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Shaw Environmental & Infrastructure, Inc.
100 Technology Center Drive
Stoughton, MA 02072

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U.S. Army Corps of Engineers - Louisville District
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14. ABSTRACT

The purpose of this DQO Report is to determine if there are any data gaps from past investigation activities at RVAAP-28 where subsurface conditions were not adequately characterized or if there are any other efforts required for environmental closure of the Area of Concern. The evaluation processes presented in this document and performed under this delivery order were conducted in accordance with the Facility-Wide Data Quality Objectives described in the Facility-Wide Sampling and Analysis Plan and the revised Scope of Work. Results of the EQM Report on the Geophysical Investigation at the Mustard Agent Burial Site identified an irregularly shaped anomaly located at the western edge of the concrete test pad and extending to the west that were interpreted to be possible CAIS mustard agent. Furthermore, interviews with former RVAAP workers indicated that NACA test pad may have been constructed over an area of buried CAIS mustard agent. An additional geophysical investigation will be required around the northern, southern and eastern portions of the concrete test pad to assess the potential for buried metal anomalies.

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Draft Data Quality Objectives Report for the **RVAAP-28 Mustard Agent Burial Site**

Version 1.0

Ravenna Army Ammunition Plant
8451 St. Route 5
Ravenna, Ohio 44266-9297

Contract No. W912QR-08-D-0013
Delivery Order 0002

Prepared for:

600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202

Prepared by:

Shaw Environmental & Infrastructure, Inc.
100 Technology Center Drive
Stoughton, MA 02072

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CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Shaw Environmental, Inc. has completed the Draft Data Quality Objectives Report for RVAAP-28 Mustard Agent Burial Site at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy, principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets customer's needs consistent with law and existing Corps policy.

Reviewed/Approved by:  Date: 3/11/2009

David Cobb
Project/Program Manager

Prepared/Approved by:  Date: 3/11/2009

David Crispo, P.E.
Technical/Regulatory Lead

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List of Figures

Acronyms and Abbreviations

A/E	Architectural/Engineering
AOC	Area of Concern
bgs	Below ground surface
CAIS	Chemical Agent Identification Sets
DQO	Data Quality Objective
DO	Delivery Order
DoD	Department of Defense
EQM	Environmental Quality Management, Inc.
EM	Electromagnetic
EMD	Electromagnetic Metal Detection
FSAP	Facility-wide Field Sampling and Analysis Plan
GPO	Geophysical Prove-Out
GPS	Global Positioning System
HD	sulfur mustard agent
IRP	Installation Restoration Program
LUCs	Land Use Controls
MABS	Mustard Agent Burial Site
MMRP	Military Munitions Response Program
NACA	National Advisory Committee for Aeronautics
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PC	personal computer
QC	Quality Control
ROD	Record of Decision
RTLS	Ravenna Training and Logistics Site
RTK	Real-Time Kinematic
RTS	Robotic Total Station
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
Shaw	Shaw Environmental & Infrastructure, Inc.
SOW	Scope of Work
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USP&FO	United States Property and Fiscal Officer

1.0 Introduction

1.1 Purpose and Scope

This *Data Quality Objectives (DQO) Report* provides a systematic approach for evaluating data requirements to support the decision making process associated with possible future actions for the RVAAP-28 Mustard Agent Burial Site (MABS) located at the Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio (**Figure 1-1**). This *DQO Report* is being prepared by Shaw Environmental & Infrastructure, Inc. (Shaw) under Delivery Order (DO) 0002 for Architectural/Engineering (A/E) Environmental Services at RVAAP under the Indefinite Delivery/Indefinite Quantity Contract No. W912QR-08-D-0013. The task order was issued by the U.S. Army Corps of Engineers, Louisville District (USACE) on September 22, 2008.

The purpose of this *DQO Report* is to determine if there are any data gaps from past investigation activities at RVAAP-28 where subsurface conditions were not adequately characterized or if there are any other efforts required for environmental closure of the Area of Concern (AOC). The evaluation processes presented in this document and performed under this DO were conducted in accordance with the Facility-Wide Data Quality Objectives described in the *Facility-Wide Sampling and Analysis Plan* (*FSAP*; SAIC 2001) and the revised *Scope of Work* (*SOW*), dated August 26, 2008, included as an attachment to the DO contract.

