediation has not been completed. Access to the MRS is gained through a locked gate or by trespass through the missing section of fence.

*5.6.1.4 Beneficial Resources*

The former load line is comprised of open grassland and is surrounded by mature forest. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

### 5.6.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 10**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 10: Load Line #1 Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Load Line #1 | Wetlands associated with open water. | Disturbed. Buildings removed. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.6.3 MEC and MC Release Profile

*5.6.3.1 Release Mechanisms*

Loading operations were conducted at the MRS for 30 years, which involved the melting and loading of TNT and Composition B explosives into large-caliber shells. These operations produced explosive dust, spills, and vapors that collected on the floors and walls of the buildings. Periodic cleaning of the buildings resulted in the occasional sweeping of loose explosive flakes, chips, dust or pink water (i.e., explosive laden wash water) out of doorways onto the ground. Further, several buildings in the load line were used for a brief period (i.e., several years) to refurbish mines which involved the dismantling, replacing of components, and repainting of the munitions. Additionally, one area was used to demilitarize primers which may have lead to propellant contamination (RVAAP-6.G.2).

MEC (152mm projectile) and triple base propellants have been observed at the MRS (RVAAP-1.A.2). In addition, analytical data from IRP investigations have confirmed the presence of explosives and metals in surface and subsurface soil, groundwater, surface water, and sediments (RVAAP-3.G.6).

The release mechanism for MC was the deliberate sweeping of explosives residue out doorways during cleaning operations. The release mechanism for MEC items is not fully understood, but is assumed to be the staging of munitions during production and/or rehabilitation activities. The investigation of MC will continue to be conducted under the IRP and will not be addressed further during the MMRP SI process. **Table 11** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 11: Summary of Potential MEC and MC Present at the Load Line #1 MRS**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Large Caliber Projectiles | TNT and Composition B. | Discharge to ground surface; uncontained. |
| Mines | HE and practice (inert). | Discharge to ground surface; uncontained. |
| Fuzes and Boosters | Lead azide diazodinitrophenol, mercury fulminate, silver azide | Discharge to ground surface; uncontained. |
| Primary/Initiating Explosives | Lead azide diazodinitrophenol, mercury fulminate, silver azide | Discharge to ground surface; uncontained. |
| Secondary Explosives | PETN, Composition B, Tetryl, TNT, RDX, HMX, Black Powder | Discharge to ground surface; uncontained. |

HMX - High Melting Explosive (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)

PETN - Pentaerythritol tetranitrate

RDX - Royal Demolition (or Research Department) explosive (hexahydro-1,3,5-trinitro-1,3,5-triazine) also known as Cyclonite

Tetryl - N-methyl-N-2,4,6-tetranitroaniline

TNT – Trinitrotoluene

(RVAAP-2.A.14)

#### *5.6.3.2 Maximum Penetration Depth*

Munitions and MC were deliberately released to the ground surface at the former load line buildings (CB-13, CB-13B, CB-14). While there was no information discovered during the HRR review to indicate that MEC had been buried at the MRS, the possibility that MEC may be present in the subsurface soils can not be totally dismissed. As such, MEC would be expected to be lying on the ground surface and possibly buried. The depth of burial, however, can not be established.

#### *5.6.3.3 MEC/MC Density*

Based on information provided by the Installation the triple base propellants were discovered within the vicinity of Buildings CB-13, CB-13B, and CB-14, while the 152mm projectile was found in what is believed to have been Building CB-801.

#### *5.6.3.4 Munitions Debris*

There is one report of a 152mm casing having been found at the MRS. While an exact location could not be determined, it is known that Building CB-801 (located within the former boundary of the MRS) was used to store inert material, such as shell casings. Considering that only one isolated report of munitions debris exists for the MRS, the likely presence of munitions debris is considered minimal.

#### *5.6.3.5 MEC Exposure and Transport Pathway Analysis*

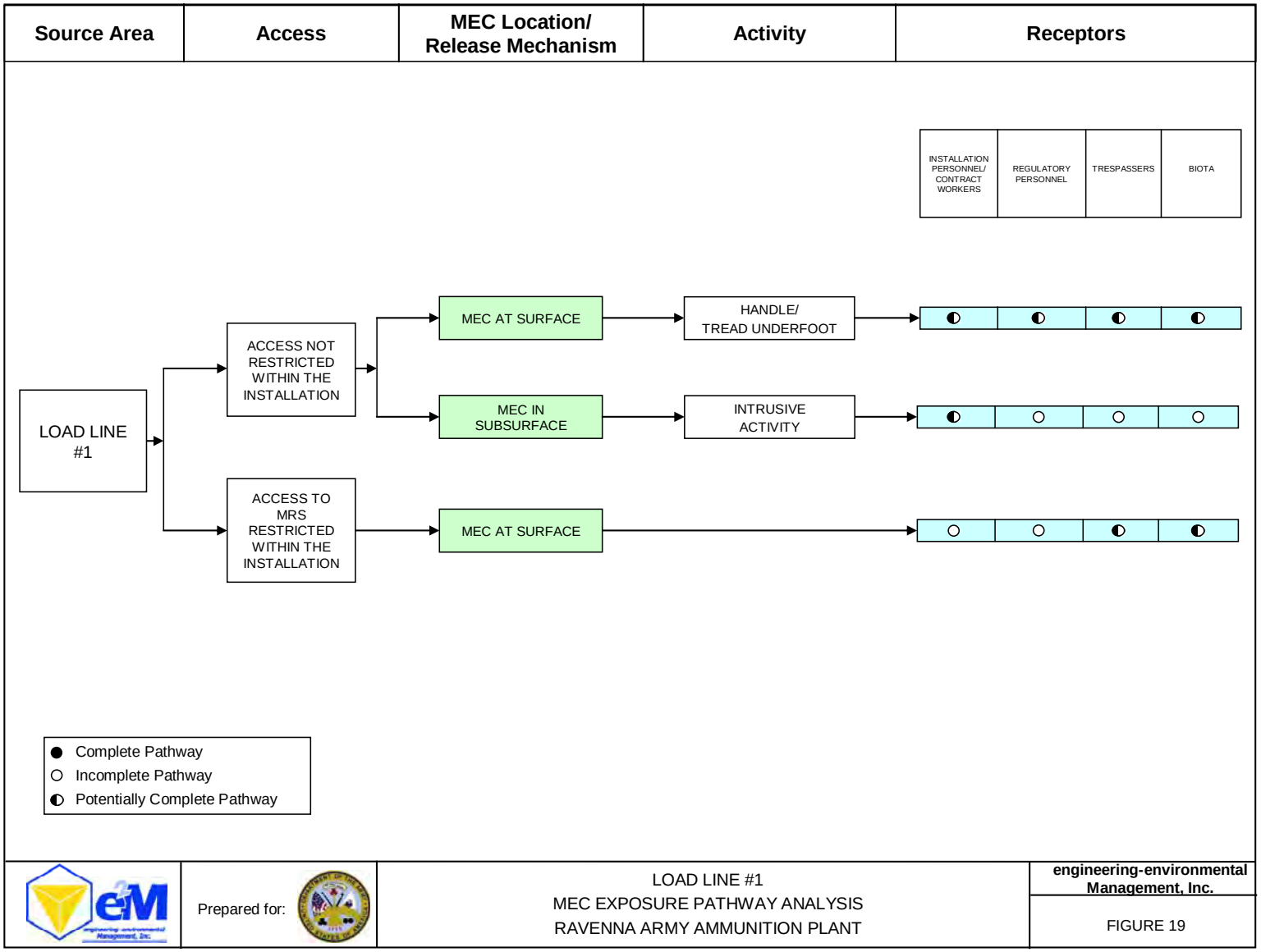
An isolated sighting of a 152mm projectile was made at the MRS (potentially near Building CB-801 located within the former boundary of the MRS). The item was removed and no other sightings have been reported. Triple base propellants are also known to exist at the MRS. While there are no reports that MEC or munitions debris had been buried or otherwise disposed of on site, the possibility that MEC may be buried can not be totally dismissed. Although unlikely, the primary exposure pathway for human and ecological receptors is to handle or tread under foot on MEC lying on the ground surface, or the disturbance of subsurface soil. **Figure 19** provides the pathways evaluated and the findings of the assessment.

#### *5.6.3.6 MC Exposure and Transport Pathway Analysis*

MC will be addressed under the IRP and not during this SI process. Regardless, the presence of explosives and metals in the groundwater, surface soil and subsurface soil, surface water, and sediments has been established by investigations conducted under the IRP. Contact is considered unlikely due to the remote/rural location of the MRS and restricted access to human receptors. Transport of MC via surface water or groundwater was demonstrated to be limited (RVAAP-3.G.6).

### 5.6.4 MRS Data Gaps

A UXO anomaly avoidance survey was conducted during the IRP environmental media field sampling efforts with no reported findings. Further, there have not been any additional sightings of MEC reported. There is some uncertainty about the nature and extent of triple base propellants that are present at the MRS.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
LOAD LINE #1
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
ACCESS TO MRS RESTRICTED WITHIN THE INSTALLATION
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
LOAD LINE #1
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 19

## 5.7 Load Line #12 (RVAAP-012-R-01)

### 5.7.1 Human Exposure Profile

*5.7.1.1 Current Land Use*

The former load line and associated structures have been removed, except for a small above grade slab at Building FF-19. Otherwise, the MRS is not developed and remains idle. Current site activities include maintenance of the grounds, fences, and signs; and the performance of security checks. For the most part, these activities are conducted infrequently. The property is scheduled to be transferred to the OHARNG after remediation of the IRP AOC is complete (RVAAP-3.J.6).

*5.7.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Typically, site visits are infrequent and of limited duration. Currently, the OHARNG does not use the area for training activities (RVAAP-3.J.6).

*5.7.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. Access is controlled by a perimeter fence and a locked gate (RVAAP-2.A.13).

*5.7.1.4 Beneficial Resources*

The MRS encompasses open grasslands and is surrounded by mature forest. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

### 5.7.2 Ecological Profile

The ecological profile at the Load Line #12 MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 12**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 12: Load Line #12 Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Load Line #12 | None. | Disturbed. Buildings removed. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.7.3 MEC and MC Release Profile

*5.7.3.1 Release Mechanisms*

Ammonium nitrate was first produced at the load line to make Amatol and later as a fertilizer-grade product. In 1944, operations were converted to demilitarize munitions, which involved the washout of projectiles after the fuzes and boosters had been removed. During the operational years, the washout water was allowed to flow from the buildings out onto the ground surface. Procedures for handling and disposal of the fuzes, boosters, and projectile casings were not determined. In 1999, approximately 100 90mm artillery projectiles were found buried just below the ground surface. It was determined that the projectiles did not contain HE. The circumstances of how the munitions came to be buried were not determined.

The release mechanism for MEC items is not fully understood, but is assumed to be the unauthorized dumping of munitions. The release mechanism for MC was the demilitarization of munitions and the deliberate sweeping and rinsing of explosives residue from the buildings through open doorways. MC will continue to be addressed under the IRP and will not be evaluated further during the MMRP SI process. **Table 13** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 13: Summary of Potential MEC and MC Present at Load Line #12**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Large Caliber Projectiles (37mm or greater) | TNT, inert | Discharge to ground surface; uncontained. |
| Low Sensitivity Explosives | Ammonium Nitrate, Explosive D | Discharge to ground surface; uncontained. |

TNT – Trinitrotoluene

(RVAAP-2.A.14)

*5.7.3.2 Maximum Penetration Depth*

There are no records to indicate that the disposal (i.e., burned or detonated) or testing of munitions were established practices at the former load line. Although MEC has been discovered buried just below the ground surface, a penetration depth can not be established. Reports of munitions being discovered lying on the ground surface were not found.

#### *5.7.3.3 MEC/MC Density*

The density of MEC at the MRS is not fully known. There is very little information to determine if the buried MEC found at the MRS was coincidental or a pervasive condition.

#### *5.7.3.4 Munitions Debris*

Other than the 90mm projectiles, there are no reports of munitions debris being discovered at the site.

#### *5.7.3.5 MEC Exposure and Transport Pathway Analysis*

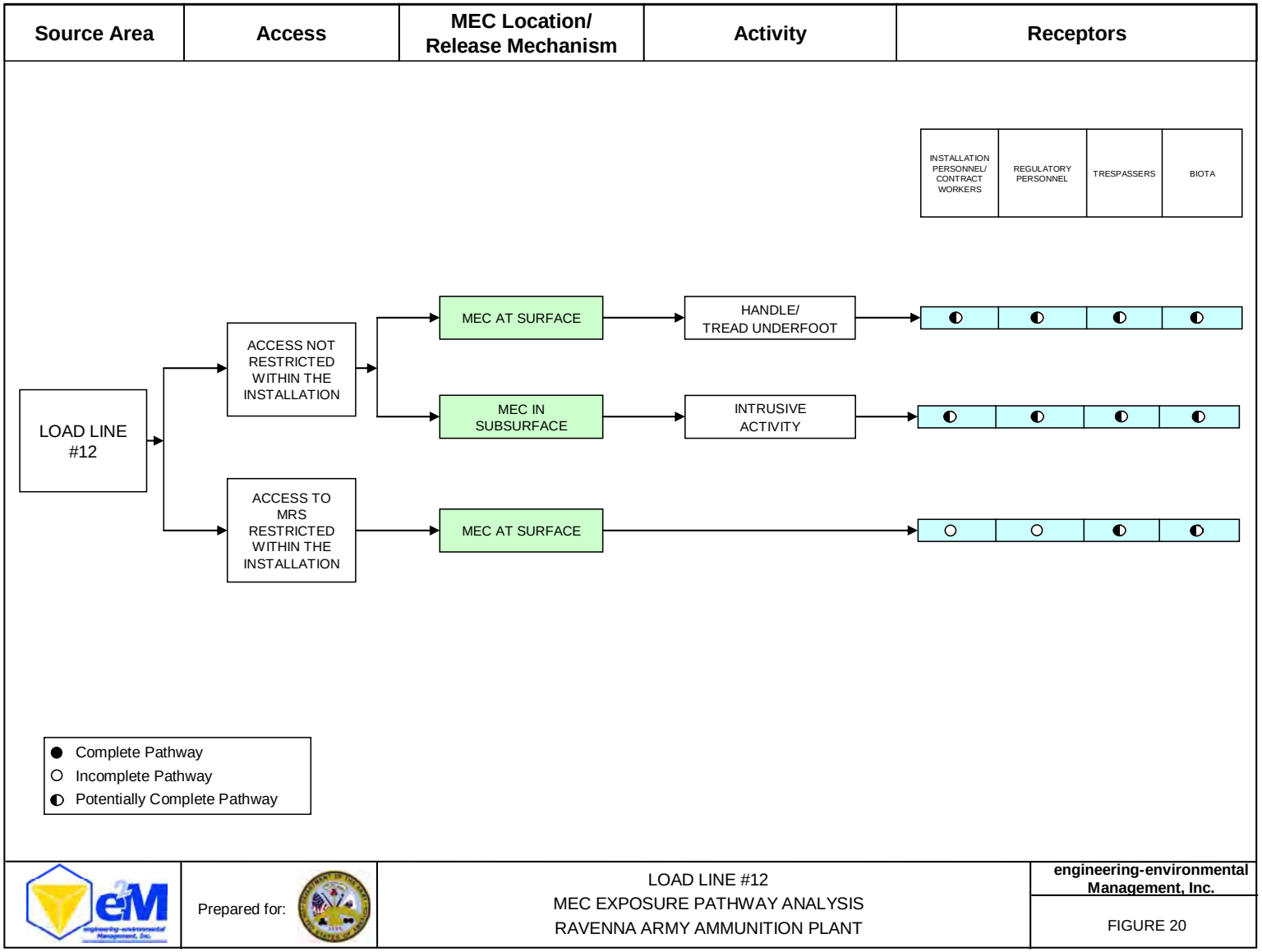
Since the 90mm artillery projectiles were discovered buried just below the ground surface, both surface and subsurface contact with MEC could be expected. Erosion or maintenance activities (e.g., mowing or grubbing) could expose shallow buried MEC, while construction (e.g., utility placement) or IRP investigative activities (e.g., drilling) could cause contact with buried MEC. As such, the primary exposure pathways for human and ecological receptors would include handle or tread underfoot, or the disturbance of subsurface soil. **Figure 20** provides the pathways evaluated and the findings of the assessment.

#### *5.7.3.6 MC Exposure and Transport Pathway Analysis*

MC is present in environmental medium at the MRS and will continue to be covered under the IRP. Further evaluation under the SI process will not be conducted.

### 5.7.4 MRS Data Gaps

There is inadequate historic data to determine whether or not MEC is pervasive at the site or if the discovery of the 90mm projectiles was an isolated incident.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
LOAD LINE #12
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
ACCESS TO MRS RESTRICTED WITHIN THE INSTALLATION
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
LOAD LINE #12
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 20

# 5.8 Fuze and Booster Quarry (RVAAP-016-R-01)

## 5.8.1 Human Exposure Profile

### *5.8.1.1 Current Land Use*

The Fuze and Booster Quarry is an undeveloped site that encompasses the three ponds constructed within the former quarry and mature forest. Access to the MRS is not restricted once on the Installation. Current site activities include intermittent security patrols, natural resource management, environmental media sampling, surveying, and maintenance activities (RVAAP-3.L.1). In addition, access is permitted to the ponds for waterfowl hunting and trapping (RVAAP-1.A.2).

### *5.8.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel, contract workers (including maintenance personnel), and the occasional hunter/trapper. Typically, visits to the MRS are infrequent and of limited duration.

### *5.8.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS or land use restrictions established by the Installation (RVAAP-3.A.13). The MRS is not fenced and access is not restricted.

### *5.8.1.4 Beneficial Resources*

The MRS is comprised of three ponds, associated wetlands, and mature forest. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

## 5.8.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 14**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 14: Fuze and Booster Quarry Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Fuze and Booster Quarry | Wetlands. | Minimally disturbed. Area originally excavated for building material. Area revegetated. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.8.3 MEC and MC Release Profile

*5.8.3.1 Release Mechanisms*

Among other things, the MRS was used as an open burning area and subsequently a landfill that accepted fuze and booster assemblies, projectiles, residual ash, and sanitary waste. Reportedly in 1976, existing debris was removed from the MRS and disposed of elsewhere (RVAAP-3.B.2). Further, according to interviews with plant personnel, any munitions produced at the plant could have been disposed at the MRS (RVAAP-2.A.9).

The release mechanisms for MEC items are the intentional open burning and disposal of munitions. The release mechanisms for MC are the burning of munitions and other items, and the deliberate disposal of ash and production waste water. The investigation of MC will continue to be conducted under the IRP and will not be addressed further during the MMRP SI process. **Table 15** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 15: Summary of Potential MEC and MC Present at the Fuze and Booster Quarry**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Aerial Rockets | Smoke, inert, white phosphorus, and HE. | Burned/Disposed on ground surface. |
| Blasting Caps, Fuzes, Boosters, or Bursters | Lead azide diazodinitrophenol, mercury fulminate, silver azide | Burned/Disposed on ground surface. |
| Bombs | Smoke, white phosphorus, incendiary, photoflash, HE, and inert. | Burned/Disposed on ground surface. |
| Bombs | Smoke, white phosphorus, incendiary, photoflash, HE, and inert. | Burned/Disposed on ground surface. |
| Flares, Signals, Simulators, Obscurant Smoke | Smokeless powder (nitrocellulose, nitroglycerin) | Burned/Disposed on ground surface. |
| Hand Grenades | Smoke, white phosphorus, incendiary, HE, inert. | Burned/Disposed on ground surface. |
| Land Mines, anti-personnel and anti-tank. | Practice (with spotting charge), HE | Burned/Disposed on ground surface. |
| Large Caliber Projectiles (37mm or greater) | Smoke, white phosphorus, incendiary, HE, practice. | Burned/Disposed on ground surface. |

**Table 15: Summary of Potential MEC and MC Present at the Fuze and Booster Quarry (continued)**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Medium Caliber Projectiles (20mm, 25mm, 30mm) | HE, inert. | Burned/Disposed on ground surface. |
| Mortars | Smoke, white phosphorus, incendiary, illumination, HE, inert. | Burned/Disposed on ground surface. |
| Primary or Initiating Explosives | Lead azide diazodinitrophenol, mercury fulminate, silver azide | Burned/Disposed on ground surface. |
| Secondary Explosives | PETN, Composition B, Tetryl, TNT, RDX, HMX, Black Powder. | Burned/Disposed on ground surface. |

HE – High Explosives

HMX – High Melting Explosive (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)

PETN – Pentaerythritol tetranitrate

RDX – Royal Demolition (or Research Department) explosive (hexahydro-1,3,5-trinitro-1,3,5-triazine) also known as Cyclonite

Tetryl – N-methyl-N-2,4,6-tetranitroaniline

TNT – Trinitrotoluene

(RVAAP-2.A.7)

#### *5.8.3.2 Maximum Penetration Depth*

Munitions and MC were deliberately released to the ground surface at the MRS. As such, MEC and MC would not be expected in the subsurface soil. MEC is visible on the banks at the southern pond, while MEC is only visible at the northern pond during periods of low water levels. No information was found regarding the presence of MEC in the middle pond.

#### *5.8.3.3 MEC/MC Density*

Records were not available to identify the quantity of munitions and other related items burned or disposed of at the MRS. The density of MEC within the ponds and along the banks is not known.

#### *5.8.3.4 Munitions Debris*

The Installation reported that munitions debris has been observed at the MRS. As such, the likelihood that munitions debris still exists at the MRS is high.