1.2 Site Description and Background

The RVAAP is located in northeastern Ohio within Portage and Trumbull Counties, approximately 1.6 km (1 mile) northwest of the city of Newton Falls and 4.8 km (3 miles) east-northeast of the city of Ravenna (**Figure 1-1**). The facility is a parcel of property 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 (**Figure 1-2**).

As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP have been transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a training site. Currently, RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of the Ravenna Training and Logistics Site (RTLS). RVAAP's remaining parcels of land are located completely within the RTLS. RTLS did not exist when RVAAP was operational, and the entire 21,683-acre parcel was a government-owned, contractor-operated industrial facility.

The RVAAP Installation Restoration Program (IRP) 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. The Ohio Environmental Protection Agency (Ohio EPA) is the lead regulatory agency for investigation and remediation conducted by the Army under the U.S. Department of Defense (DoD) IRP.

1.2.1 Mustard Agent Burial Site

The previous study areas at the MABS were performed in the more heavily wooded area adjacent to the west of the National Advisory Committee for Aeronautics (NACA) Test Area; however, the current MABS study area is open and flat and is located adjacent to the concrete test pad at the west end of the RVAAP-38 (**Figure 1-3**). MABS is a location where Chemical Agent Identification Sets (CAIS), believed to consist of sulfur mustard agent (HD), are suspected to have been buried. The CAIS mustard agent suspected to have been buried at the facility was developed by the Department of the Army from the 1930s through the 1960s. The mustard agent was reportedly buried at RVAAP in the 1950's. The depth at which the CAIS may have been buried is not known. Of the various types of CAIS glass containers that have been identified as potentially containing mustard agent, all are believed to have been packed in metal, either metal paint/coffee-type cans, 55-gallon drums, or steel shipping cylinders called PIGs. In 1969, an "investigation pit" was performed at the west end of the NACA runway by the Arsenal to check the integrity of the mustard agent containers. The only materials recovered included a rusty 55-gallon drum and seven rusty cans. To date, no material related to mustard agents have been recovered from the site.

1.2.2 Previous Investigation Activities

Environmental Quality and Management, Inc. (EQM) conducted a series of geophysical surveys at the MABS in 2006 using various methodologies (EQM 2008). The objective of the project was to determine if CAIS mustard agent had been buried in an approximate one acre area located on the western portion of the RVAAP. The suspected area, as reported by a former employee, is located adjacent to the NACA test strip.

The electromagnetic metal detection (EMD) and electromagnetic (EM) conductivity maps included in the EQM *Report on the Geophysical Investigation* (EQM 2008) at MABS identified buried metallic objects within the study area. Based on the results of the geophysical survey, the large metallic anomalies detected in the survey area, especially those that were trench shaped extending off of the edge of the concrete pad, were interpreted to be possible mustard agent test kits. It was noted in the EQM report that steel mill slag was commonly used as fill at the installation and could possibly be the source of the metallic anomalies.

Figure 1-1
Location Map

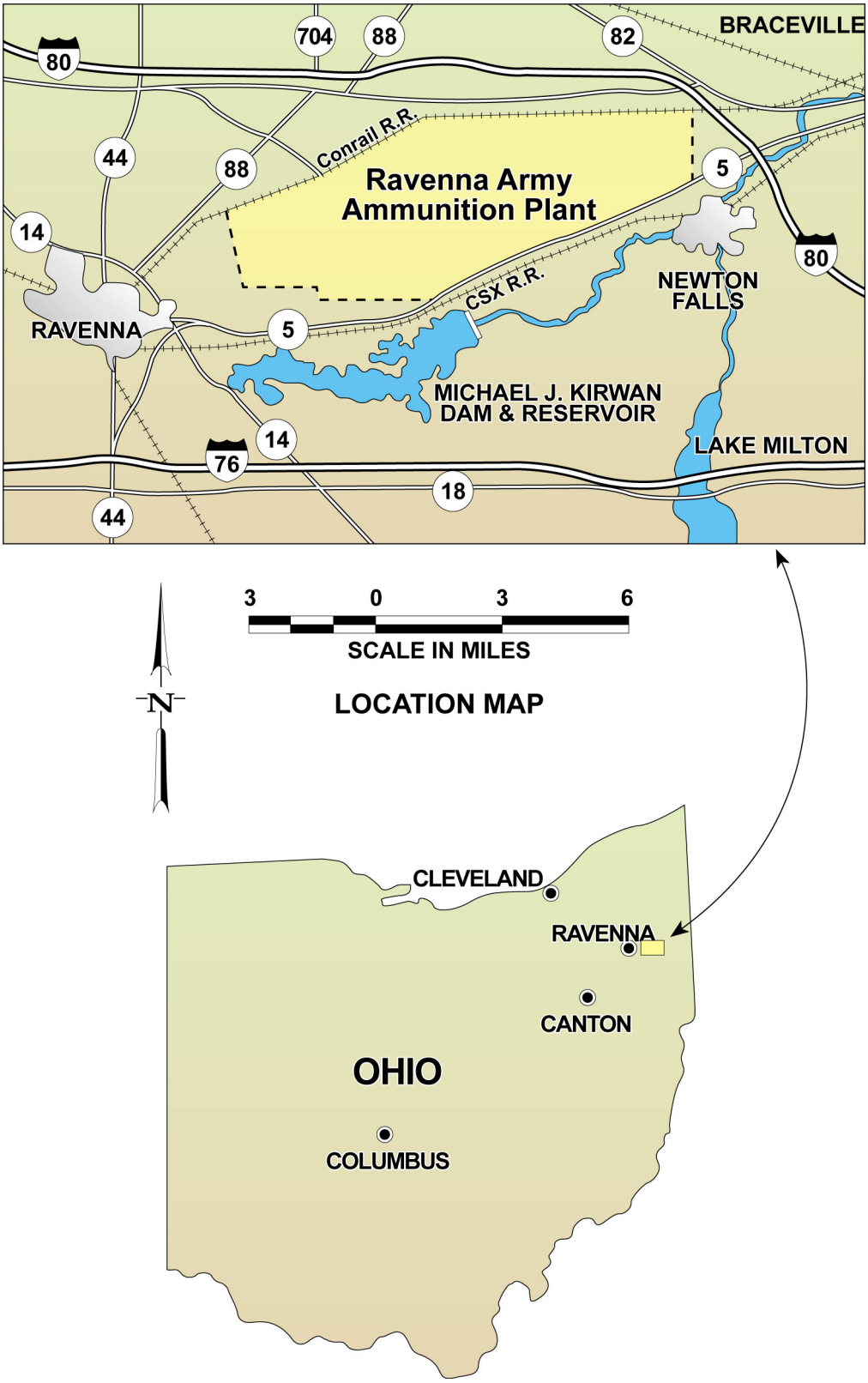

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