#### *5.8.3.5 MEC Exposure and Transport Pathway Analysis*

Any MEC remaining at the ponds would be located along the banks or below the water line. The depths of the ponds have been reported to be anywhere from 20 to 30 ft. Therefore, the exposure pathway for human receptors, especially at the southern pond, is considered to be potentially complete and

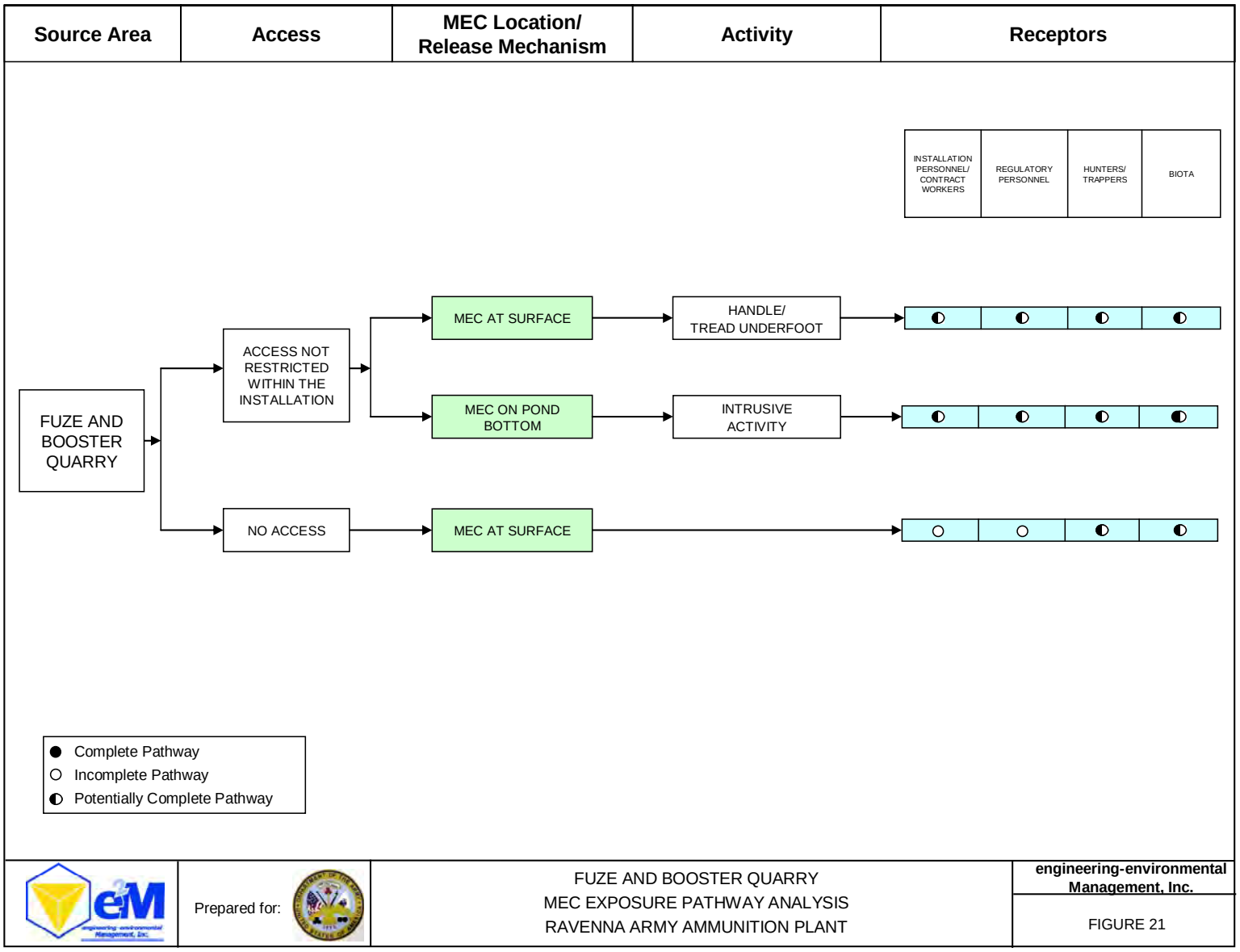
would include the handling or treading underfoot of MEC. There is a possible exposure pathway for ecological receptors (e.g., beaver) involving the handling of MEC. **Figure 21** provides the pathways evaluated and the findings of the assessment.

#### *5.8.3.6 MC Exposure and Transport Pathway Analysis*

MC will be addressed under the IRP and not during this SI process. Regardless, the presence of explosives and metals in the groundwater, surface soil and subsurface soil, surface water, and sediments has been established by an investigation conducted under the IRP (RVAAP-3.L.1).

### 5.8.4 MRS Data Gaps

Surveys for MEC or munitions debris have not been conducted at the Fuze and Booster Quarry MRS. MEC is suspected to be present within the northern and southern ponds, and along the banks of the southern pond. Very little information is known about the presence of MEC in the middle pond or concerning the type, condition, and extent of MEC located at the MRS. An assessment of MEC will be required at all three ponds during the SI phase.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
HUNTERS/ TRAPPERS
BIOTA
FUZE AND BOOSTER QUARRY
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC ON POND BOTTOM
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
FUZE AND BOOSTER QUARRY
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 21

# 5.9 Landfill North of Winklepeck (RVAAP-019-R-01)

## 5.9.1 Human Exposure Profile

### *5.9.1.1 Current Land Use*

The MRS is an undeveloped site that consists of a wooded slope situated between the IRP AOC landfill and the adjacent stream. Access to the MRS is not restricted once on the Installation. Current site activities include intermittent security patrols, natural resource management, surveying, environmental media sampling, and maintenance activities. Concerning the landfill AOC, this area will continue to be addressed under the IRP; that is, MC contamination within the known boundaries of the landfill and any MEC discovered incidental during its' continued investigation will be handled under the IRP.

### *5.9.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Typically, visits by personnel to the MRS are infrequent and of short duration.

### *5.9.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS or land use restrictions established by the Installation (RVAAP-3.A.13). The MRS is not fenced and access is not restricted. However, the area is fairly remote and can be difficult to find.

### *5.9.1.4 Beneficial Resources*

The MRS is located next to a perennial stream and wetlands. Mature forest surrounds the MRS. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

## 5.9.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 16**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 16: Landfill North of Winklepeck Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Landfill North of Winklepeck | Wetlands. | Disturbed. Area originally excavated for a landfill. Area recovering/revegetated. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.9.3 MEC and MC Release Profile

*5.9.3.1 Release Mechanisms*

MEC observed at the MRS is the possible result of deliberate side-casting of materials down the slope. This was the possible result of the disposal activities that were conducted at the adjacent IRP AOC landfill where general plant refuse, explosives residue, and open burn wastes from Winklepeck Burning Grounds were disposed (RVAAP-2.A.9). Therefore, the release mechanism for MEC items is the intentional disposal of munitions. The release mechanism for MC is the deliberate disposal of ash, explosive plant residues, and remnants of munitions filler not completely flashed during burning operations. While the investigation of MC at the IRP AOC landfill area will continue to be conducted under the IRP, soil samples will have to be collected to assess the presence of MC within the newly identified MRS boundary. **Table 17** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 17: Summary of Potential MEC and MC Present at the Landfill North of Winklepeck**

| Potential MEC | Potential MC | Primary Release Mechanism |
|---|---|---|
| Booster cups, Fuzes, Bursters, Blasting Caps | Lead azide diazodinitrophenol, mercury fulminate, silver azide | Burial |
| Flares, Signals, Simulators, or Obscurant Smoke | Smokeless powder (nitrocellulose, nitroglycerin) | Burial |

(RVAAP-2.A.14)

*5.9.3.2 Maximum Penetration Depth*

MEC has been observed lying on the ground surface at the MRS. Further, based on the lack of information to prove otherwise, the possibility that MEC may be buried at the MRS can not be dismissed. Further, it is likely that some items may be partially buried at the base of the slope due to slumping soils and erosion. There was no information discovered during the HRR that indicated the potential depth that MEC may be buried.

#### *5.9.3.3 MEC/MC Density*

Records describing the quantities of munitions, waste materials, and other related items disposed of at the MRS were not found. However, considering the volume of material thermally treated at Winklepeck Burning Grounds this quantity could be substantial. Therefore, the entire MRS has the potential to contain MEC and/or MC.

#### *5.9.3.4 Munitions Debris*

While there are no reports that distinguish between MEC and munitions debris discovered lying on the ground surface at the MRS, it is likely that munitions debris is present considering the source of the waste material (i.e., from burning operations).

#### *5.9.3.5 MEC Exposure and Transport Pathway Analysis*

Potential MEC is lying on the ground surface and is potentially buried at the MRS. Considering this, the potential exposure pathway for human and ecological receptors would be contact with MEC in surface soils by handling or treading underfoot or through disturbing subsurface soil. Transport of MEC would occur through erosion and surface water transport (i.e., especially during flood events). **Figure 22** provides the pathways evaluated and the findings of the assessment.

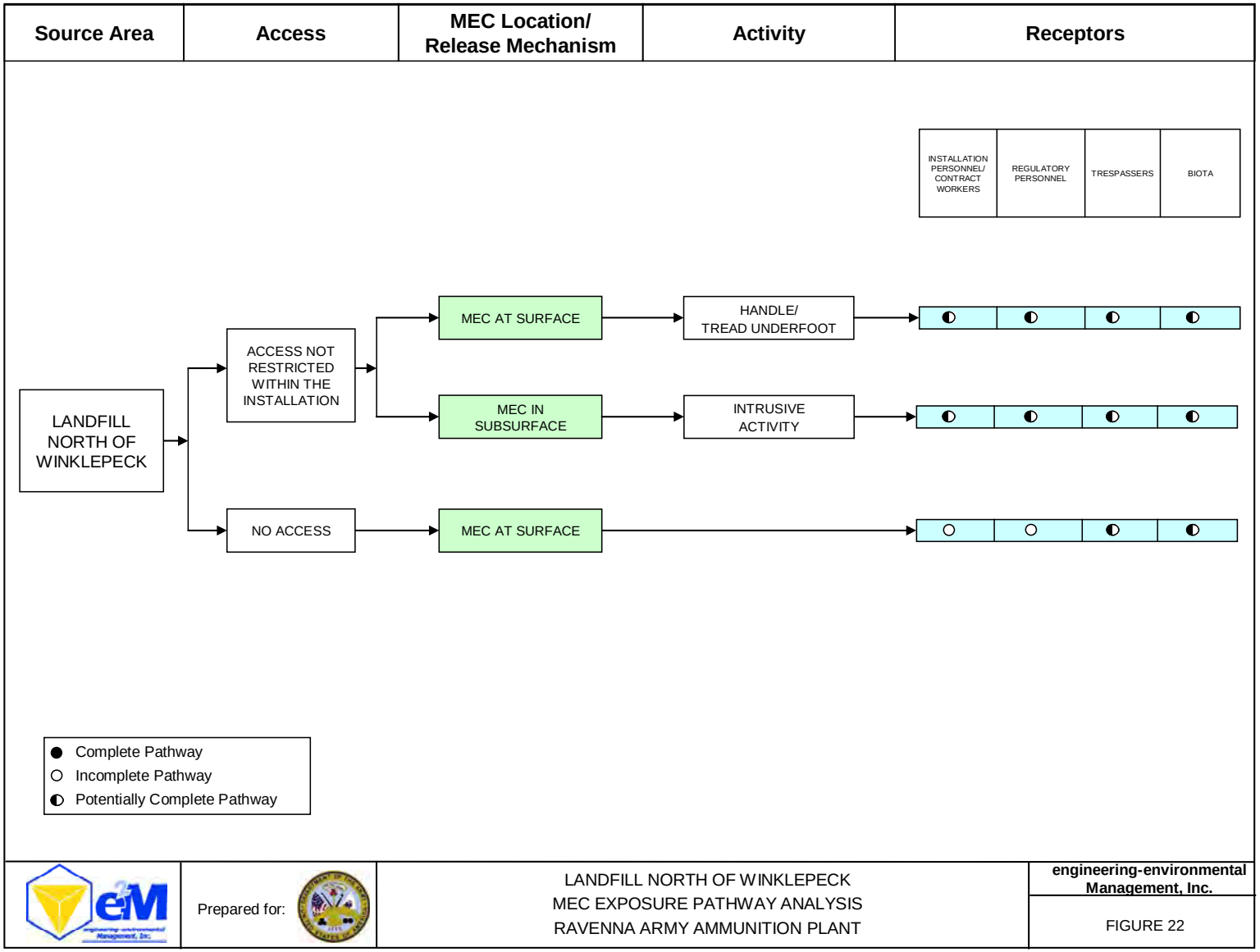
#### *5.9.3.6 MC Exposure and Transport Pathway Analysis*

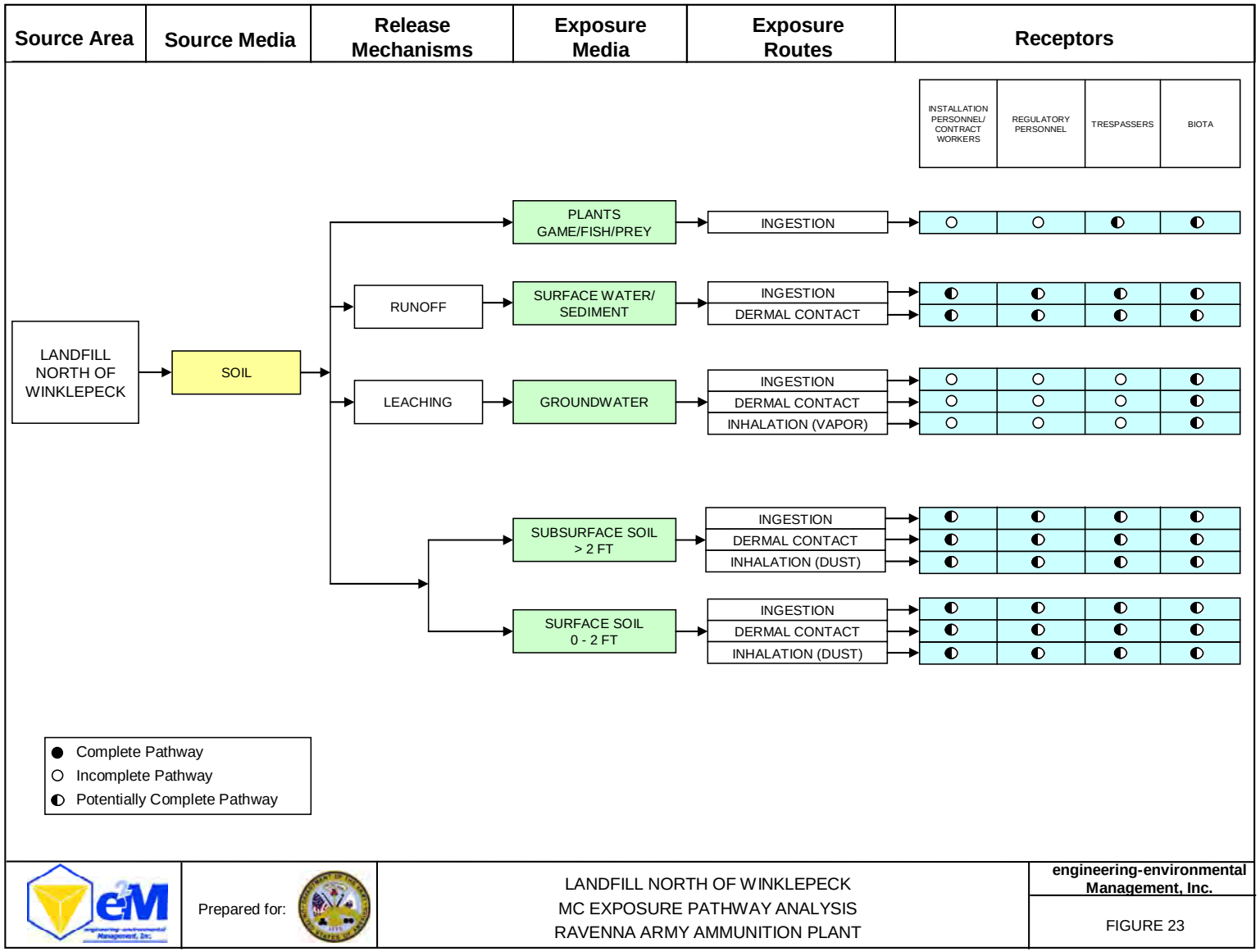
Investigations to determine the presence or nature of MC have not been conducted within the MRS. However, metals in groundwater, surface soil, and sediments have been detected at the adjacent IRP AOC landfill (RVAAP-3.K.5/6). It is anticipated that similar conditions may exist at the MRS. Therefore, potential exposure would include ingestion or dermal contact with contaminated soil, surface water, and/or sediment. Potential transport would occur via surface water, erosion of soils and sediment, and through a release to groundwater. **Figure 23** provides the pathways evaluated and the findings of the assessment.

### 5.9.4 MRS Data Gaps

Potential MEC and munitions debris exist at the MRS. The type, extent, and condition of the items are not known.

Characterization studies to assess MC in surface and subsurface soil, surface water and sediment, and groundwater have not been conducted at the newly identified MRS. The extent and nature of MC at the MRS, if present, is not known.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
LANDFILL NORTH OF WINKLEPECK
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
LANDFILL NORTH OF WINKLEPECK
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 22


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
LANDFILL NORTH OF WINKLEPECK
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
LANDFILL NORTH OF WINKLEPECK
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 23

# 5.10 40mm Firing Range (RVAAP-032-R-01)

## 5.10.1 Human Exposure Profile

*5.10.1.1 Current Land Use*

The MRS is an undeveloped site that consists of an open field that is surrounded by mature forest. Access to the MRS is not restricted once on the Installation. Current site activities include security patrols, natural resource management, environmental media sampling, surveying, and maintenance activities.

*5.10.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Typically, visits by personnel to the MRS are infrequent and of short duration.

*5.10.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS or land use restrictions established by the Installation (RVAAP-3.A.13). The only restriction is the Installation-wide perimeter fence. The MRS is not fenced and access is not restricted. However, the MRS is fairly remote and can be difficult to locate.

*5.10.1.4 Beneficial Resources*

The MRS encompasses an open field situated on a small rise that overlooks the Fuze and Booster Quarry. Mature forest surrounds the entire MRS. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

## 5.10.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 18**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

### Table 18: 40mm Firing Range Ecological Profile

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| 40mm Firing Range | None. | Minimally disturbed. Area revegetated. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.10.3 MEC and MC Release Profile

*5.10.3.1 Release Mechanisms*

The MRS was used to test fire 40mm grenade cartridges from a fixed firing point. The release mechanisms for MEC are the intentional firing of munitions and the unintentional discarding of munitions or rounds falling outside of the target area. The release mechanism for MC (specifically metals) is the decomposition of projectiles not removed from the site. The investigation of MC will continue to be conducted under the IRP and will not be addressed further during the MMRP SI process. **Table 19** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 19: Summary of Potential MEC and MC Present at the 40mm Firing Range**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| 40mm, HE, M406 | Composition B, M9 propellant | Intentional test firing. |
| 40mm, Practice, M407A1 (inert) | Inert (spotting charge consists of dye), M9 propellant, RDX pellets | Intentional test firing. |

(RVAAP-2.A.7)

*5.10.3.2 Maximum Penetration Depth*

Potential MEC is reportedly located at the MRS and includes 40mm grenades. Penetration of the rounds into the subsurface soil (i.e., greater than 1-foot bgs) is not expected. Based on maximum penetration depths provided in the document entitled "Penetration of Projectiles into Earth, An Analysis of UXO Clearance Depths at Ft. Ord", the maximum penetration depth for 40mm grenades (HE and inert rounds in clay soil) would not exceed 5-inches. As such, MEC would only be expected in the surface soil.

*5.10.3.3 MEC/MC Density*

Installation personnel have reported that potential MEC is present at the MRS. Quantities are not known, but the entire target area potentially contains MEC.

*5.10.3.4 Munitions Debris*

There were no reports that munitions debris had been discovered lying on the ground surface at the MRS. However, it is likely that munitions debris is present considering the activities conducted at the site.