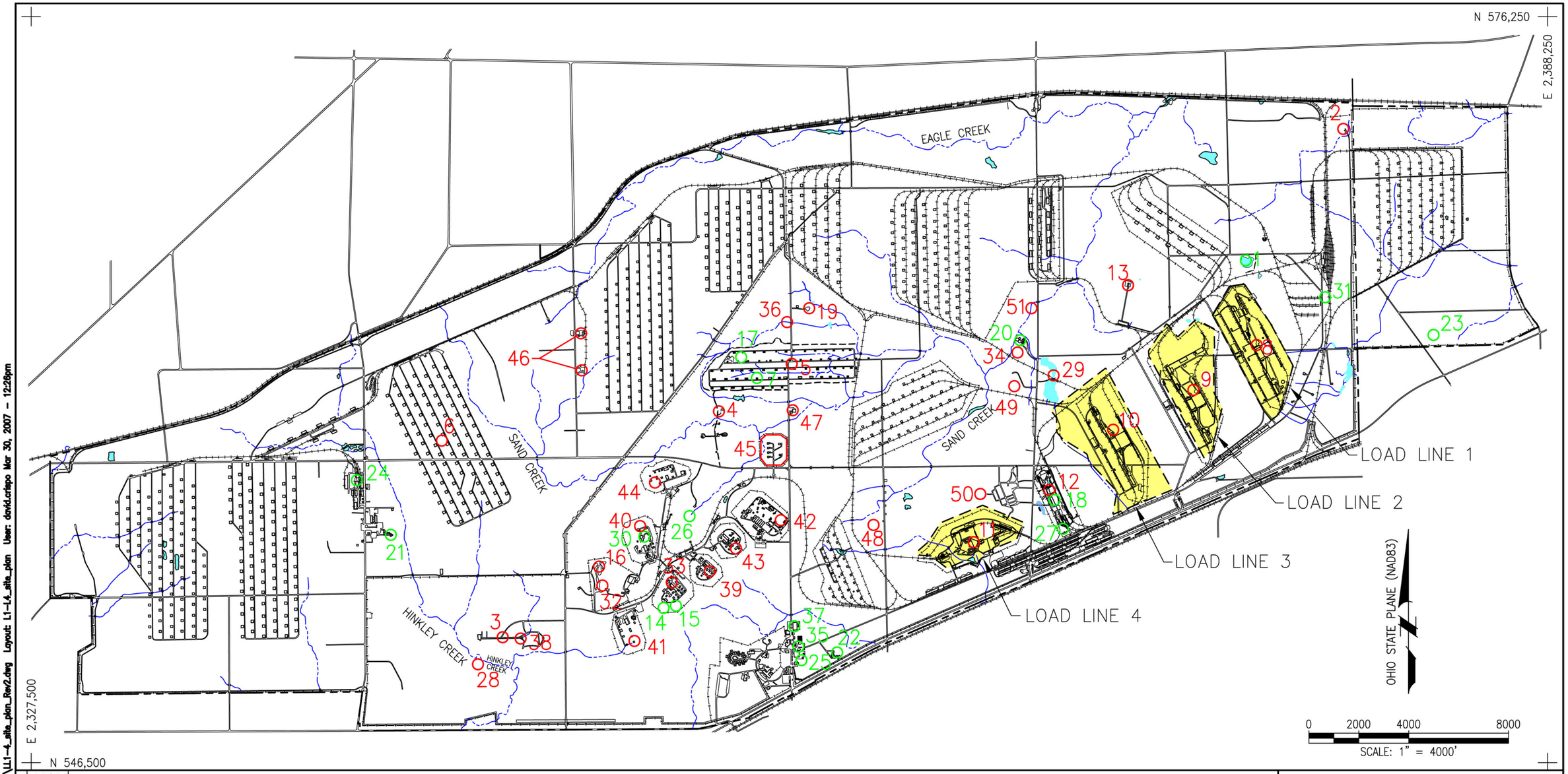
Figure 1-2
RVAAP Facility Map



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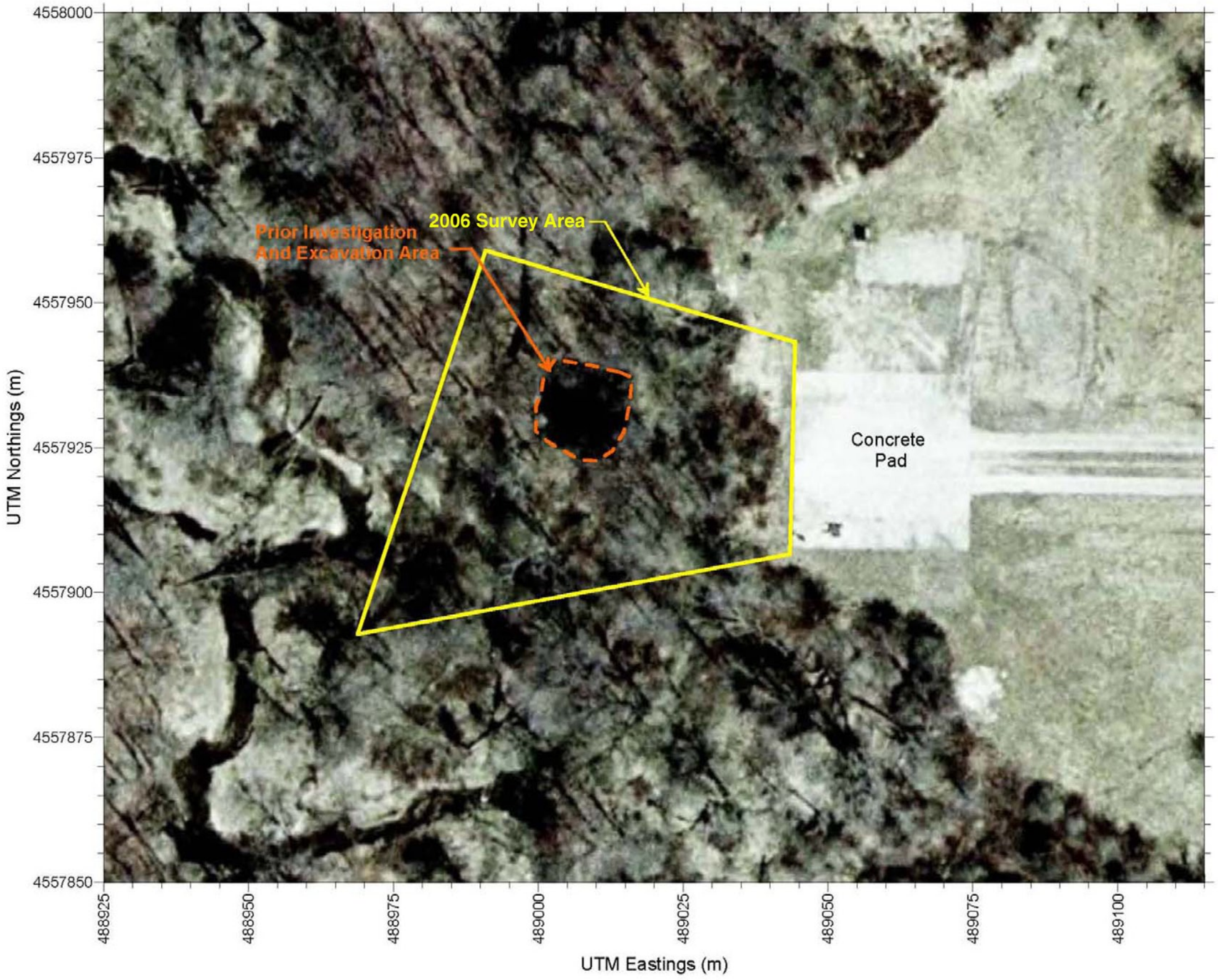

Scale in Feet

0 20 40 60 80 100

Scale in Meters

0 10 20 30 40 50

	U.S. ARMY CORPS OF ENGINEERS LOUISVILLE DISTRICT
FIGURE NUMBER 1-3	SITE MAP MUSTARD AGENT BURIAL SITE RAVENNA ARMY AMMUNITION PLANT
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2.0 Data Quality Objectives

As part of the facility-wide approach to environmental investigation activities at RVAAP, facility-wide DQOs have been developed per the requirements outlined in the *FSAP* (SAIC 2001). As stated in the *FSAP*, the DQO process is a tool to guide investigations at CERCLA sites and will be incorporated to identify data gaps at RVAAP-28. The DQO process culminates in the reduction of uncertainty associated with decisions related to remedial design and response actions. There following are the steps that Shaw will utilize to implement the DQO process:

1. Develop the Conceptual Site Model
2. State the problem
3. Identify decisions to be made
4. Define the study boundaries
5. Develop the decision rule (if/then)
6. Identify inputs to the decision (data uses and data needs)
7. Specify limits on uncertainty
8. Optimize the sample design

2.1 Conceptual Site Model

The conceptual site model presented in the FSAP (SAIC 2001) is applicable to the MABS for this *DQO Report* based on current knowledge. Interviews of former employees conducted on July 20, 2006 indicated that the suspected MABS is located west of the NACA concrete runway and test pad. The interviews further indicated that the NACA test pad may cover part of the burial site. The geophysical investigation conducted in 2006 indicated anomalies in the area immediately west of the NACA test pad. The anomalies abut the test pad and; therefore, the limits of the buried material could not be delineated to the east. The survey area did not include the areas north or south of the test pad and the results in the areas immediately west of the test pad indicate that the anomalies may extend along the north and south of the test pad as well.

The overall facility geology is characterized by sedimentary bedrock overlain by a thin veneer of glacial sediments consisting of tills and outwash deposits. The site soil consists of silt and clay glacial deposits, which have apparently been disturbed by construction and fill activities. The specific study area is relatively flat, sloping gently towards Hinkley Creek to the west and south. The area around the concrete test pad is open; however, the EQM survey area to the west of the test pad is heavily vegetated with scrub brush and trees, some of them greater than 10 inches in diameter.