#### *5.10.3.5 MEC Exposure and Transport Pathway Analysis*

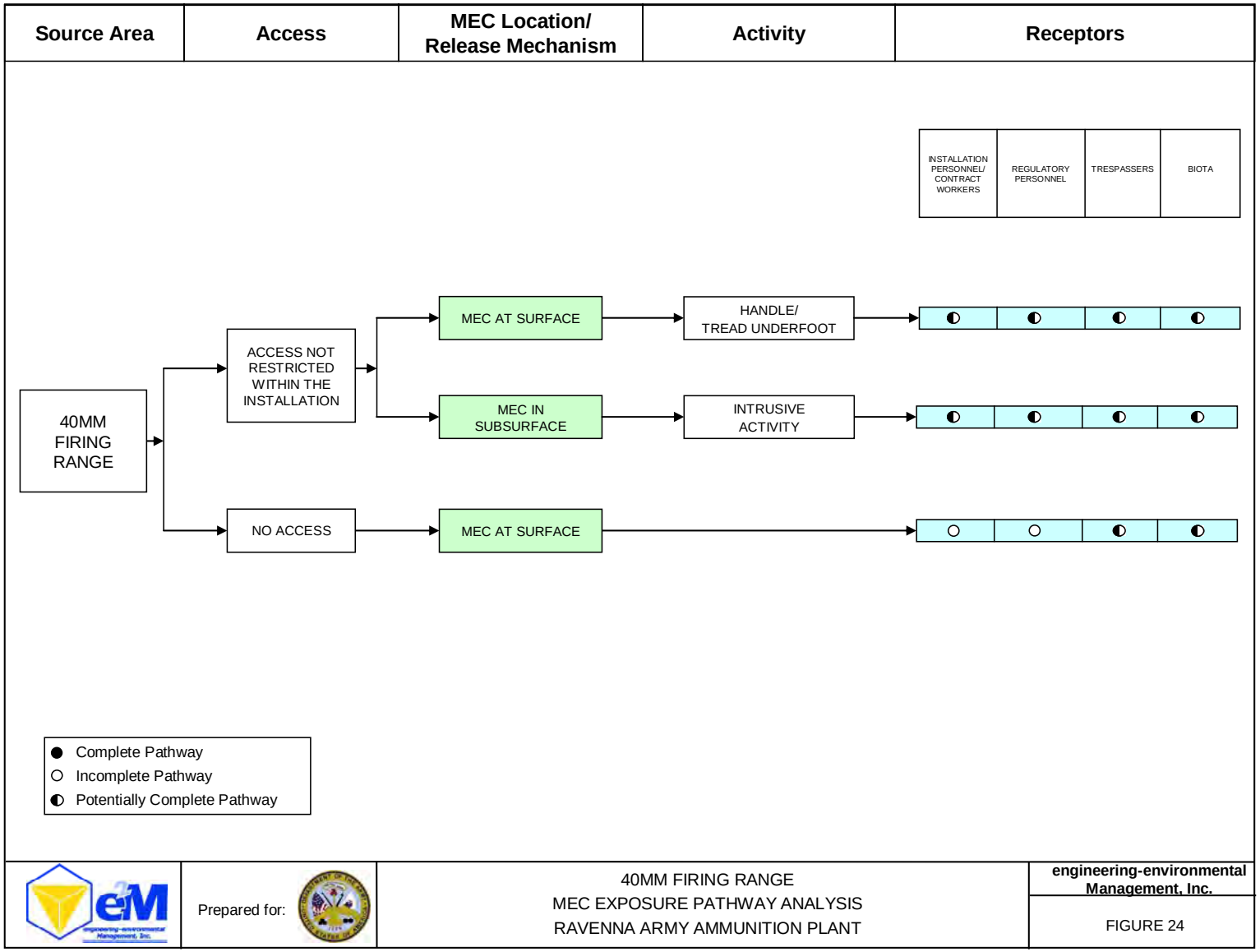
Potential MEC is reportedly lying on the ground surface at the MRS. Considering this, the potential exposure pathway for human and ecological receptors would be contact with MEC on the surface; that is, by handle/treading underfoot of munitions. Transport mechanisms would include movement under gravity (i.e., located on a steep slope) and surface water transport. **Figure 24** provides the pathways evaluated and the findings of the assessment.

#### *5.10.3.6 MC Exposure and Transport Pathway Analysis*

MC will be addressed under the IRP and will not be addressed further during this SI process (RVAAP-1.A.2).

### 5.10.4 MRS Data Gaps

Installation personnel have reported that potential MEC is present at the MRS. However, little is known about the density, condition, or extent of MEC, or if the items represent MEC or munitions debris.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
40MM FIRING RANGE
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
40MM FIRING RANGE
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 24

# 5.11 Firestone Test Facility (RVAAP-033-R-01)

## 5.11.1 Human Exposure Profile

### *5.11.1.1 Current Land Use*

The MRS is collocated with the former Load Line 6 Fuze and Booster area, which has been completely demolished. The MRS consisted of three buildings (since removed) and a pond that remains at the site. Load Line 6, including the MRS, is undeveloped and remains idle. The suspected test range may be included as part of the MRS, depending on the findings of the SI field work. Current site activities include maintenance of the grounds, fences, and signs, and performing security checks. For the most part, these activities are conducted infrequently (RVAAP-10.A.1).

### *5.11.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel, contract workers (including maintenance personnel), and Operation Command personnel who train in the area. Site visits are infrequent and of short duration.

### *5.11.1.3 Land Use Restrictions*

Currently, access to the MRS is controlled by a fenced perimeter and a locked gate (RVAAP-2.A.13). However, there are no formalized land use controls ratified under CERCLA in place at the MRS.

### *5.11.1.4 Beneficial Resources*

The MRS was formerly a test area which was located within a production area. Recently, the buildings located at Load Line 6, along with the test chamber buildings, have been removed. Open areas consist mostly of grasslands, while the surrounding area is mature forest. The shaped charge test pond still remains at the MRS. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

## 5.11.2 Ecological Profile

The ecological profile at the Firestone Test Facility MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 20**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 20: Firestone Test Facility Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Firestone Test Facility | None. | Disturbed. Ground disturbance from construction/demolition of buildings. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.11.3 MEC and MC Release Profile

*5.11.3.1 Release Mechanisms*

The MRS included a pond and three enclosed test ranges. Shaped charges were tested underwater in the pond and one of the test chambers, while TOW and Dragon missiles were test fired in the remaining two test chambers. Little is known about the activities conducted at the suspected test range located northeast of the facility, although it is suspected that munitions (type unknown) may have been fired at a berm. While the release mechanism for MEC was the intentional testing of these munitions types, the tests were contained limiting any release. The investigation of MC will continue to be conducted under the IRP and will not be addressed further during the MMRP SI process. **Table 21** provides a summary of the types of munitions tested and potentially present at the MRS, and the release mechanisms.

**Table 21: Summary of Potential MEC and MC Present at the Firestone Test Facility**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| TOW/Dragon Missiles | RDX, TNT, PETN, Composition B, nitrocellulose, nitroglycerin, lead azide | Test fired within closed range. |
| Shaped Charges | RDX, TNT, PETN, Composition B | Tested underwater. |

RDX - Royal Demolition (or Research Department) explosive (hexahydro-1,3,5-trinitro-1,3,5-triazine) also known as Cyclonite
PETN - Pentaerythritol tetranitrate
TNT – Trinitrotoluene

*5.11.3.2 Maximum Penetration Depth*

There is no penetration depth associated with the test activities conducted at the MRS. Shaped charges were submerged or suspended in the test chamber, while the TOW and Dragon missiles were test fired inside two concrete buildings, typically at steel plates. No information was discovered that would indicate that MEC had been found lying on the ground surface or buried at the MRS.

#### *5.11.3.3 MEC/MC Density*

With the exception of an anomaly avoidance survey conducted to clear sample locations, a comprehensive UXO survey has not been conducted. Further, the pond used to test shaped charges has never been investigated. While there are no reports that MEC has been found at the three test chambers or the small clearing, the presence of MEC in the pond can not be ruled out. As such, MEC may be present in the pond and will require further investigation.

#### *5.11.3.4 Munitions Debris*

There are no reports of munitions debris being discovered at the MRS.

#### *5.11.3.5 MEC Exposure and Transport Pathway Analysis*

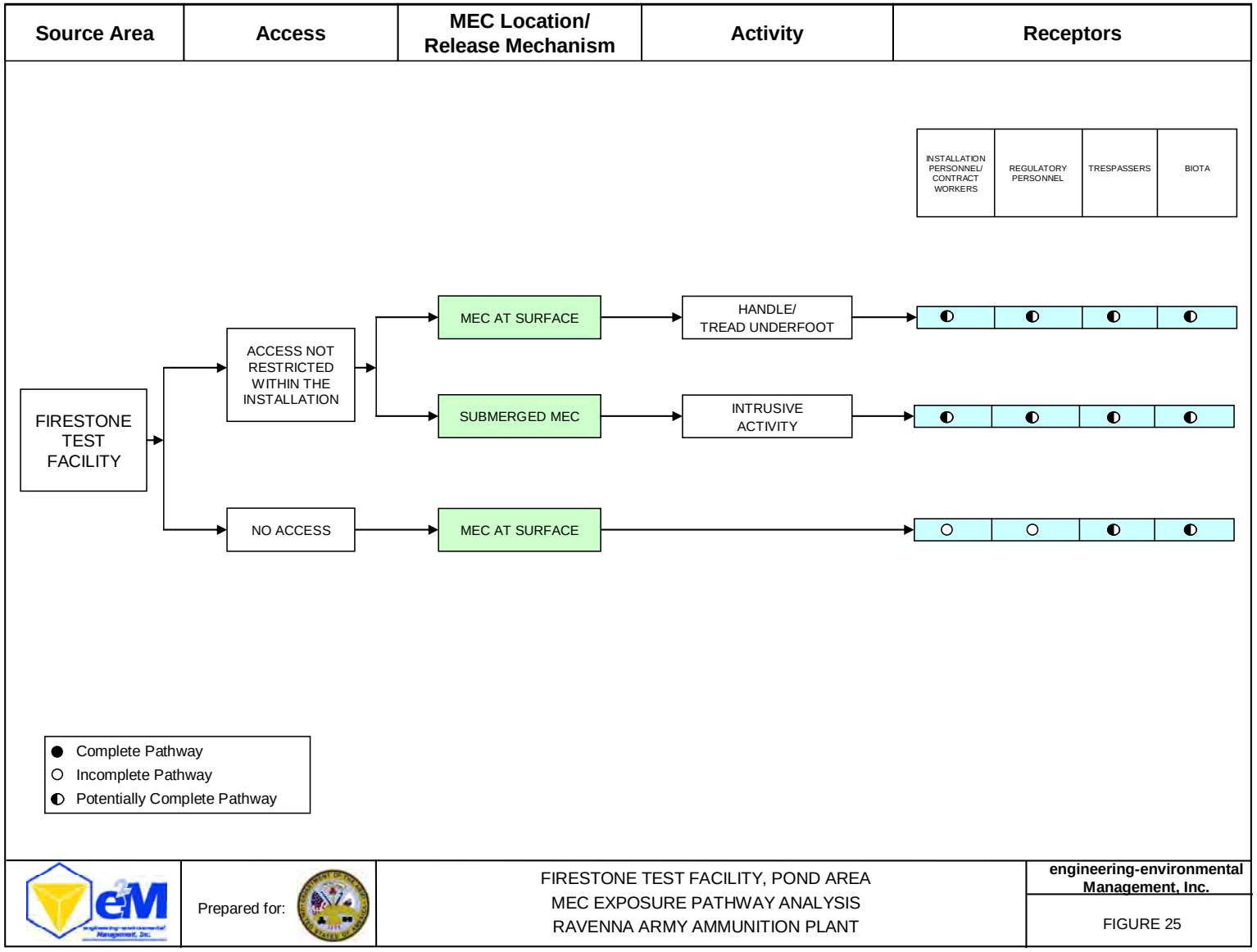
MEC is potentially present at the pond used to test shaped charges. As such, an exposure pathway for human and ecological receptors is potentially complete. **Figure 25** provides the pathways evaluated and the findings of the assessment.

#### *5.11.3.6 MC Exposure and Transport Pathway Analysis*

MC is present in environmental medium at the MRS, but will continue to be covered under the IRP. Further evaluation under the MMRP SI process will not be conducted.

### 5.11.4 MRS Data Gaps

Historic land use at the MRS indicates there is a potential for MEC to be present in the pond. Data is not adequate to determine the absence of MEC in this area; thus this area will require further investigation under the MMRP. Further, additional investigation of the suspected test range area will have to be conducted during the SI field work. Based on these findings, the area may or may not be included as part of the MRS footprint.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
FIRESTONE TEST FACILITY
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
SUBMERGED MEC
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
FIRESTONE TEST FACILITY, POND AREA
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 25

# 5.12 Sand Creek Dump (RVAAP-034-R-01)

## 5.12.1 Human Exposure Profile

*5.12.1.1 Current Land Use*

The MRS is an undeveloped site that consists of a wooded flood plain located adjacent to Sand Creek. Mature forest surrounds the entire site. Access to the MRS is not restricted once on the Installation. Current site activities include security patrols, natural resource management, surveying, environmental media sampling, and maintenance activities.

*5.12.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Typically, visits by personnel to the MRS are infrequent and of short duration.

*5.12.1.3 Land Use Restrictions*

There are no land use restrictions or formalized land use controls ratified under CERCLA in place at the MRS, other than the Installation-wide perimeter fence. The MRS is not fenced and access is not restricted.

*5.12.1.4 Beneficial Resources*

The MRS is located adjacent to Sand Creek and includes wetland areas. Mature forest surrounds the site. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

## 5.12.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 22**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 22: Sand Creek Dump Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Sand Creek Dump | Wetlands. | Disturbed. Area used as landfill/surface dumping. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.12.3 MEC and MC Release Profile

*5.12.3.1 Release Mechanisms*

The former dump was used to dispose of general construction debris, including asbestos debris, concrete, fluorescent light tubes, lab bottles, 55-gallon drums, and wood. There is no information to indicate that MEC or related munitions items had been disposed of at the MRS. However, two inert 75mm rounds were discovered at the site in 2003 during ongoing IRP field work (RVAAP-2.A.5).

The release mechanism for MEC items is the disposal of munitions. The investigation of MC will continue to be conducted under the IRP and will not be addressed further during the MMRP SI process. **Table 23** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanism.

**Table 23: Summary of Potential MEC and MC Present at the Sand Creek Dump**

| Potential MEC Item | Potential MC | Primary Release Mechanism |
|---|---|---|
| 75mm | Inert | Surface disposal. |

(RVAAP-2.A.14)

*5.12.3.2 Maximum Penetration Depth*

Waste materials were dumped on the ground surface at the Sand Creek Dump MRS. There is no information to indicate that munitions were not buried at the MRS during the operational years. As such, the presence of MEC in the subsurface soil can not be ruled out. It is possible that MEC may be buried or co-mingled with general waste material that had been deposited over the years.

*5.12.3.3 MEC/MC Density*

There are no reports of MEC having been found at the MRS. Two inert 75mm projectiles (i.e., munitions debris) were found and removed in 2003. MEC may be present, but likely in very limited numbers.

*5.12.3.4 Munitions Debris*

The only report of munitions debris found at the site involved the two inert 75mm projectiles.

#### *5.12.3.5 MEC Exposure and Transport Pathway Analysis*

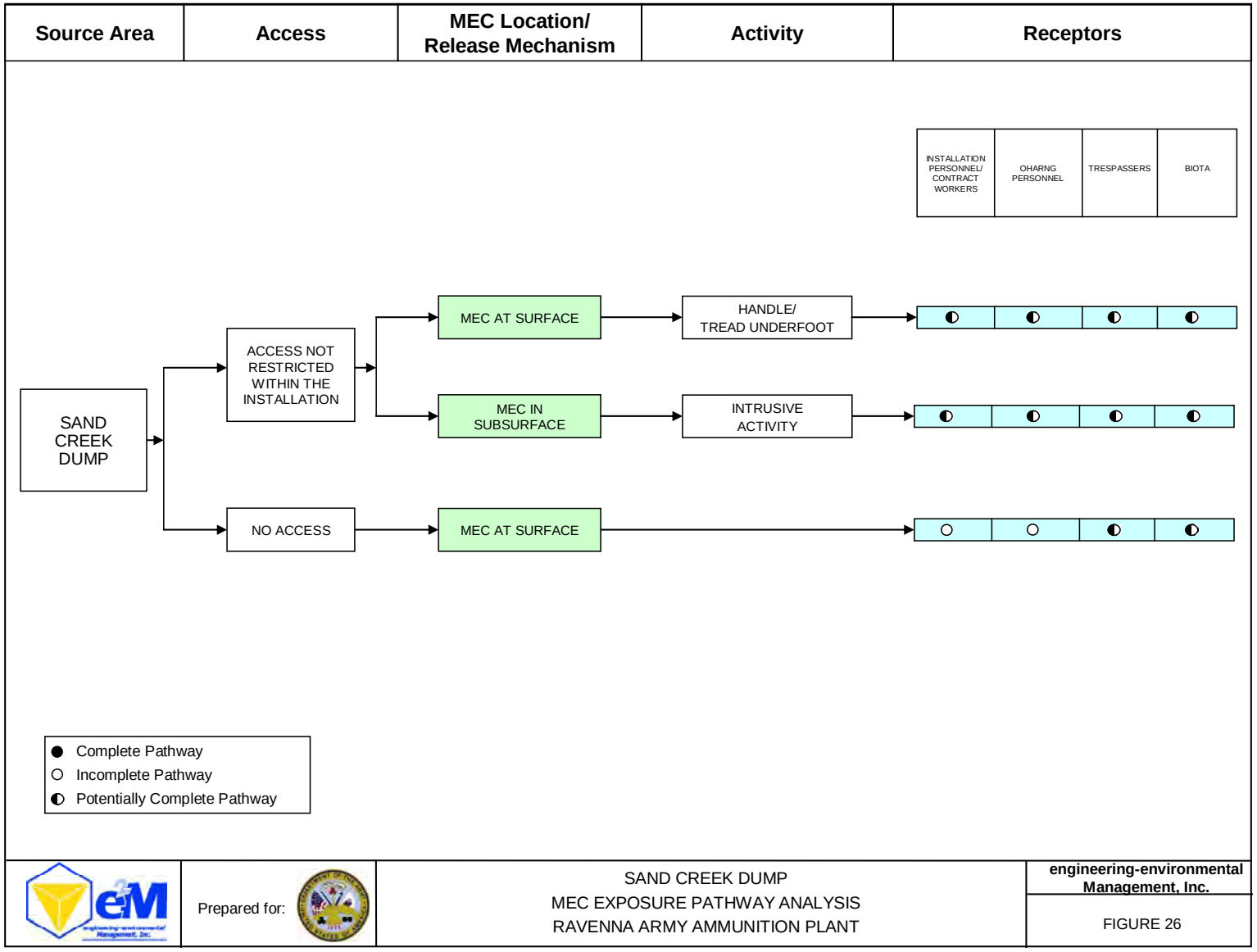
While MEC has not been found at the MRS, the possibility exists that items may have been buried and mixed with general waste material that has been deposited over the years. Considering this, the potential exposure pathways for human and ecological receptors would be contact with MEC in surface soils by handling or treading under foot or disturbance of subsurface soils. **Figure 26** provides the pathways evaluated and the findings of the assessment.

#### *5.12.3.6 MC Exposure and Transport Pathway Analysis*

MC will be addressed under the IRP and not during this SI process. The presence of metals may be a concern, but will be evaluated under the IRP.

### 5.12.4 MRS Data Gaps

The extent of MEC present at the MRS is not fully understood; specifically, whether or not MEC is mixed with the general waste material and/or has been buried.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
TRESPASSERS
BIOTA
SAND CREEK DUMP
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
SAND CREEK DUMP
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 26

# 5.13 Building #F-15 and F-16 (RVAAP-046-R-01)

## 5.13.1 Human Exposure Profile

### *5.13.1.1 Current Land Use*

With the exception of the concrete foundations, Buildings F-15 and F-16 have been demolished. The only remnants remaining are the raised concrete building slabs. At Building F-16, the debris pile rests on top of the slab. The site is currently undeveloped and idle. Current site activities include limited maintenance, security patrols, and natural resource management activities. Although this property has been transferred to the OHARNG, they do not use the MRS for training purposes.

### *5.13.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Although site visits are limited, they are necessary to conduct security patrols and to perform grounds keeping and maintenance tasks.

### *5.13.1.3 Land Use Restrictions*

There are no land use restrictions or formalized land use controls ratified under CERCLA in place at the MRS. The MRS is not fenced and access is not restricted.

### *5.13.1.4 Beneficial Resources*

The MRS consists of two open areas where the building foundations are located, which are surrounded by mature forest. Specific details of the beneficial resources located at the Installation are provided in **Section 5.2.3**.

## 5.13.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 24**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 24: Building #F-15 and F-16 Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Building #F-15 and F-16 | None. | Disturbed. Grounds disturbed by building construction/demolition. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.13.3 MEC and MC Release Profile

*5.13.3.1 Release Mechanisms*

Buildings F-15 and F-16 were referred to as the Surveillance Work Shop, where large caliber artillery rounds were dismantled and inspected as part of a cyclic inspection procedure. The procedure involved the random selection of completed rounds from storage which were subsequently dismantled for inspection and testing of individual components (i.e., fuzes, primer, propellant, and HE). Information concerning the final disposition of the tested components was not disclosed.

Large caliber artillery projectiles void of HE have been found at the MRS. The exact location where the rounds were found was not disclosed, but it is assumed that they were lying on the ground surface next to the buildings. The release mechanisms for MEC are not fully understood, but are assumed to be the deliberate storage or disposal of MEC items at the facility. MC is being addressed under the IRP and will not be evaluated further under the SI process. **Table 25** provides a summary of the types of munitions either observed at the MRS or potentially present, and the release mechanisms.

**Table 25: Summary of Potential MEC and MC Present at the Building #F-15 and F-16 MRS**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Shell, 120mm, M73 | HE | Disposal/Storage. |
| Shell, 155mm, M112, M101, M107, MkIAI, Mk III, Mk IIIAI | AP, HE | Disposal/Storage. |
| Shell, 240mm, Mk, M114 | HE | Disposal/Storage. |
| Shell, 4.5-inch, M65, M65A1, | HE, Spotting Charge | Disposal/Storage. |
| Shell, 6-inch, Mk IIAI, Mk IIA2 | HE | Disposal/Storage. |
| Shell 8-inch, M103, M106, Mk I, Mk IAI | HE | Disposal/Storage. |

AP – Armor Piercing
HE – High Explosives
(RVAAP-4.A.5)

*5.13.3.2 Maximum Penetration Depth*

It is speculated that munitions were stored on the ground surface at the MRS. As such, MEC would only be expected to be present lying on the surface. However, it can not be said with certainty that MEC is not buried on site or at what depth.

#### *5.13.3.3 MEC/MC Density*

There have not been any reported findings of MEC located at the MRS. Munitions debris have been found and recorded. However, the presence and extent of MEC items is not fully understood since UXO investigations have not been conducted.

#### *5.13.3.4 Munitions Debris*

Munitions debris has been found at the MRS. Based on the activities conducted at the surveillance workshop, the likelihood that munitions debris may still be present at the MRS is likely.

#### *5.13.3.5 MEC Exposure and Transport Pathway Analysis*

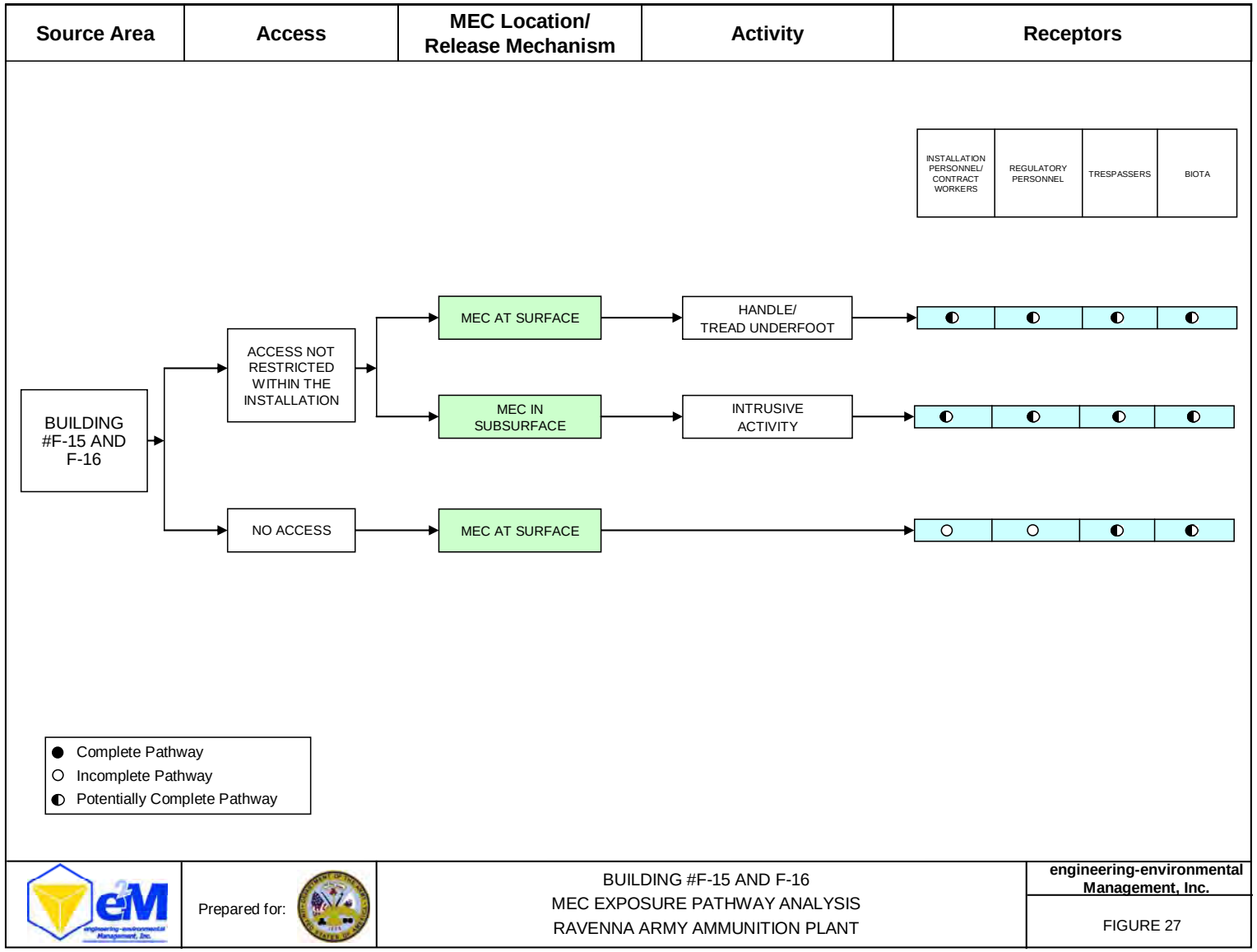
Conclusive information regarding whether or not MEC is present lying on the ground surface or buried on site was not found. Considering this, the potential exposure pathways for human and ecological receptors would be contact with MEC in surface soils by handling or treading under foot, or disturbance of subsurface soil. Transport of MEC off site is not likely to be a concern. **Figure 27** provides the pathways evaluated and the findings of the assessment.

#### *5.13.3.6 MC Exposure and Transport Pathway Analysis*

MC is being addressed under the IRP and will not be evaluated further during the MMRP SI process.

### 5.13.4 MRS Data Gaps

The extent of MEC present at the MRS is not fully understood; specifically, whether or not MEC may be buried or lying on the ground surface at the MRS.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
BUILDING #F-15 AND F-16
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
BUILDING #F-15 AND F-16
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 27

# 5.14 Anchor Test Area (RVAAP-048-R-01)

## 5.14.1 Human Exposure Profile

### *5.14.1.1 Current Land Use*

The former Anchor Test Area is heavily overgrown with trees, shrubs, and tall grass (RVAAP-14.A.1). The approximate 2.57 acre site is currently undeveloped (RVAAP-2.A.10). Current activities include natural resource management, security patrols, maintenance activities, and site investigation under the IRP.

### *5.14.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel, contract workers, and hunters/trappers. Although site visits are limited, they are necessary to conduct security patrols and to perform grounds keeping, maintenance tasks, and field sampling.

### *5.14.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. However, the OHARNG has established a digging prohibition restriction for guard personnel due to concerns over the presence of MEC/MC.

### *5.14.1.4 Beneficial Resources*

The MRS is heavily overgrown with trees, shrubs, and tall grass. The area is surrounded by mature forest. Specific details of the beneficial resources present at the Installation are provided in **Section 5.2.3**.

## 5.14.2 Ecological Profile

The ecological profile at the Anchor Test Area MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 26.** Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 26: Anchor Test Area Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Anchor Test Area | None. | Minimally disturbed. Area reforested. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

## 5.14.3 MEC and MC Release Profile

*5.14.3.1 Release Mechanisms*

Beginning in the early 1960s, the Anchor Test Area was reportedly used to test fire anchoring devices into the ground. Small explosive devices were used to drive anchors for ropes and cables into the ground (RVAAP-1.A.2). The distinct surface features at the MRS are two large dirt mounds and a nearby sandpit. It is suspected that anchor tests were performed within the 12 × 36 ft sandpit, and the dirt mounds functioned as blast walls. Metal debris is visible in the area. A section of cement culvert can be seen in one of the mounds. It is suspected that the culvert was used to store anchors while tests were being conducted (RVAAP-14.A.2).

The release mechanisms for MEC and MC are the firing of small explosive devices into the ground. The analytical results of a site characterization performed in 2005 indicated that the concentrations of explosive constituents in shallow and subsurface soils were below detection levels. The study also indicated that metals were the only constituents detected in concentrations above Installation-specific background and/or the EPA Region 9 residential PRGs (RVAAP-14.A.3). The metal constituents represent MC, which will be addressed under the IRP and will not be evaluated further under the MMRP SI process. **Table 27** provides a summary of the potential MEC and MC present at the MRS and the release mechanism.

**Table 27: Summary of MEC and MC in Soil at the Anchor Test Area**

| Potential MEC | Potential MC | Primary Release Mechanism |
|---|---|---|
| Experimental charges | Arsenic, Chromium, Manganese | Firing of small explosive devices into the ground. |

*5.14.3.2 Maximum Penetration Depth*

The explosive devices were reportedly fired into the ground. Considering that the purpose of the charge was to securely place an anchoring device into the ground, the depth of penetration was limited by the length of the anchoring device. However, the length of the anchoring devices could not be determined.

*5.14.3.3 MEC/MC Density*

No MEC has been identified at the Anchor Test Area. The 2005 site characterization indicated that MC was identified in the MRS soils. MC is expected to be present throughout the 12 × 36 ft sandpit.

#### *5.14.3.4 Munitions Debris*

Some metal debris of unknown origin was found in the Anchor Test Area (RVAAP-2.A10). No additional information was found regarding the debris.

#### *5.14.3.5 MEC Exposure and Transport Pathway Analysis*

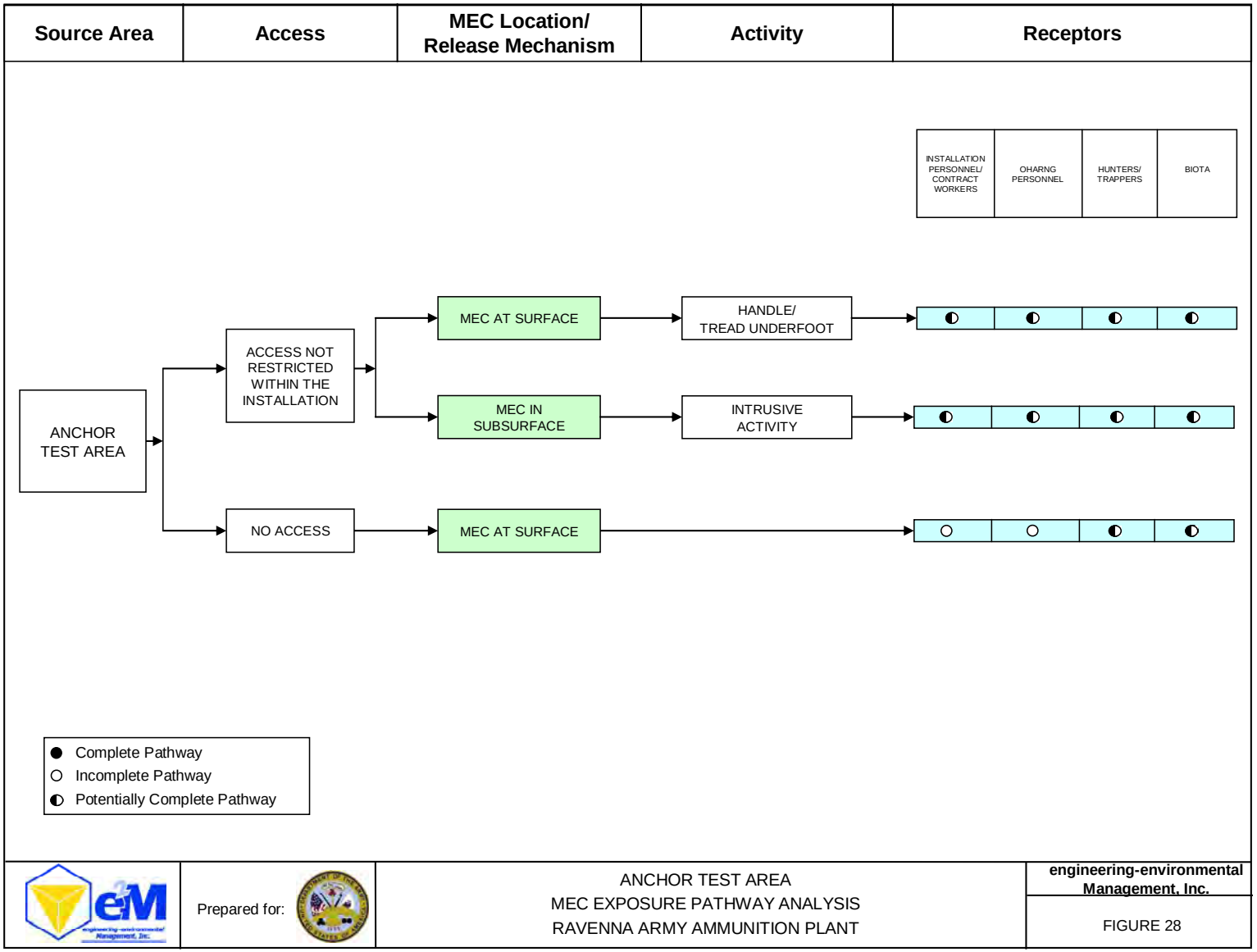
MEC has not been identified at the MRS. If present, MEC is expected on the ground surface and in the subsurface soil. Human and ecological exposure pathways include contact with MEC during disturbance of subsurface soil and contact with MEC lying on the ground surface. **Figure 28** provides the pathways evaluated and the findings of the assessment.

#### *5.14.3.6 MC Exposure and Transport Pathway Analysis*

The presence of metals in shallow and subsurface soil was established by the 2005 site characterization study. However, current contact is limited due to limited access to the MRS. MC will be covered under the IRP and will not be addressed further during the MMRP SI process.

### 5.14.4 MRS Data Gaps

MEC investigations have not been conducted at the Anchor Test Area. However, Installation personnel have reported the presence of metal debris of unknown origin. Further characterization at the MRS will be required during the SI phase to determine if MEC is present at the site.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
HUNTERS/ TRAPPERS
BIOTA
ANCHOR TEST AREA
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
ANCHOR TEST AREA
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 28

# 5.15 Atlas Scrap Yard (RVAAP-050-R-01)

## 5.15.1 Human Exposure Profile

### *5.15.1.1 Current Land Use*

The approximate 66.04 acre Atlas Scrap Yard is covered with thick grass and patches of forest, and is littered with miscellaneous non-explosive scrap. Current activities include natural resource management, security patrols, and maintenance activities.

### *5.15.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel (e.g., security guards), contract workers (e.g., maintenance and natural resource management personnel), and recreational users (e.g., hunters/trappers).

### *5.15.1.3 Land Use Restrictions*

There are no formalized land use controls ratified under CERCLA in place at the MRS. However, the OHARNG has established a digging prohibition restriction for guard personnel due to concerns over the presence of MEC and MC.

### *5.15.1.4 Beneficial Resources*

The former scrap yard is comprised of grasslands and isolated stands of mature forest. The site is surrounded by forest. Specific details of the beneficial resources present at the Installation are provided in **Section 5.2.3**.

## 5.15.2 Ecological Profile

The ecological profile at the MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 28**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 28: Atlas Scrap Yard Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Atlas Scrap Yard | None. | Disturbed. Grounds disturbed by building construction/demolition. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

## 5.15.3 MEC and MC Release Profile

*5.15.3.1 Release Mechanisms*

Since the end of WWII, the Atlas Scrap Yard has served as a storage area for non-explosive scrap materials (RVAAP-14.B.1). A more recent characterization study (2005) suggested that the area may also have been used to store munitions. To date, no investigations have been performed to assess whether or not MEC is present at the MRS. A 2005 IRP site characterization identified MC, consisting of metals, SVOCs, and/or explosive COPCs in shallow soil, sediment, surface water, and groundwater (RVAAP-14.B.2).

The release mechanisms for MEC and MC are the open storage of munitions in ammunition boxes and the deliberate disposal of munitions items. MC is being addressed under the IRP and will not be evaluated further under the MMRP SI process. **Table 29** provides a summary of the types of munitions either identified at the MRS or potentially present, and the release mechanisms.

**Table 29: Summary of Potential MEC and Documented MC Present at the Atlas Scrap Yard**

| Potential MEC | Documented MC (Identified as COPCs) | Primary Release Mechanisms |
|---|---|---|
| Blasting caps, fuzes, boosters, or bursters; bombs, high explosive; detonators; flares, signals, simulators, or screening smoke (other than white phosphorus); hand grenades; antipersonnel landmines; antitank landmines; medium and large caliber practice; large caliber high explosive; mortars, practice and high explosive; practice ordnance; primary or initiating explosives; propellants; pyrotechnics; secondary explosives; small arms; small arms rounds. | Aluminum; arsenic; cadmium; chromium; cobalt; iron; lead; vanadium; mercury; manganese; 2- methylnaphthalene; acenaphthylene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(ghi)perylene; dibenzo(ah)anthracene; indeno(1,2,3-cd)pyrene; phenanthrene; 2-amino-4,6- dinitrotoluene; bis(2-ethylhexyl)phthalate; nitrocellulose. | Open storage, open disposal |

*5.15.3.2 Maximum Penetration Depth*

There are no reports that munitions were buried at the MRS. All debris located at the MRS appears to have been placed on the ground; therefore, little or no penetration is expected.

#### *5.15.3.3 MEC/MC Density*

There is one report that MEC was found in the southwest corner of the MRS. Regardless, disposal operations appear to have occurred over the entire MRS. Consequently, MEC (if present) and MC are expected to be found over the entire MRS.

#### *5.15.3.4 Munitions Debris*

The purpose of the MRS was the storage of non-explosive scrap and possibly munitions. As such, it is likely that the MRS contains some quantity of munitions debris.

#### *5.15.3.5 MEC Exposure and Transport Pathway Analysis*

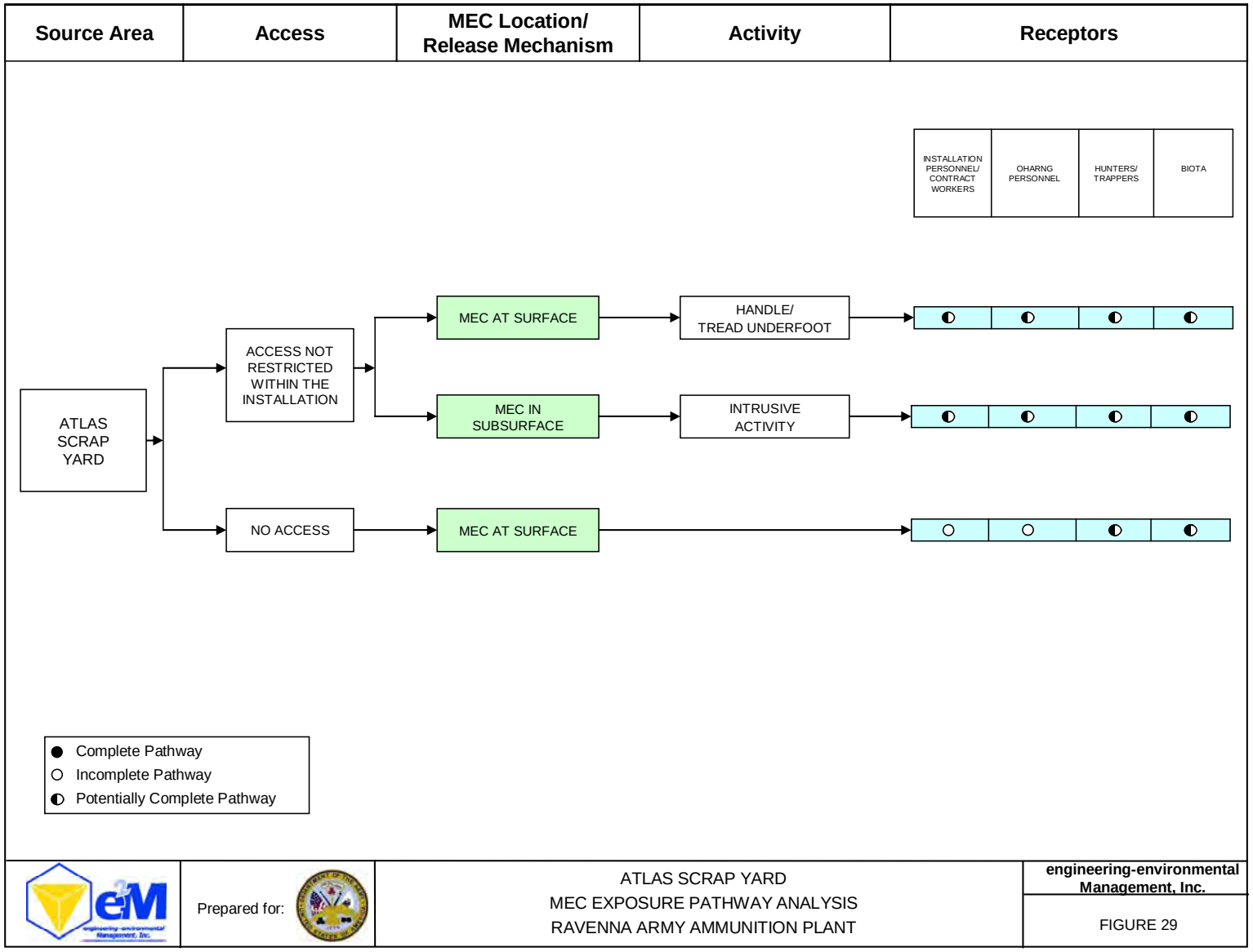
A one time discovery of MEC has been reported at the MRS. If present, MEC is expected to be lying on the ground surface, mixed in a pile with other debris, or potentially buried at the MRS. Exposure pathways include direct contact with MEC through handling and treading under foot and through the disturbance of subsurface soil. **Figure 29** provides the pathways evaluated and the findings of the assessment.

#### *5.15.3.6 MC Exposure and Transport Pathway Analysis*

The presence of explosives and metals in shallow soil, sediment, surface water, and groundwater has been established and will be addressed under the IRP. Regardless, contact is considered to be limited due to the remote/rural location of the MRS. Transport of MC via groundwater, surface water, and sediment is possible. Concerns regarding the presence of MC will be covered under the IRP. As such, further evaluation during the SI process will not be conducted.

### 5.15.4 MRS Data Gaps

The extent of MEC lying on the ground surface or buried at the MRS is not completely understood. Comprehensive UXO investigations have not been performed at the site; therefore, further characterization of the presence of MEC will be required during the SI phase.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
HUNTERS/ TRAPPERS
BIOTA
ATLAS SCRAP YARD
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
ATLAS SCRAP YARD
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 29

# 5.16 Block D Igloo (RVAAP-060-R-01)

## 5.16.1 Human Exposure Profile

### *5.16.1.1 Current Land Use*

The D block of igloos is located in the heavily forested north-central portion of RVAAP. Currently, the igloos are inactive and the area sits mostly idle (RVAAP-1.A.2). Except for the igloos, the site is currently undeveloped (RVAAP-2.A.12). Current activities include natural resource management, security patrols, and maintenance activities.

### *5.16.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Site visits are infrequent. Currently, the OHARNG does not use the area for training activities (RVAAP-1.A.2).

### *5.16.1.3 Land Use Restrictions*

There are no known access restrictions to the Block D Igloo MRS. Once on the Installation, access to the MRS is not restricted.

### *5.16.1.4 Beneficial Resources*

The Block D igloos are surrounded by mature forest.

## 5.16.2 Ecological Profile

The ecological profile at the Block D Igloo MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 30**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 30: Block D Igloo Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Block D Igloo | None. | Minimally disturbed. Majority of acreage is forested. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of

State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

## 5.16.3 MEC and MC Release Profile

*5.16.3.1 Release Mechanism*

The release mechanism for MEC and MC at the Block D Igloo was the accidental explosion of bombs stored in Igloo number 7-D-15 on March 24, 1943. Ravenna Ordnance Plant personnel reported that the MRS was considered clean of UXO some time after the explosion, although this is not documented or confirmed (RVAAP-1.A.2 and RVAAP-2.A.12). **Table 31** provides a summary of the potential MEC and MC present at the MRS and their release mechanism.

**Table 31: Summary of Potential MEC and MC Present at the Block D Igloo MRS**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Fragmentation Bombs (M-41) | TNT | Accidental igloo explosion |

TNT – Trinitrotoluene

*5.16.3.2 Maximum Penetration Depth*

Based on an accident report of the detonation, the majority of the blast force was directed in a horizontal direction (or low trajectory). As such, MEC would have been deposited on the ground surface. Therefore, minimal to no penetration would be expected.

*5.16.3.3 MEC/MC Density*

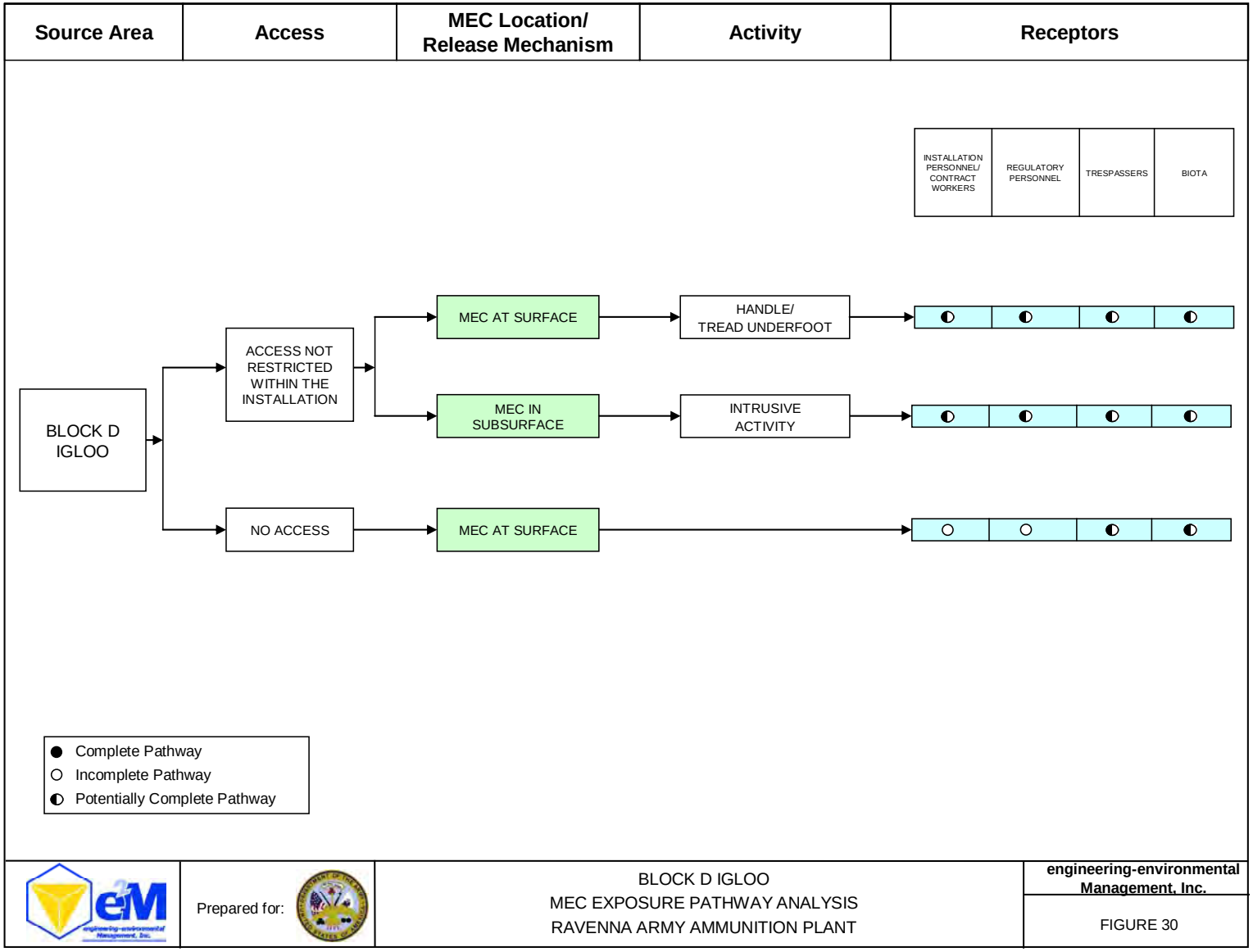
There is no apparent evidence of UXO at the Block D Igloo MRS.

*5.16.3.4 Munitions Debris*

There are no reports of munitions debris being discovered at the site. However, the 1943 explosion generated debris consisting of concrete fragments (large [two ton pieces] and small [pebble size]), parts of clothing, the demolished tractor, and a vehicle oil filter (RVAAP-2.A.12).

*5.16.3.5 MEC Exposure and Transport Pathway Analysis*

The potential MEC exposure pathways for human and ecological receptors would be to handle or tread under foot, (possibly in the upper subsurface also) should MEC be found at the MRS. **Figure 30** provides the pathways evaluated and the findings of the assessment.

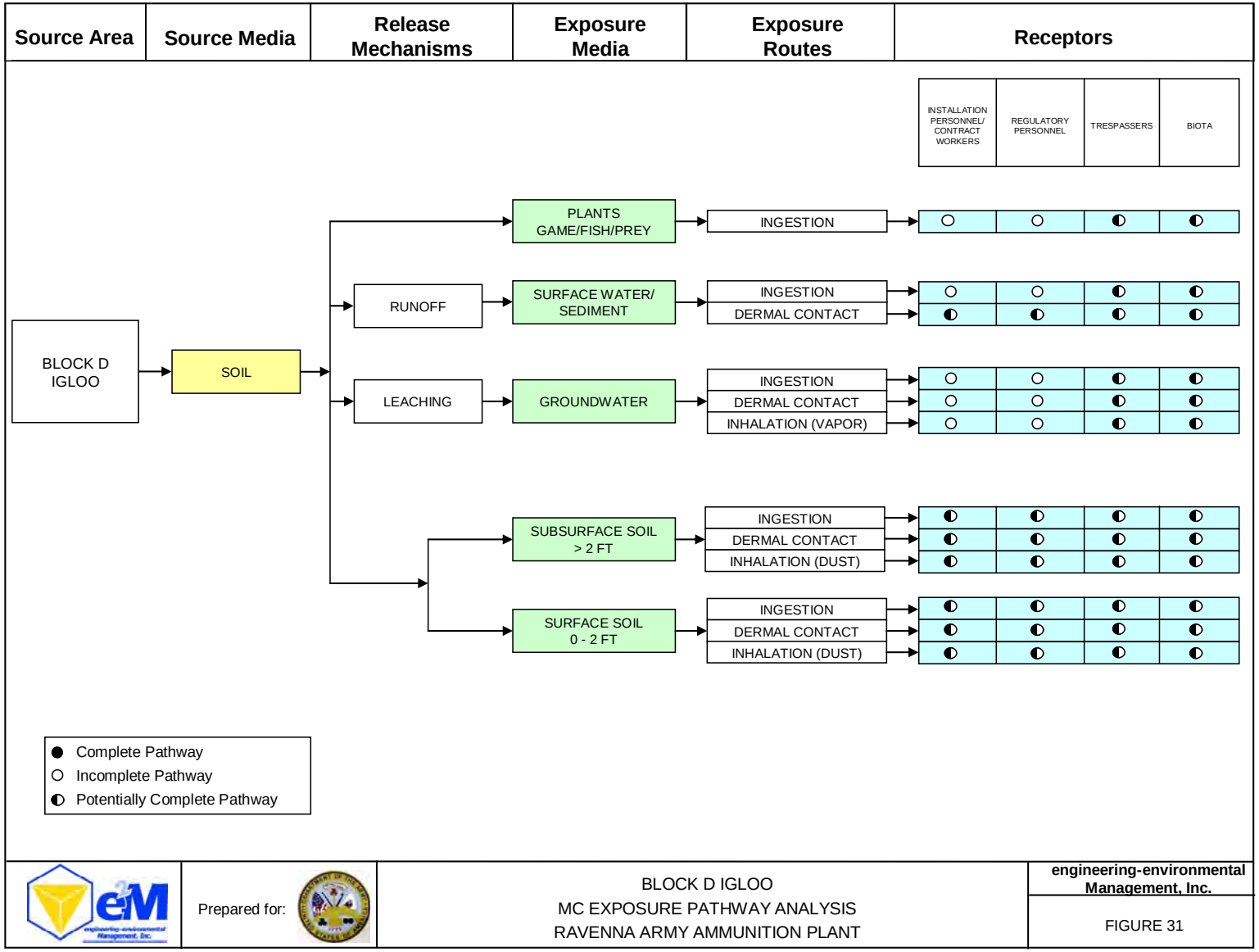

Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
BLOCK D IGLOO
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
BLOCK D IGLOO
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 30

#### *5.16.3.6 MC Exposure and Transport Pathway Analysis*

The presence of MC has not been determined at the Block D Igloo MRS and is considered a potential concern, thus pathways are considered potentially complete. Further evaluation under the SI process will be conducted. **Figure 31** provides the pathways evaluated and the findings of the assessment.

### 5.16.4 MRS Data Gaps

Although RVAAP personnel indicated the site was considered clean of UXO some time after the 1943 explosion, this was not documented or confirmed (RVAPP-2.A.12). Therefore, it is not known with certainty if MEC is still present within the MRS. Analytical data determining the presence or absence of MC at the MRS does not exist; therefore, further characterization work will be required during the SI phase.


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
BLOCK D IGLOO
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
BLOCK D IGLOO
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 31

# 5.17 Block D Igloo–TD (RVAAP-061-R-01)

## 5.17.1 Human Exposure Profile

*5.17.1.1 Current Land Use*

This MRS consists of the portion of the circular Block D Igloo MRS that extends beyond the Installation boundary, north of the central portion of the Installation. This area is privately owned. The Block D Igloo–TD covers an area of approximately 19.25 acres and includes farmland, forested areas, and a segment of the railroad that follows the northern boundary of the RVAAP. Except for the railroad and right-of-way and farmland, the MRS is currently undeveloped (RVAAP-2.A.11). Current activities include railroad maintenance, security patrols, and farming.

*5.17.1.2 Current Human Receptors*

Current human receptors may include railway maintenance workers, recreational users (i.e., hunters), security personnel, and farmers.

*5.17.1.3 Land Use Restrictions*

There are no access restrictions to the Block D Igloo–TD MRS.

*5.17.1.4 Beneficial Resources*

The MRS consists of open agricultural field, woodlands, and the section of railway that borders the Installation.

## 5.17.2 Ecological Profile

The ecological profile at the Block D Igloo-TD MRS is a mixture of industrial (railroad right-of-way) and agricultural land. **Table 32** provides site-specific information.

**Table 32: Block D Igloo–TD Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Block D Igloo–TD | None. | Disturbed. Area includes agriculture fields and railroad right-of-way. | Presence of federal threatened or endangered species unknown. |

## 5.17.3 MEC and MC Release Profile

*5.17.3.1 Release Mechanism*

The release mechanism for MEC and MC at the Block D Igloo–TD MRS was the accidental explosion of the bombs stored in Igloo number 7-D-15 on March 24, 1943. However, no UXO was reported to

have been found at the MRS as a result of the explosion. Ravenna Ordnance Plant personnel reported that the Block D Igloo and blast area within the Installation were considered clean of UXO some time after the explosion although this is not documented or confirmed (RVAAP-1.A.2 and RVAAP-2.A.12). While it is not known if a search of the adjacent private property was conducted, some items were found northeast of the former igloo outside of the Installation boundaries. **Table 33** provides a summary of the potential MEC and MC present at the MRS and their release mechanism.

**Table 33: Summary of Potential MEC and MC Present at the Block D Igloo–TD MRS**

| Potential MEC | Potential MC | Primary Release Mechanism |
|---|---|---|
| Fragmentation Bombs (M-41) | TNT | Accidental igloo explosion |

TNT – Trinitrotoluene

*5.17.3.2 Maximum Penetration Depth*

MEC would have been deposited on the surface as fallout from the explosion. Therefore, minimal to no penetration would be expected.

*5.17.3.3 MEC/MC Density*

There are no reports that MEC has been found at the MRS. As such, an assessment of the extent of MEC can not be made.

*5.17.3.4 Munitions Debris*

There are no reports of munitions debris being discovered at the site. However, the 1943 explosion generated debris consisting of concrete fragments, parts of clothing, and a vehicle oil filter that were discovered on the Installation, as well as debris found at locations off the Installation (RVAAP-2.A.12).

*5.17.3.5 MEC Exposure and Transport Pathway Analysis*

Should MEC be present at the MRS, the potential exposure pathway for human and ecological receptors would be handling or tread under foot. **Figure 32** provides the pathways evaluated and the findings of the assessment.

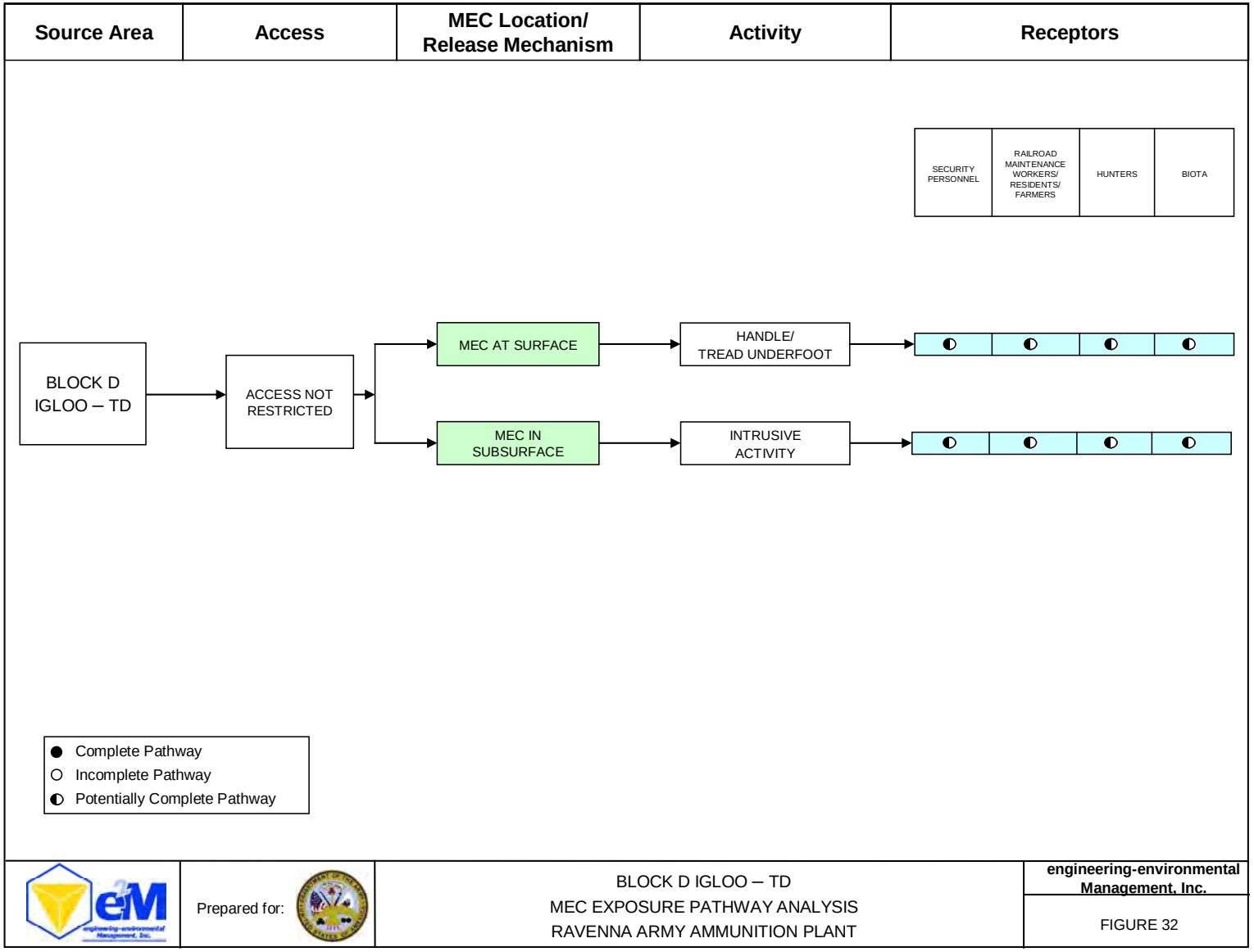
*5.17.3.6 MC Exposure and Transport Pathway Analysis*

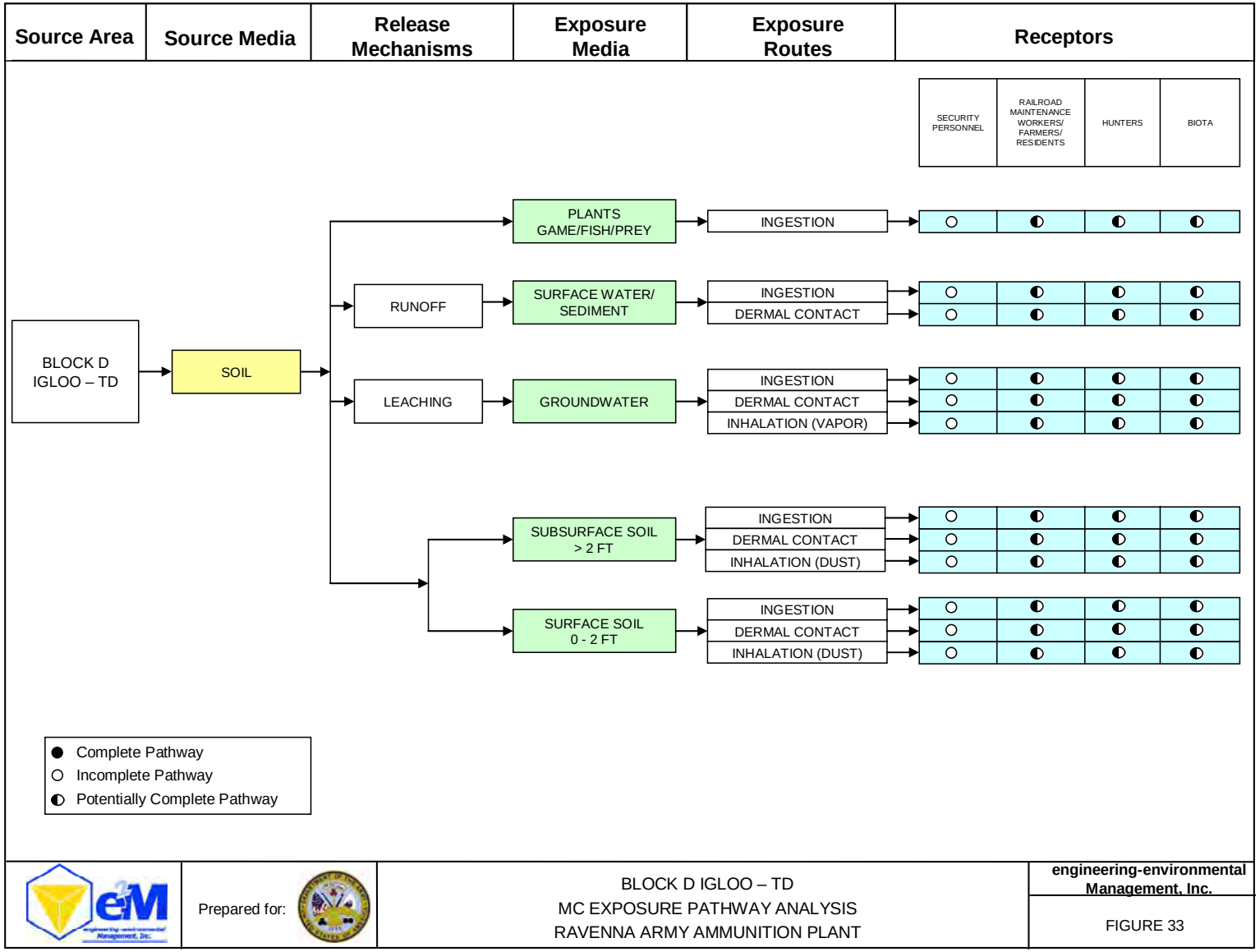
The presence of MC has not been determined at the Block D Igloo - TD MRS and is considered a potential concern; therefore, exposure pathways are considered potentially complete. Further

evaluation under the SI process will be conducted. **Figure 33** provides the pathways evaluated and the findings of the assessment.

### 5.17.4 MRS Data Gaps

Although RVAAP personnel indicated the adjacent Block D Igloo MRS was considered clean of UXO some time after the 1943 explosion, this was not documented or confirmed (RVAAP-2.A.12). Additionally, it is not known if a search of the adjacent private property was conducted. Therefore, it is not known with certainty whether or not MEC is present within the MRS. Sampling has not been conducted at the MRS. As such, data is not adequate to confirm the presence or absence of MC at the MRS and will require further investigation during the SI phase.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
SECURITY PERSONNEL
RAILROAD MAINTENANCE WORKERS/ RESIDENTS/ FARMERS
HUNTERS
BIOTA
BLOCK D IGLOO – TD
ACCESS NOT RESTRICTED
MEC AT SURFACE
MEC IN SUBSURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
BLOCK D IGLOO – TD
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 32


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
SECURITY PERSONNEL
RAILROAD MAINTENANCE WORKERS/ FARMERS/ RESIDENTS
HUNTERS
BIOTA
BLOCK D IGLOO – TD
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
BLOCK D IGLOO – TD
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 33

# 5.18 Water Works #4 Dump (RVAAP-062-R-01)

## 5.18.1 Human Exposure Profile

### *5.18.1.1 Current Land Use*

The Water Works #4 Dump is an approximate 6.15 acre wooded area located in the southwestern portion of RVAAP, immediately west of Water Works #4 and Load Line 7. The site is currently undeveloped (RVAAP-2.A.5). Current activities include natural resource management, security patrols, and maintenance activities.

### *5.18.1.2 Current Human Receptors*

Current human receptors are limited to Installation personnel and contract workers (including maintenance personnel). Site visits are infrequent. Currently, the OHARNG does not use the area for training activities (RVAAP-1.A.2).

### *5.18.1.3 Land Use Restrictions*

There are no known access restrictions to the Water Works #4 Dump MRS. Once on the Installation, access to the MRS is not restricted.

### *5.18.1.4 Beneficial Resources*

The Water Works #4 Dump MRS is covered by mature forest.

## 5.18.2 Ecological Profile

The ecological profile at the Water Works #4 Dump MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 34**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 34: Water Works #4 Dump Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Water Works #4 Dump | None. | Minimally disturbed. Area originally cleared, now revegetated. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

## 5.18.3 MEC and MC Release Profile

*5.18.3.1 Release Mechanisms*

The type and origin of the large caliber casings and ogives from 155mm shrapnel projectiles are unknown but it may be assumed that the release mechanism is the intentional disposal of non-explosive metal parts of large caliber ordnance rounds (RVAAP-2.A.5). **Table 35** provides a summary of the potential MEC and MC present at the MRS and their release mechanisms.

**Table 35: Summary of Potential MEC and MC Present at the Water Works #4 Dump MRS**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Fragments of Ordnance Casing<br>(Rifling propagators)<br>Ogives 155mm shrapnel projectiles | Metals | Intentional Disposal |

*5.18.3.2 Maximum Penetration Depth*

Fragments of ordnance casings (rifling propagators) and parts of ogives were observed scattered on the ground surface, as well as partially buried. A field assessment performed by the USACE and reported in the ASR stated that "This area is considered to have no OE presence". The assessment team determined that the metal parts found in the area were inert. However, the field assessment did not evaluate potential buried MEC. As such, it can not be ruled out that MEC may be buried on site; the potential depth, however, is not known.

*5.18.3.3 MEC/MC Density*

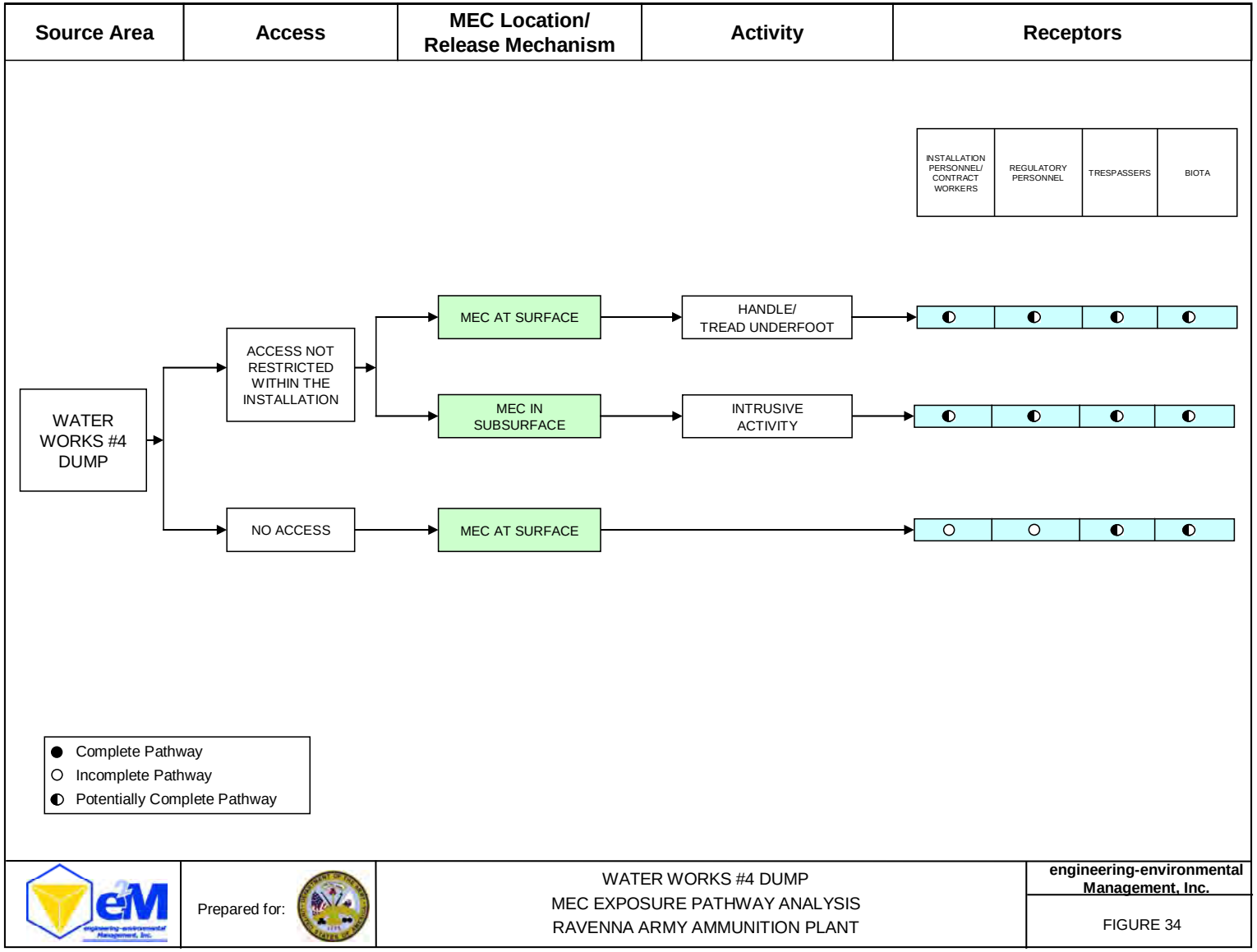
Although munitions debris have been found scattered around the MRS, there is no information to indicate the density of MEC, should it be present.

*5.18.3.4 Munitions Debris*

The available information suggests that the casing fragments and ogives may represent munitions debris. However, no investigation has been performed to assess the components of the casing fragments or ogives.

*5.18.3.5 MEC Exposure and Transport Pathway Analysis*

In case the presence of MEC is confirmed, the potential exposure pathway for human and ecological receptors would be to handle or tread under foot and the disturbance of subsurface soil. **Figure 34** provides the pathways evaluated and the findings of the assessment.

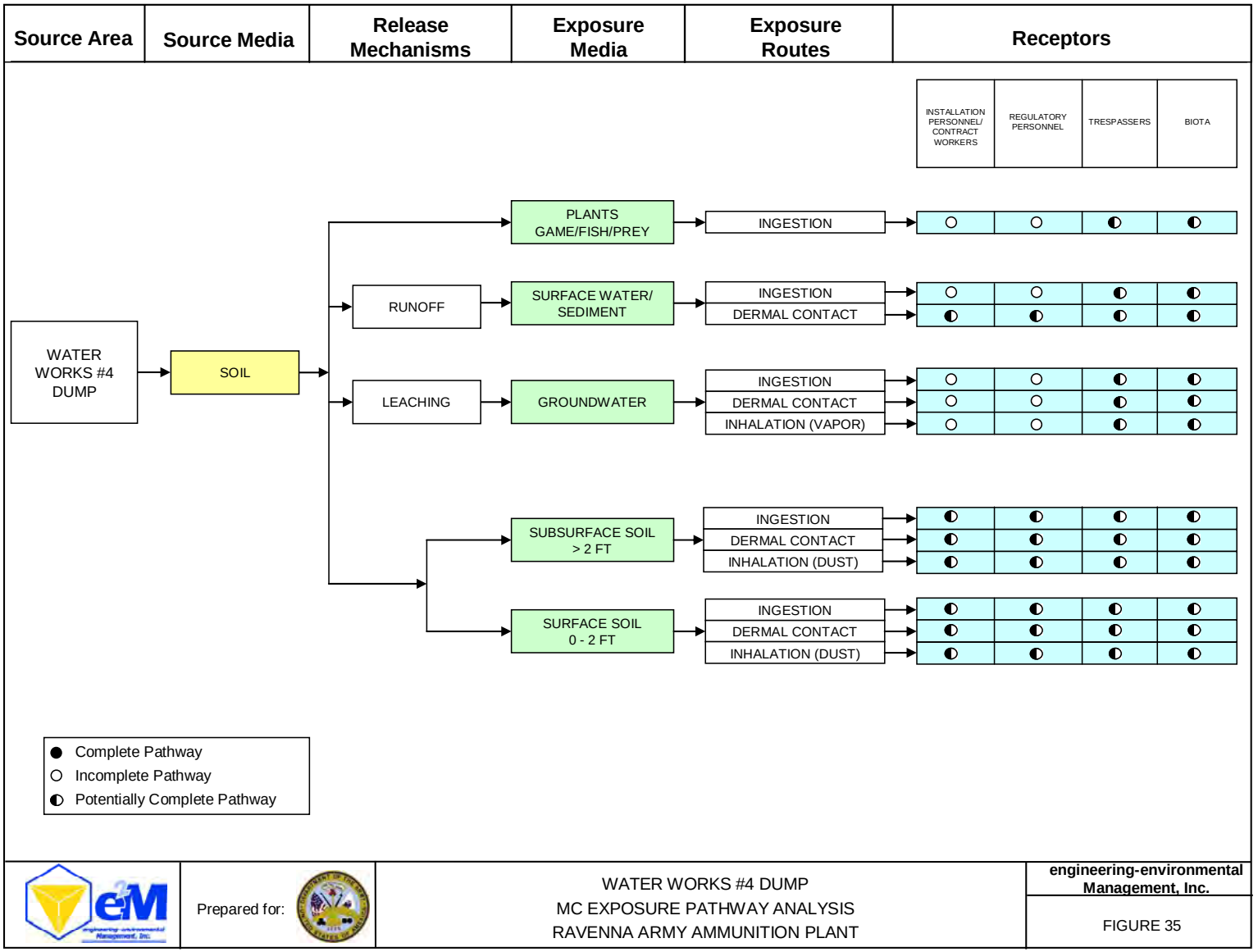

Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
WATER WORKS #4 DUMP
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
WATER WORKS #4 DUMP
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 34

#### *5.18.3.6 MC Exposure and Transport Pathway Analysis*

The presence of MC at the MRS has not been investigated. Therefore, further evaluation under the SI process will be required to determine the presence or absence of MC. **Figure 35** provides the pathways evaluated and the findings of the assessment.

### 5.18.4 MRS Data Gaps

Conclusive evidence that the munitions debris found on site contain explosives, propellants, or other fillers does not exist. Adequate data indicating the presence or absence of MC at the MRS does not exist.


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
REGULATORY PERSONNEL
TRESPASSERS
BIOTA
WATER WORKS #4 DUMP
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
WATER WORKS #4 DUMP
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 35

# 5.19 Area Between Buildings 846 and 849 (RVAAP-063-R-01)

## 5.19.1 Human Exposure Profile

### *5.19.1.1 Current Land Use*

The MRS is located in the south-central portion of RVAAP, between Buildings 846 and 849. The approximate 2.65 acre site is actively used to store heavy equipment and to gain access to the buildings. The buildings are used to store NGB equipment (RVAAP-2.A.10). The MRS is flat and includes gravel roads and grass areas. Current activities include driving, warehousing work, security patrols, and maintenance activities.

### *5.19.1.2 Current Human Receptors*

Current human receptors include OHARNG personnel and contract workers.

### *5.19.1.3 Land Use Restrictions*

There are no known access restrictions to the Area Between Buildings 846 and 849. Once on the Installation, access to the MRS is not restricted.

### *5.19.1.4 Beneficial Resources*

The MRS is flat and includes buildings, gravel roads, and grass and dirt areas. The area is occasionally used by the OHARNG to stage vehicles.

## 5.19.2 Ecological Profile

The ecological profile at the Area Between Buildings 846 and 849 is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 36**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 36: Area Between Buildings 846 and 849 Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Area Between Buildings 846 and 849 | None. | Disturbed. Area contains buildings and roads. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.19.3 MEC and MC Release Profile

*5.19.3.1 Release Mechanisms*

The Area Between Buildings 846 and 849 may have been used for burning of construction debris and rubbish in the past, as well as a collection center for salvaged items that were to be auctioned off. In 1996 an antipersonnel bomb containing HE was found on the ground surface. In addition, one inert 175mm projectile was found on the ground within the MRS. No investigation work has been conducted at the site to determine the presence of UXO/MEC (RVAAP-2.A.10). The release mechanism for the antipersonnel bomb and inert projectile is assumed to be the deliberate disposal of the munitions at the MRS. **Table 37** provides a summary of the potential MEC and MC present at the MRS and their release mechanisms.

**Table 37: Summary of Potential MEC and MC Present at the Area Between Buildings 846 and 849 MRS**

| Potential MEC | Potential MC | Primary Release Mechanisms |
|---|---|---|
| Bombs | HE | Mishandling |
| Large Caliber Practice Rounds (37mm and larger) | Inert materials | Deliberate disposal |

HE – High Explosives

*5.19.3.2 Maximum Penetration Depth*

The ordnance was found on the ground surface. However, there are no records to indicate that the area was not used to bury MEC. The potential depth of burial, however, is not known.

*5.19.3.3 MEC/MC Density*

Available records do not indicate the site was used for ammunition storage or disposal, and the presence of the two pieces of ordnance found on the ground appears to be the result of mishandling or deliberate disposal. As such, the MEC density at the Area Between Buildings 846 and 849 is expected to be very low. However, an assessment of UXO/MEC has not been performed at the MRS.

*5.19.3.4 Munitions Debris*

The available information appears to suggest that the 175mm projectile may represent munitions debris. However, no investigation has been performed to assess the components of the projectile.

#### *5.19.3.5 MEC Exposure and Transport Pathway Analysis*

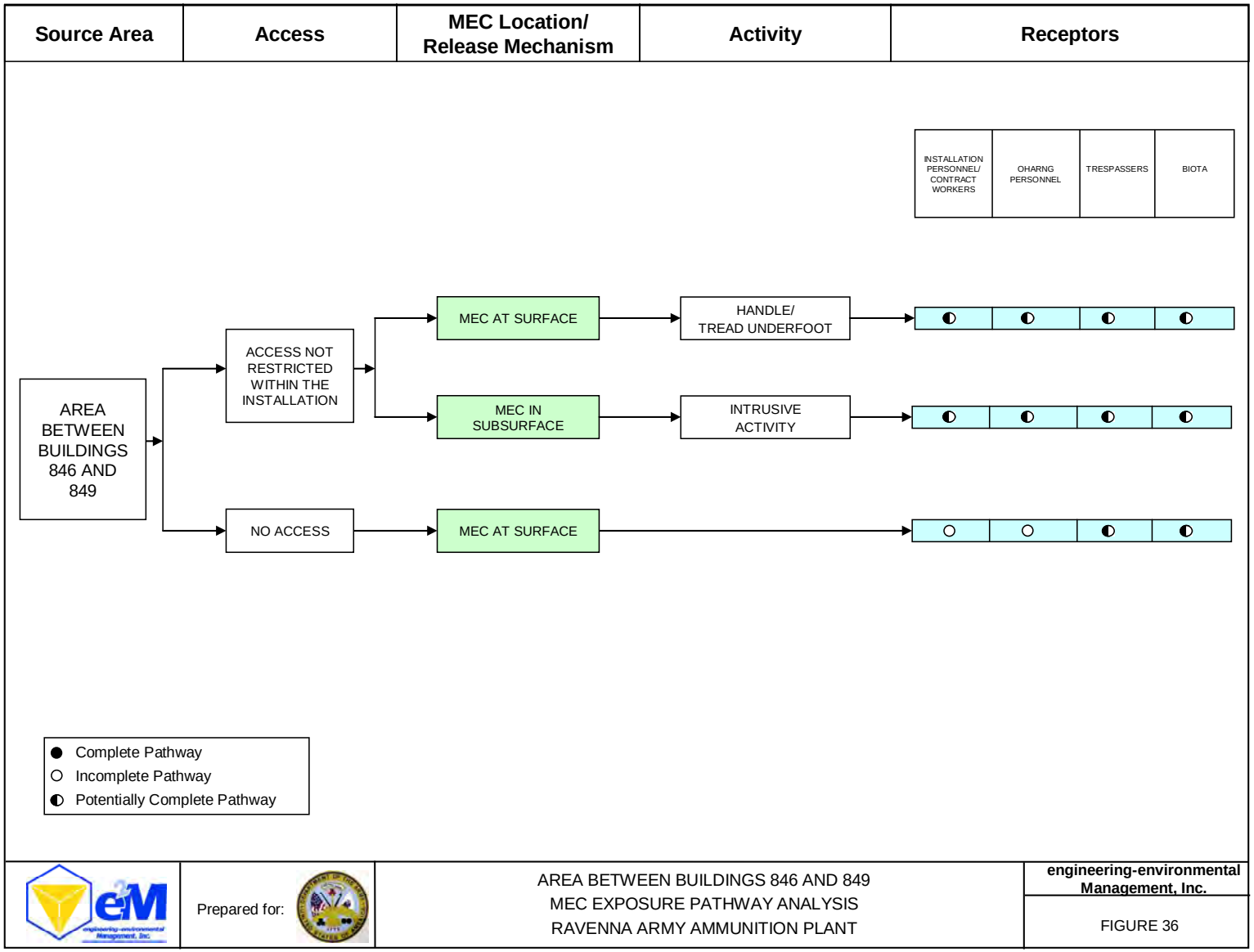
The potential exposure pathway for human and ecological receptors would be to handle or tread under foot or the disturbance of subsurface soil. **Figure 36** provides the pathways evaluated and the findings of the assessment.

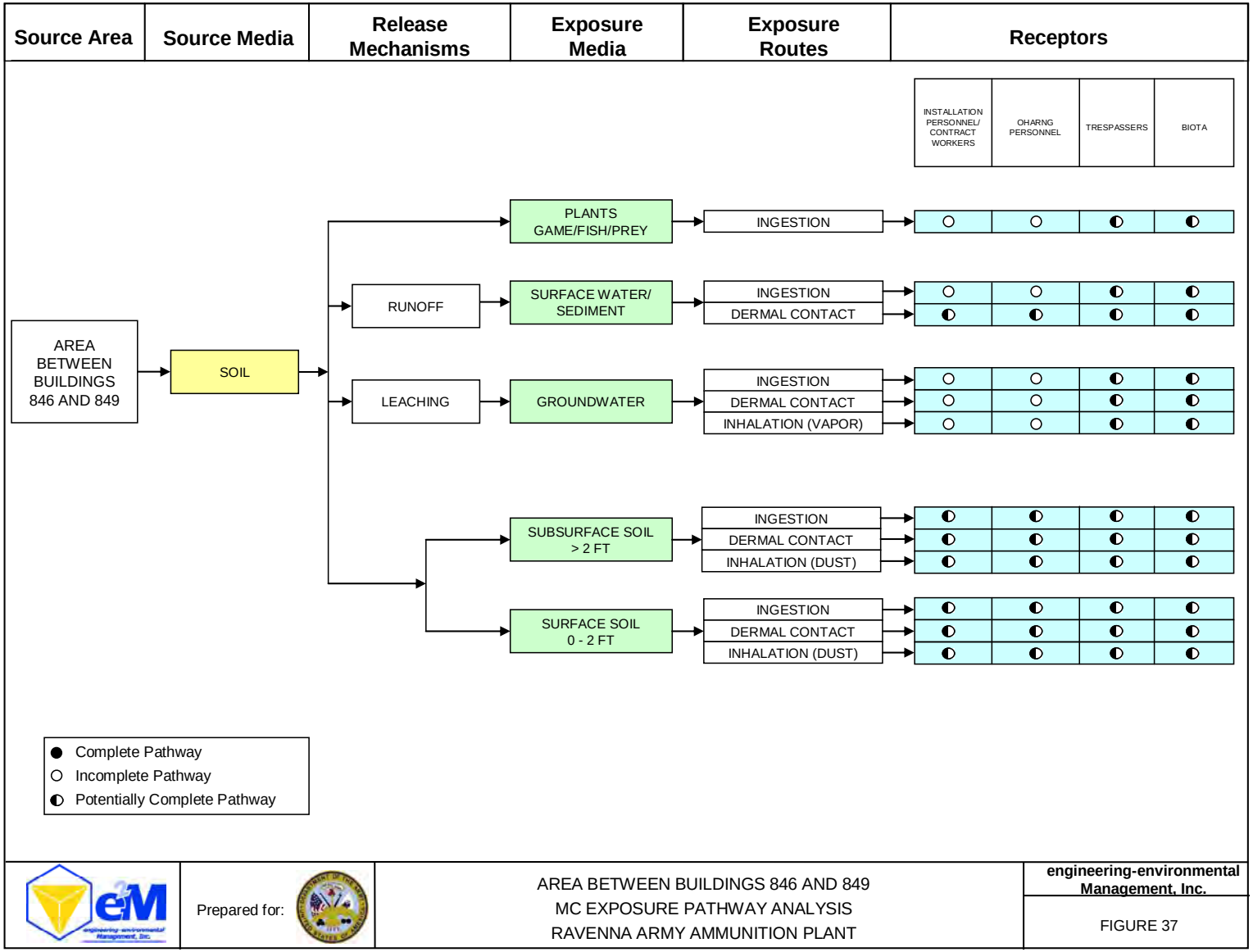
#### *5.19.3.6 MC Exposure and Transport Pathway Analysis*

The presence of MC has not been investigated at the Area Between Buildings 846 and 849, and its presence can not be dismissed. If MEC is found on site, further evaluation of MC under the SI process may be warranted. **Figure 37** provides the pathways evaluated and the findings of the assessment.

### 5.19.4 MRS Data Gaps

The site has not been investigated for the presence of MEC or MC (RVAAP-2.A.10). There is no definitive information to determine whether or not MEC or MC exists at the site and to what degree.


Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
TRESPASSERS
BIOTA
AREA BETWEEN BUILDINGS 846 AND 849
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
AREA BETWEEN BUILDINGS 846 AND 849
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 36


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
TRESPASSERS
BIOTA
AREA BETWEEN BUILDINGS 846 AND 849
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
AREA BETWEEN BUILDINGS 846 AND 849
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 37

# 5.20 Field at the NE Corner of Intersection (RVAAP-064-R-01)

## 5.20.1 Human Exposure Profile

### *5.20.1.1 Current Land Use*

The MRS is an approximate 91.86 acre field located in the central-northeastern section of RVAAP, at the northeastern corner of the intersection of Paris-Windham Road and Smalley Road. The area was formerly used for agricultural purposes by lease between 1942 and 1991, when the land was reassigned to RTLS (RVAAP-2.A.6). The area is currently undeveloped and used for heavy lift training by rotary aircraft. Current activities include training, natural resource management, security patrols, and maintenance activities.

### *5.20.1.2 Current Human Receptors*

Current human receptors include OHARNG personnel and contract workers.

### *5.20.1.3 Land Use Restrictions*

There are no known access restrictions to the Field at the NE Corner of Intersection MRS. Once on the Installation, access to the MRS is not restricted.

### *5.20.1.4 Beneficial Resources*

The Field at the NE Corner of Intersection MRS is covered with tall, mature grasses and is completely surrounded by mature forest land.

## 5.20.2 Ecological Profile

The ecological profile at the Field at the NE Corner of Intersection MRS is analogous to the rest of RVAAP with only minor differences. These site-specific variances are provided in **Table 38**. Specific details of the ecological setting at RVAAP are provided in **Section 5.2.2**.

**Table 38: Field at the NE Corner of Intersection Ecological Profile**

| MRS | Sensitive Habitat | Degree of Disturbance | Ecological Receptors |
|---|---|---|---|
| Field at the NE Corner of Intersection | None. | Minimally disturbed. Area is old field growth. | No federal threatened or endangered species. |

In some cases, ecological surveys that have been conducted at the Installation included areas that contain MRSs. In these areas, information has been collected documenting the presence (or absence) of State-listed plant and animal species. While beyond the scope of this report, this information is available and can be obtained from the RTLS-Environmental Office.

### 5.20.3 MEC and MC Release Profile

*5.20.3.1 Release Mechanism*

One inert anti-tank landmine (14 to 16 inches in diameter, pressure detonated), was discovered adjacent to Paris-Windham Road in the northern central portion of the MRS. No other MEC have been observed at the site by OHARNG personnel who perform training activities at the site. The fact that the discovery was a one-time occurrence suggests that the placement of the land mine at the site was a unique or very infrequent event. The release mechanism is unknown but it may be assumed that the landmine was lost by OHARNG personnel during training exercises. **Table 39** provides a summary of the potential MEC and MC present at the MRS and their release mechanism.

**Table 39: Summary of Potential MEC and MC Present at the Field at the NE Corner of Intersection MRS**

| Potential MEC | Potential MC | Primary Release Mechanism |
|---|---|---|
| Anti-tank Landmine | None | Mishandling |

*5.20.3.2 Maximum Penetration Depth*

Landmines are typically deployed just below the ground surface. However, the landmine found at the MRS was discovered lying on the ground surface. As such, no penetration would be expected.

*5.20.3.3 MEC/MC Density*

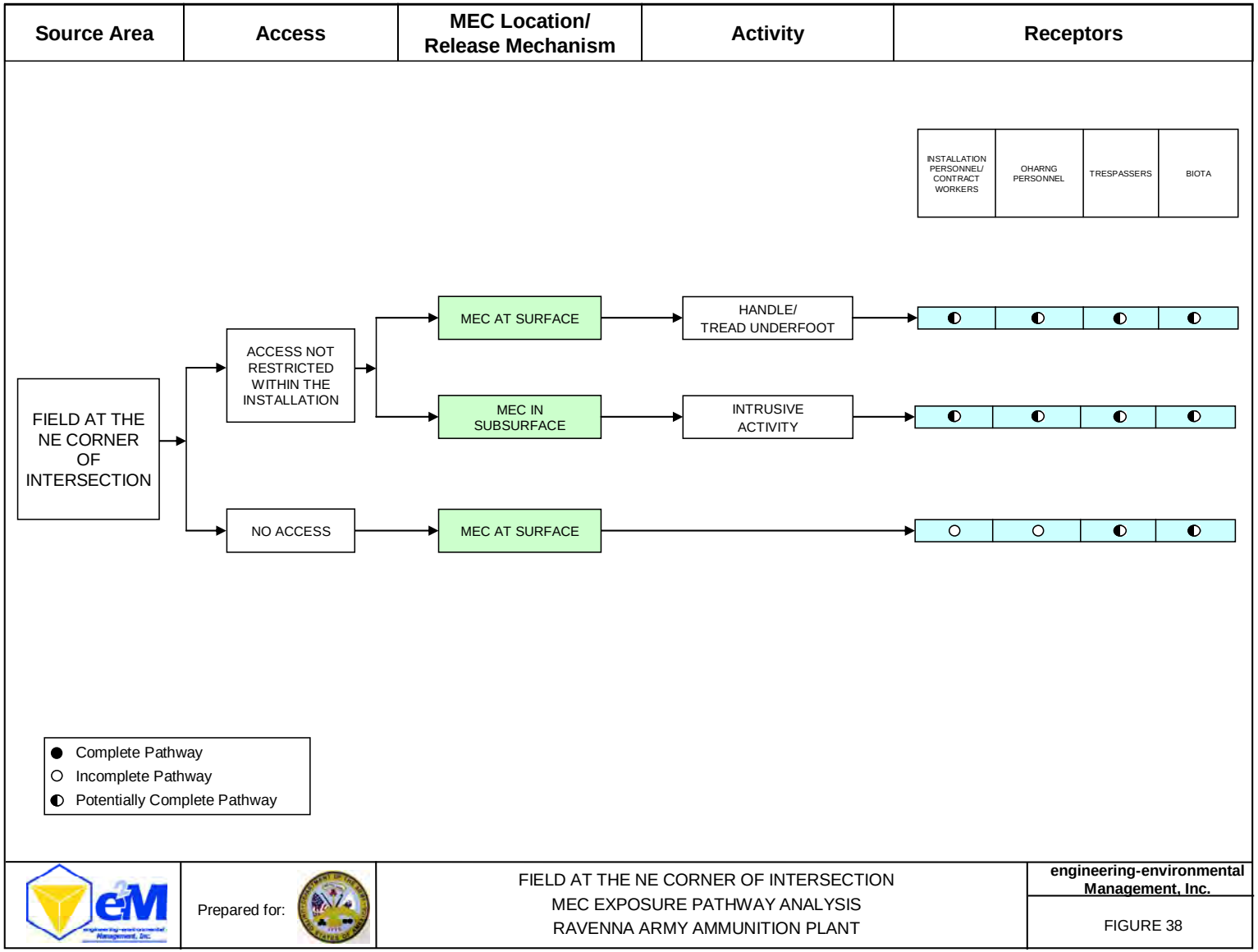
There is no record of ammunition disposal at the MRS. The area was used for farming from the opening of the installation until 1991. It is likely that the MEC/MC density at the MRS is negligible. However, no assessment of UXO/MEC has been performed at the MRS.

*5.20.3.4 Munitions Debris*

Other than the inert landmine, no munitions debris has been found at the MRS.

*5.20.3.5 MEC Exposure and Transport Pathway Analysis*

One inert landmine was found on the MRS and it is possible additional MEC may be present at the site. Therefore, the exposure pathways for human and ecological receptors for handle/tread underfoot are potentially complete. **Figure 38** provides the pathways evaluated and the findings of the assessment.

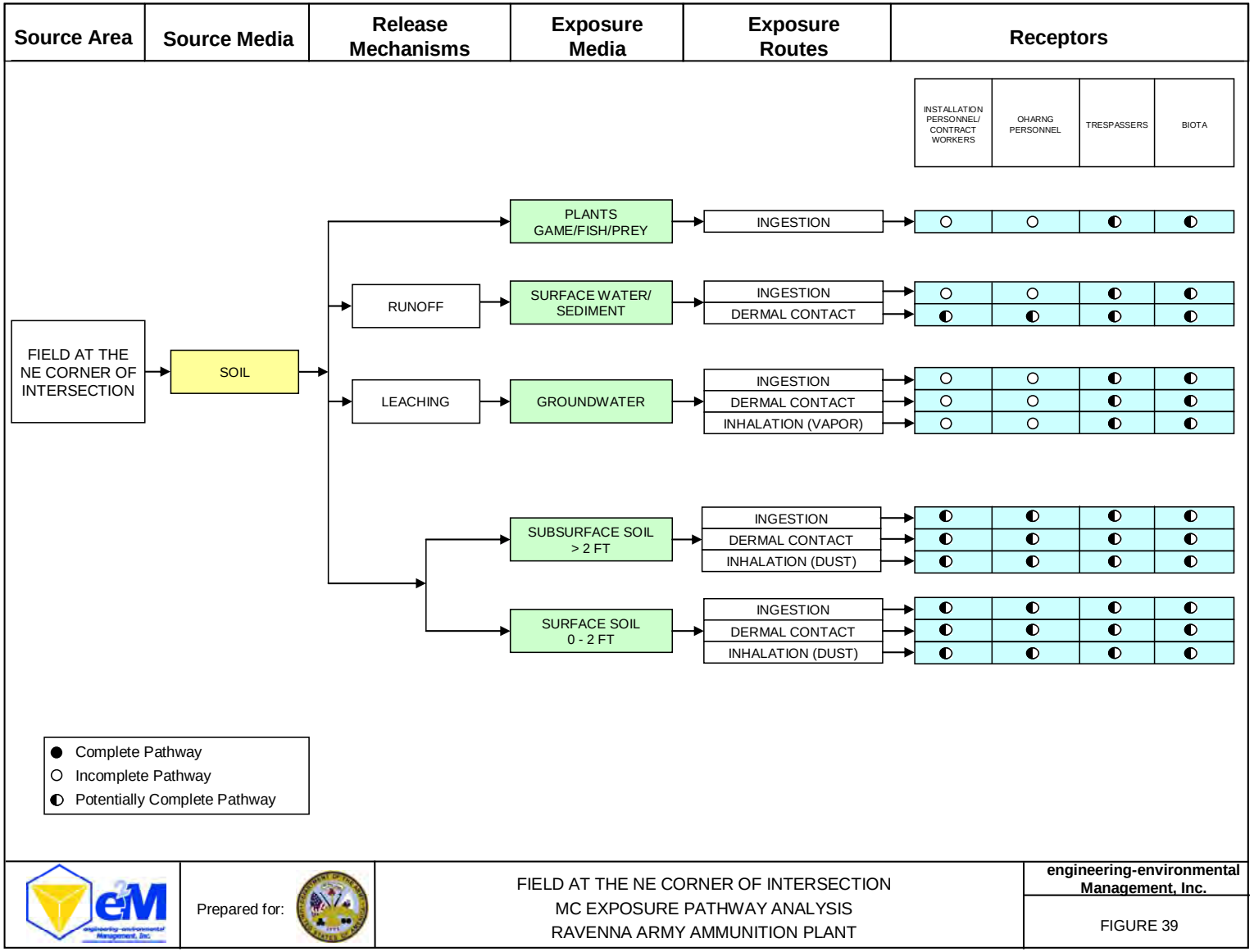

Source Area
Access
MEC Location/ Release Mechanism
Activity
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
TRESPASSERS
BIOTA
FIELD AT THE NE CORNER OF INTERSECTION
ACCESS NOT RESTRICTED WITHIN THE INSTALLATION
NO ACCESS
MEC AT SURFACE
MEC IN SUBSURFACE
MEC AT SURFACE
HANDLE/ TREAD UNDERFOOT
INTRUSIVE ACTIVITY
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
FIELD AT THE NE CORNER OF INTERSECTION
MEC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 38

#### *5.20.3.6 MC Exposure and Transport Pathway Analysis*

The presence of MC has not been investigated at the MRS. While inert landmines do not contain MC, the presence of MC can not be ruled out. Thus the exposure pathways for human and ecological receptors have been determined to be potentially complete. **Figure 39** provides the pathways evaluated and the findings of the assessment.

### 5.20.4 MRS Data Gaps

While there have been no other reports of MEC or munitions debris found at the site, a UXO/MEC site investigation has not been completed. Therefore, the potential presence of MEC or munitions debris can not be ruled out. Further, there have been no investigations conducted at the MRS to determine the presence or absence of MC. As such, further investigation in the area is required.


Source Area
Source Media
Release Mechanisms
Exposure Media
Exposure Routes
Receptors
INSTALLATION PERSONNEL/ CONTRACT WORKERS
OHARNG PERSONNEL
TRESPASSERS
BIOTA
FIELD AT THE NE CORNER OF INTERSECTION
SOIL
RUNOFF
LEACHING
PLANTS GAME/FISH/PREY
SURFACE WATER/ SEDIMENT
GROUNDWATER
SUBSURFACE SOIL > 2 FT
SURFACE SOIL 0 - 2 FT
INGESTION
DERMAL CONTACT
INHALATION (VAPOR)
INHALATION (DUST)
Complete Pathway
Incomplete Pathway
Potentially Complete Pathway
Prepared for:
FIELD AT THE NE CORNER OF INTERSECTION
MC EXPOSURE PATHWAY ANALYSIS
RAVENNA ARMY AMMUNITION PLANT
engineering-environmental Management, Inc.
FIGURE 39

# 6.0 CONCLUSIONS

The intent of the HRR is to perform a limited-scope records search to document historical and other known information on the MRSs identified at RVAAP, to supplement the US Army CTT Range/Site Inventory information, and to support the TPP process designed to facilitate decisions on those areas where more information is needed to determine the next step(s) in the CERCLA process.

After reviewing the information collected during the HRR, the following conclusions have been made for the MRSs at RVAAP. Nineteen MMRP-eligible sites were identified during the US Army CTT Range/Site Inventory. Since the completion of that phase, Winklepeck Burning Grounds (RVAAP-005-R-01) has been addressed under the BRAC and IRP. Chemical contamination at the MRS was addressed under the IRP, whereas BRAC funding was used to address explosive safety. Further, the MRS is no longer eligible for the MMRP as the land is being developed as an operational range (Mark 19 Range) by the OHARNG. Therefore, this MRS has been removed from the MMRP.

The remaining eighteen MRSs qualify for the MMRP due to the demolition and/or disposal activities that were conducted on the sites which resulted in the possible presence of MEC and/or MC, and where the releases occurred prior to September 2002. Summaries of the findings for the eighteen MMRP-eligible sites (MRSs) are provided below.

**Ramsdell Quarry Landfill (RVAAP-001-R-01)**

Based on information collected during the HRR, it was determined that the MRS boundary identified in the US Army CTT Range/Site Inventory did not capture the entire area where OB/OD operations were conducted, as well as other suspect areas. As a result, the MRS boundary has been expanded to the north to include the entire quarry area and to the south to include an open area outside and south of the quarry that was identified by the Installation as potentially containing MEC. In addition, the former landfill area has been removed from further consideration as part of the MRS since this area satisfies the requirements of a Response Complete site. The new acreage of the MRS is approximately 13.43 acres.

For approximately four years, the MRS was used to thermally treat (i.e., open burn) explosives waste and munitions, as well as napalm bombs. MEC (e.g., 81mm mortar rounds) has been observed at the former quarry area and analytical data from IRP investigations have confirmed the presence of explosives and metals. There is no definitive information on the presence of MEC or MC at the open field south of the quarry.

Based on the findings, the entire MRS is considered to contain MC, and may potentially contain MEC on the ground surface at the former quarry area, as well as on the ground surface and buried at the open field. Within the quarry area, the primary exposure pathway for human and ecological receptors would be contact with MEC lying on the ground surface, while at the open field the exposure pathways for human and ecological receptors would be through the handling or treading under foot and the disturbance of subsurface soil.

Adequate historic data determining the presence of MEC at the former quarry area exists; however, little information is known concerning the extent and nature of MEC that may potentially be present or concerning the activities that were conducted in the open field south of the former quarry. As such, further characterization during the SI phase is required at the open field and the former quarry area.

**Erie Burning Grounds (RVAAP-002-R-01)**

The MRS covers approximately 33.93 acres and is bordered to the east by the Portage/Trumbull County line and is located just south of the Installation boundary. From 1941 through 1951, the MRS was used to thermally treat bulk, obsolete, off-spec propellants, conventional explosives, rags, and large explosives contaminated items (e.g. railcars) by open burning on the ground surface.

In the early 1990s, the majority of the MRS became flooded leaving only the railroad embankment and a portion of the T-Area exposed. Within these areas, the primary exposure pathway for human and ecological receptors would be contact with MEC lying on the ground surface. Periodically, the open water body north of the rail spurs drains on its own, leaving open the possibility of contact with MEC that had previously been submerged.

Adequate historic data determining the presence and density of MEC items has not fully been determined and will require additional characterization during the SI phase. MC in soils and dry sediments has been addressed under the IRP, with a likely decision (based on the risk assessment) of NFA. However, a decision concerning MC in wet sediments, surface water, or ground water has not been made. As such, MC will be further investigated under the SI phase.

**Demolition Area #2 (RVAAP-004-R-01)**

This MRS consisted of approximately 14.91 acres located in the central portion of the facility north of Old Newton Falls Road, north of the load lines. The MRS was used between 1948 and 1991 to detonate large caliber munitions and off-spec bulk explosives that could not be deactivated or

demilitarized by any other means due to their condition. The MRS was also used to bury white phosphorous and bombs. During the HRR, it was determined that the US Army CTT Range/Site Inventory MRS boundary did not capture Burial Sites 1 and 2, or the Rocket Ridge area. Further, a determination was made that the interim RCRA unit and the portion of the 40mm prototype test range contained within it were not MMRP-eligible and, subsequently, have been removed for consideration as part of the MRS. The RCRA unit is still used periodically for the detonation of munitions found during IRP investigations. The unit will remain open until its use is no longer needed, at which time it will be closed in accordance with all applicable state and federal requirements. Based on these updates, the MRS footprint was increased to approximately 32.95 acres. Additional information was provided by the Installation that indicated that there is a bomb disposal area located near the northwestern portion of the MRS. While this could not be corroborated by additional documentation, the area will require further investigation during the SI. Based on the SI findings, this area may or may not be included as part of the MRS footprint.

The presence of MEC is expected in the subsurface soil (e.g., burial areas and demolition pits) and lying on the ground surface throughout the AOC (e.g., Rocket Ridge). Human and ecological exposure pathways include contact with MEC during disturbance of subsurface soil and contact with MEC lying on the ground surface. The presence of MC is also expected at the MRS. Potential human exposure pathways include dermal contact with surface and subsurface soil, and surface water and sediment. Potential exposure pathways for ecological receptors would include ingestion and dermal contact with surface water and sediment, surface and subsurface soil, and groundwater.

The extent and density of MEC items and MC have not fully been determined and will require additional characterization during the SI phase.

**Load Line #1 (RVAAP-008-R-01)**

Based on information collected during the HRR, the size of the MRS has been reduced from the 163.62 acres identified during the US Army CTT Range/Site Inventory to approximately 4.63 acres. According to Installation personnel, the only potential MEC/MC concerns that remain at the MRS are the triple base propellants that are lying on the ground surface adjacent to the former locations of Buildings CB-13, CB-14, and the popping furnace, as well as existing Building CB-13B. Therefore, the MRS boundary was reduced to capture only those areas immediately surrounding the buildings (i.e., CB-13, CB-13B, and CB-14) and the popping furnace. There was also a report that a 152mm shell casing was found in a building located on site (potentially Building CB-801). The prospect that MEC may be addressed during

the next removal action to be conducted at the MRS is currently being evaluated. Should the removal action include MEC, this MRS will be considered "Response Complete" and no further action will be undertaken. However, until this determination is made, MEC concerns at the MRS will be addressed in the SI process.

Triple base propellants are known to exist lying on the ground surface at the MRS. There are no reports that MEC or munitions debris had been buried or otherwise disposed on site. Accordingly, the primary exposure pathway for human and ecological receptors is to handle or tread under foot MEC lying on the ground surface.

A UXO anomaly avoidance survey was conducted during the IRP environmental media field sampling efforts with no reported findings. Further, there have not been any additional sightings of MEC reported. There is some uncertainty about the extent of triple base propellants that will be removed under the current PBC removal work. To ensure that all triple base propellants are removed, further investigation will be conducted to assess the presence of MEC and MC during the SI phase.

**Load Line #12 (RVAAP-012-R-01)**

Based on information collected during the HRR, the size of the MRS has been reduced from the 77.58 acres identified during the US Army CTT Range/Site Inventory to approximately 1.0 acre. The MRS boundary was reduced based on the findings of several IRP investigations that have been conducted at the site, demolition actions (i.e., removal of buildings), and input from installation personnel. The revised MRS boundary includes the area immediately surrounding the location where the 90mm projectiles were found.

Munitions debris was discovered buried at the MRS and removed; however, a determination has not been made whether or not all buried MEC had been found. Should the presence of shallow buried MEC be pervasive, both a surface and subsurface exposure pathway would exist for human and ecological receptors.

There is inadequate historic data to determine whether or not MEC is pervasive at the site or if the discovery of the 90mm projectiles was an isolated incident. As such, further characterization during the SI phase is required to establish the presence or absence of MEC. MC will be covered under the IRP.

**Fuze and Booster Quarry (RVAP-016-R-01)**

The Fuze and Booster Quarry is an undeveloped site that encompasses the three ponds constructed within the former quarry. The MRS was used as an open burning area and subsequently a landfill that accepted fuze and booster assemblies, projectiles, residual ash, and sanitary waste. Reportedly in 1976, existing debris was removed from the MRS and disposed of elsewhere. According to Installation personnel, the MRS contains MEC.

Any MEC remaining at the ponds would be located along the banks or below the water line. The depths of the ponds have been reported to be anywhere from 20 to 30 ft. Considering this, the exposure pathway for human receptors would potentially include handling or treading under foot. There is a possible potentially complete exposure pathway for ecological receptors (e.g., beaver) involving the handling of MEC.

Surveys for MEC or munitions debris have not been conducted at the Fuze and Booster Quarry MRS. MEC is suspected to be contained within the northern and southern ponds. However, very little information is known about the presence of MEC in the middle pond or concerning the type, condition, and extent of MEC located at the MRS. Therefore, further characterization will be conducted at all three ponds during the SI phase. MC will be covered under the IRP.

**Landfill North of Winklepeck (RVAAP-019-R-01)**

The MRS is an undeveloped site that consists of a wooded slope and creek bottom situated adjacent and east of the IRP AOC landfill. Based on the findings of the HRR records search, the location and size of the MRS has been revised from that identified during the US Army CTT Range/Site Inventory (from 7.55 acres, to approximately 14.05 acres).

According to Installation personnel, potential MEC is lying on the ground surface and may be potentially buried at the MRS. Considering this, the potential exposure pathways for human and ecological receptors would be contact with MEC in surface soils by handling or treading underfoot and through the disturbance of subsurface soil.

There is no supporting documentation to verify that MC is present or absent at the MRS. Therefore, the potential exposure pathways for human receptors would include dermal contact with contaminated soil (i.e., surface and subsurface), surface water, and/or sediment. Potential exposure pathways for

ecological receptors would include both dermal contact and ingestion of contaminated environmental media.

Characterization studies to assess MC in surface soils have not been conducted at the newly identified MRS. Data collected during the investigation of the landfill IRP AOC have determined that sediment samples contained elevated levels of metals.

Potential MEC and munitions debris exist at the MRS. The type, extent, and condition of the items are not known. Further characterization will be conducted to establish the absence (or presence) of MEC and MC at the MRS.

**40mm Firing Range (RVAAP-032-R-01)**

The MRS is an undeveloped site that consists of an open field that is surrounded by mature forest. From 1969 until 1971, the MRS was used to test fire 40mm grenade cartridges from a fixed firing point.

Potential MEC is reported lying on the ground surface at the MRS. Considering this, the potential exposure pathway for human and ecological receptors would be contact with MEC on the surface; that is, by handle/treading underfoot.

While potential MEC may be present at the MRS, little is known about its density, condition, or extent. Further characterization will be conducted to establish the absence (or presence) of MEC.

**Firestone Test Facility (RVAAP-033-R-01)**

The MRS is collocated with the former Load Line 6 Fuze and Booster area, which has been completely demolished. The MRS consisted of three buildings (since removed) used as test chambers, and a pond that remains at the site. The areas are not contiguous. According to personnel interviews and information reviewed, two of the test chambers were used to test TOW and Dragon missiles, while the third test chamber was used to test shaped charges. The pond was also used to test shaped charges underwater. It was determined during this HRR that one of the test chambers used to test the missiles and the one used to test the shaped charges were left out of the US Army CTT Range/Site Inventory; the locations of these former buildings have since been added.

Since the missile test operations were conducted in enclosed test chambers, which were demolished and removed, MEC is not expected to be present at these locations within the MRS. MEC is also not

expected to be present at the test chamber used for the shaped charges. However, no investigations of the pond have been conducted; consequently, the presence of MEC can not be dismissed. Therefore, an exposure pathway for human and ecological receptors potentially exists at the MRS. Further, there is very little information concerning the presence or absence of MEC at the suspected test range located northeast of the former facility. As such, an exposure pathway for human and ecological receptors could potentially exist at the MRS.

There is adequate historic data to determine that MEC is not present at the former test chambers. However, there is insufficient information to rule out the presence of MEC at the pond area. As such, further characterization of the pond area will be required during the SI phase. Very little is known about the presence or absence of MEC at the suspected test range area. As such, the area will have to be investigated during the SI field work. Based on these findings, the area may or may not be included as part of the MRS footprint. MC will be covered under the IRP.

**Sand Creek Dump (RVAAP-034-R-01)**

The former dump was used to dispose of general construction debris, including asbestos debris, concrete, fluorescent light tubes, lab bottles, 55-gallon drums, and wood. There is no information to indicate that MEC or related munitions items had been disposed of at the MRS. However, two inert 75mm rounds were discovered at the site in 2003 during ongoing IRP field work.

While MEC has not been found at the MRS, the possibility exists that items may have been buried or mixed with the general waste material that has been deposited over the years. Considering this, the potential exposure pathways for human and ecological receptors would be contact with MEC in surface soils by handling or treading under foot or disturbance of the waste material and subsurface soil.

The extent of MEC present at the MRS is not fully understood; specifically, it is not fully known whether or not MEC lying on the ground surface is mixed with the general waste material, or buried at the MRS. Therefore, further characterization during the SI phase will be required. MC will be addressed under the IRP.

**Building #F-15 and F-16 (RVAAP-046-R-01)**

Building #F-15 and F-16 were referred to as the Surveillance Work Shop, where large caliber artillery rounds were dismantled and inspected as part of a cyclic inspection procedure. The procedure involved the random selection of completed rounds from storage which were subsequently dismantled for

inspection and testing of individual components (i.e., fuzes, primer, propellant, and HE). Information concerning the final disposition of the tested components was not disclosed. However, large caliber artillery projectiles void of HE have been found at the MRS. The exact location where the rounds were found was not disclosed, but it is assumed that they were lying on the ground surface next to the buildings. There was no information found that MEC had been buried at the MRS.

The MRS has the potential to contain munitions debris and possibly MEC. Considering this, the potential exposure pathways for human and ecological receptors would be contact with MEC in surface soils by handling or treading under foot or through the disturbance of subsurface soil.

The extent of MEC present at the MRS is not fully understood; specifically, whether or not MEC may be buried at the MRS. Therefore, further characterization during the SI phase will be required. MC will be addressed under the IRP.

**Anchor Test Area (RVAAP-048-R-01)**

Beginning in the early 1960s, the Anchor Test Area was reportedly used to test fire anchoring devices into the ground. Small explosive devices were used to drive anchors for ropes and cables into the ground. The distinct surface features at the MRS are two large dirt mounds and a nearby sandpit. It is suspected that anchor tests were performed within the 12 × 36 ft sandpit, and the dirt mounds functioned as blast walls. Metal debris is visible in the area. A section of cement culvert can be seen in one of the mounds. It is suspected that the culvert was used to store anchors while tests were being conducted.

While some metal debris of unknown origin has been found in the area, the MRS has not been evaluated for the presence of MEC nor have there been reports of ordnance located at the site. If present, MEC is expected on the ground surface or at a shallow depth. Human and ecological exposure pathways include contact with MEC during disturbance of subsurface soil and contact with MEC lying on the ground surface.

MEC investigations have not been conducted at the Anchor Test Area. However, it has been reported that metal debris of unknown origin has been observed at the site. Therefore, further characterization during the SI phase will be required to determine if MEC is present. MC will be addressed under the IRP.

**Atlas Scrap Yard (RVAAP-050-R-01)**

The Atlas Scrap Yard MRS is approximately 66.04 acres in size and is located in the southeastern area of RVAAP. The MRS is an old construction camp built to house workers during the construction of the Installation. After demolition of the camp in 1969, the MRS became a storage area for non-explosive scrap. Currently, the MRS is heavily overgrown with tall grasses, isolated stands of trees, and shrubs. There are scattered piles of debris located throughout the site that appear to be comprised of construction debris, dunnage, and metal scraps. Reportedly, UXO has been uncovered in the southwest corner of the MRS and the material was sorted and removed from the site in 2003. This disclosure was based on the findings of a removal action that was conducted at the MRS. In a recent characterization study conducted under the IRP, the report states that the study focused on areas of concern including stockpiles of debris consisting of pipes, railroad ballast, railroad ties, concrete rubble, and chipped ammunition boxes, as well as portions of the AOC where specific operations occurred, such as munitions storage.

The only reports of MEC being present at the MRS have involved the discovery of items lying on the ground surface or mixed with miscellaneous debris. However, there is insufficient information to dismiss that MEC is not buried at the MRS. Based on this, the exposure pathways anticipated at the MRS include direct contact with MEC by handling or treading under foot and through the disturbance of subsurface soil.

The presence of MEC has not been fully investigated and defined. Therefore, further characterization during the SI phase will be required. MC will be covered under the IRP.

**Block D Igloo (RVAAP-060-R-01)**

The Block D Igloo MRS consists of the area contained within the suspected debris field that resulted when Igloo 7-D-15 ("D" Block) accidentally exploded on 24 March 1943. To capture the potential debris field, the USACE Huntsville District placed a 3,000 ft radius circle centered on the former igloo. The calculations were based on the type of ordnance contained in the igloo when it detonated. Based on an accident report issued by the Office of the Chief of Ordnance, Safety and Security Division, the blast was definitely directional and formed two fans: the first and smaller fan was roughly circular in shape and extended to the right, to the rear, and to the left of the igloo, while the larger fan extended forward from the igloo in an easterly direction toward the "E" block of igloos. The major force was directed along a median line in conjunction with the long axis of the igloo. Some of the concrete

fragments were propelled forward in the larger of the two fans up to 3,800 ft. There was no mention of the distance that the smaller fan stretched.

No UXO removal documentation has been identified. Should MEC be present, the potential exposure pathway for human and ecological receptors would be to handle or tread under foot. Likewise, there are no analytical data to establish that MC is not present at the MRS. Therefore, it is presumed that a potentially complete exposure pathway for human and ecological receptors exists.

Insufficient information exists documenting the presence or absence of MEC and MC at the MRS. Therefore, further characterization will be required during the SI phase.

**Block D Igloo–TD (RVAAP-061-R-01)**

The Block D- TD MRS consists of the portion of the circular Block D Igloo MRS that extends beyond the Installation boundary in the north-central portion of RVAAP. The Block D Igloo–TD covers an area of approximately 19.25 acres and includes a segment of the railroad that follows the northern boundary of the RVAAP, farmland, and forested areas.

Although RVAAP personnel indicated the site was considered clean of UXO some time after the 1943 explosion, this was not documented or confirmed. It is anticipated that the potential presence of MEC or munitions at the MRS is low. However, should MEC be present, the potential exposure pathway for human and ecological receptors would be by handling or treading under foot. Analytical data to establish that MC is present or absent at the MRS has not been collected. Therefore, it is presumed that a potentially complete exposure pathway for human and ecological receptors exists at the MRS.

Considering the area has not been the subject of an investigation, further characterization of MEC and MC will be required during the SI phase.

**Water Works #4 Dump (RVAAP-062-R-01)**

The Water Works #4 Dump is an approximate 6.15 acre wooded area immediately west of Water Works #4 and Load Line 7, in the southwestern portion of RVAAP. Large caliber casings were found scattered throughout the MRS, as well as metal parts identified as ogives. According to RVAAP personnel, the dates of disposal are estimated to be between 1941 and 1949. The type and origin of the casings are unknown, while the ogives were identified as part of 155mm shrapnel projectiles. In addition

to the casings and ogives, Installation personnel have indicated that rifling propagators are present at the MRS. No UXO investigations have been performed on the site.

Available information suggests that some of the casing fragments may be MEC, while the majority of the items are considered munitions debris. Currently no investigations have been conducted to assess the constituents present in the casing fragments or ogives. In case the presence of MEC is confirmed, the potential exposure pathway for human and ecological receptors would be to handle or tread under foot. Analytical data to establish the presence or absence of MC at the MRS does not exist. Therefore, it is presumed that a potentially complete exposure pathway for human and ecological receptors exists at the MRS.

Conclusive evidence does not exist documenting the presence or absence of MEC and MC. Therefore, further characterization during the SI phase will be required.

**Area Between Buildings 846 and 849 (RVAAP-063-R-01)**

This approximate 2.65 acre MRS consists of the area between Buildings 846 and 849. The MRS may have been used for burning of construction debris and rubbish in the past, as well as a collection center for salvaged items that were to be auctioned off. In 1996, one anti-personnel bomb, loaded with HE was found by the OHARNG lying on the ground surface. In addition, one inert 175mm projectile was found on the ground surface at the site. The site has not been evaluated for presence of MEC and no site investigations have been performed at the site.

Available records do not indicate the site was used for ammunition disposal, and the presence of the two pieces of ordnance found on the ground appears to be the result of mishandling. However, conclusive evidence that the MRS was not used to bury MEC was not found during the HRR review. As such, the potential exposure pathway for human and ecological receptors would be to handle or tread under foot or through the disturbance of subsurface soil. Analytical data to establish the presence or absence of MC at the MRS does not exist. Therefore, it is presumed that a potentially complete exposure pathway for human and ecological receptors exists at the MRS.

The site has not been evaluated for the presence of MEC or MC. Therefore, further characterization during the SI phase will be required.

**Field at the NE Corner of Intersection (RVAAP-064-R-01)**

The MRS consists of an open field that encompasses approximately 91.86 acres. The open field is bisected by Paris-Windham Road, which runs north-south through the MRS. Between 1941 and 1991, the field had been leased for agricultural purposes. In 1992, the land was transferred to the NGB and reassigned to RTLS. One inert anti-tank landmine was discovered in 1996 by OHARNG personnel lying on the ground surface in the north-central portion of the MRS approximately 100 ft east of Paris-Windham Road. The inert practice mine was removed by the OHARNG from the MRS. The inert practice landmine is now a show-piece at Building 1036. No other reports of MEC or munitions debris having been found at the MRS have been discovered. According to input from the OHARNG and Installation personnel, it is believed that the discovery of the inert land mine was a one-time occurrence that probably resulted from the accidental misplacement by a guardsman.

No UXO investigations have been performed at the MRS. Therefore, human and ecological exposure pathways at the MRS are considered to be potentially complete for a surface exposure. Analytical data to establish the presence or absence of MC at the MRS does not exist. Therefore, it is presumed that a potentially complete exposure pathway for human and ecological receptors exists at the MRS.

Further characterization will be conducted to establish the absence (or presence) of MEC and MC.

**Table 40** below provides a summary of the conclusions.

**Table 40: Summary of Conclusions**

| MRS Name | AEDB-R Site ID* | MRS Added During HRR (yes/no) | CTT Acreage | HRR Acreage | Presence of MEC/MC | | Data Gaps |
|---|---|---|---|---|---|---|---|
| | | | | | MEC Yes/No/ Unknown | MC Yes/No/ Unknown | |
| Ramsdell Quarry Landfill | RVAAP-001-R-01 | No | 3.79 | 13.43 | Unknown | Yes | Presence and type of MEC at the former OB/OD area at the bottom of the quarry and area south of the quarry are not fully known. Presence of MC at the OB/OD area has been established. Presence of MC at the area south of the quarry is not fully known. |
| Erie Burning Grounds | RVAAP-002-R-01 | No | 33.93 | Same | Unknown | IRP[1]/MMRP | Presence and type of MEC at the MRS is not fully known. Presence of MC in wet sediments is not fully understood. |
| Demolition Area #2 | RVAAP-004-R-01 | No | 14.91 | 32.95 | Yes | Yes | Presence of MEC has been established, but type is not fully known. Presence of MC at the two burial areas, Rocket Ridge, and the northwestern disposal area is not fully known. |
| Winklepeck Burning Grounds | RVAAP-005-R-01 | Removed | 317.01 | N/A | BRAC[2] | IRP[1] | Winklepeck Burning Grounds is not MMRP-eligible and has been removed from further consideration. |
| Load Line #1 | RVAAP-008-R-01 | No | 163.62 | 4.63 | Unknown | IRP[1]/MMRP | Presence and extent of triple base propellants is not fully known. MMRP will address any MEC/MC issues not addressed by the PBC contractor. |
| Load Line #12 | RVAAP-012-R-01 | No | 77.58 | 1.0 | Unknown | IRP[1] | Presence and type of potentially buried MEC is not fully known. |

**Table 40: Summary of Conclusions (continued)**

| MRS Name | AEDB-R Site ID* | MRS Added During HRR (yes/no) | CTT Acreage | HRR Acreage | Presence of MEC/MC | | Data Gaps |
|---|---|---|---|---|---|---|---|
| | | | | | MEC Yes/No /Unknown | MC Yes/No /Unknown | |
| Fuze and Booster Quarry | RVAAP-016-R-01 | No | 12.74 | Same | Unknown | Yes/IRP[1] | Presence and type of MEC in the three ponds is not fully known. Munitions debris is present. |
| Landfill North of Winklepeck | RVAAP-019-R-01 | No | 7.55 | 14.05 | Unknown | Yes | Presence and type of MEC at the revised MRS location is not fully known. Presence of MC is not fully known. Presence of munitions debris has been established. |
| 40mm Firing Range | RVAAP-032-R-01 | No | 5.17 | Same | Unknown | IRP[1] | Presence and type of MEC at the firing range is not fully known. |
| Firestone Test Facility | RVAAP-033-R-01 | No | 0.25 | 0.91 | Unknown | IRP[1] | Presence and type of MEC at the shaped charge test pond, test chambers (3), and clearing is not fully known. |
| Sand Creek Dump | RVAAP-034-R-01 | No | 0.85 | Same | Unknown | IRP[1] | Presence and type of MEC at the MRS is not fully known. |
| Building #F-15 and F-16 | RVAAP-046-R-01 | No | 12.23 | Same | Unknown | IRP[1] | Presence and type of MEC is not fully known. |
| Anchor Test Area | RVAAP-048-R-01 | No | 2.57 | Same | Unknown | IRP[1] | Presence and type of MEC is not fully known. |
| Atlas Scrap Yard | RVAAP-050-R-01 | No | 66.04 | Same | Unknown | Yes/IRP[1] | Presence of munitions debris has been established. However, presence and type of MEC is not fully known. |
| Block D Igloo | RVAAP-060-R-01 | No | 622.24 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |

**Table 40: Summary of Conclusions (continued)**

| MRS Name | AEDB-R Site ID* | MRS Added During HRR (yes/no) | CTT Acreage | HRR Acreage | Presence of MEC/MC | | Data Gaps |
|---|---|---|---|---|---|---|---|
| | | | | | MEC Yes/No /Unknown | MC Yes/No /Unknown | |
| Block D Igloo–TD | RVAAP-061-R-01 | No | 19.25 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |
| Water Works #4 Dump | RVAAP-062-R-01 | No | 6.15 | Same | Unknown | Unknown | Presence of munitions debris has been established. Presence and type of MEC is not fully known. Presence of MC is not fully known. |
| Area Between Buildings 846 and 849 | RVAAP-063-R-01 | No | 2.65 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |
| Field at the NE Corner of Intersection (Paris-Windham Rd) | RVAAP-064-R-01 | No | 91.86 | Same | Unknown | Unknown | Presence and type of MEC is not fully known. Presence of MC is not fully known. |

[1] = MC will be covered under the IRP and will not be investigated further under the MMRP.

[2] = Explosive concerns are addressed under BRAC and will not be investigated further under the MMRP.

* AEDB-R Site ID = Army Environmental Database-Restoration Site Identification Number

IRP=Installation Restoration Program, BRAC= Base Realignment and Closure