The EQM geophysical investigation identified the presence of buried metallic objects near the western edge of the concrete test pad and shallow conductivity maps show an area of elevated

conductivity in the same general area. From the results it is likely that substantial portions of this metallic debris may be buried within 5-feet of the ground surface, although accumulations of materials could exceed this depth in some areas. The report noted that steel mill slag was commonly used as fill at the installation and could, possibly be the source of the metallic anomalies.

2.2 State the Problem

The 2006 geophysical investigation showed anomalies in the area where CAIS mustard agent was reportedly buried but the extent of the area potentially affected has not been delineated.

2.3 Identify Decisions to be Made

The key decisions for all investigations at RVAAP have been identified in Section 3.2.4 and in Table 3-1 of the *FSAP (SAIC 2001)*. Additional investigation is needed at RVAAP-28 to ultimately obtain a *Record of Decision* (*ROD*) using Land Use Controls (LUCs) that addresses all investigation results, both environmental and Military Munitions Response Program (MMRP) related. Data generated by the additional geophysical investigation will address the key decisions presented in Table 3-1 of the *FSAP (SAIC 2001)* and will be used to determine if the extent of the suspected mustard agent burial extends to the north, south, and east of the concrete test pad or if any other metal objects are identified.

2.4 Define Study Boundaries

The boundaries for the proposed additional survey areas at MABS are discussed in **Section 4.0**. The area to be investigated is intended to supplement the previous geophysical investigation survey area as shown in **Figure 1-3** by extending the survey areas along the north, south, and east sides of the NACA test pad. This boundary is believed to encompass the area potentially impacted by the burial of the CAIS mustard agent.

2.5 Identify Decision Rules

Decision rules to guide remediation decisions are provided in Section 3.2.6 of the *FSAP* (SAIC 2001); however, this site differs from most other sites at RVAAP since contact with concentrated mustard agent would be immediately dangerous to life and health. Therefore, the decision rule for this investigation is what is most protective of human health and the environment given the presumed presence of intact mustard agent containers at the burial site. No intrusive activities will be included in the identified decision.

2.6 Identify Inputs to the Decision

The inputs to the decision include the results of the geophysical investigation. The preferred instrument for this investigation will be the EM61-MKII metal detector. The EM61-MKII has very good stability, is very reliable in the detection of metallic anomalies, and is less affected by

disturbed soils and the highly conductive clay soils at the site than the EM31 (a conductivity instrument).

2.7 Specify Limits on Decision Error

The objectives of the geophysical investigation is to accurately locate and record the location of anomalies and measurement errors in the collected data that can be minimized through proper planning and implementation of Quality Control (QC) procedures. The limits on the decision errors for the geophysical investigation, including QC and corrective measures to be implemented to correct, mitigate or eliminate potential cause of DQO failure is presented in the Shaw *Geophysical Investigation Plan for RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area 1 and RVAAP-28 Mustard Agent Burial Site* (Shaw 2009).

2.8 Optimize the Sample Design

Further investigation at the MABS will focus on thorough subsurface characterization of the site using geophysical investigation methodology. In order to accomplish the geophysical investigation, biased locations will be used based on historical information, the results of previous geophysical investigations, interviews with previous workers at the RVAAP and the conceptual site model. Data generated by the additional geophysical investigation will be used to determine if the extent of the MABS extends to the north, south and east of the concrete test pad or if any metal objects are identified. The proposed survey area will be the locations north, south, and east of the NACA test pad to an approximate depth of five feet below ground surface (bgs)**.** Grid design will be such that the coverage area is >90 of the total survey area, as specified in *Section G, Contractor Minimum Quality Control Requirements*, of the *SOW*.

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3.0 Evaluation of Geophysical Data

EQM performed a geophysical investigation at the MABS in 2006 using various survey methodologies including EMD, EM conductive mapping and ground penetrating radar. The surveys were conducted in the area west of the NACA test pad to determine if CAIS mustard gas had been buried within an approximate one acre area located on the western portion of the RVAAP. The CAIS mustard gas was reportedly buried in metal shipping containers; therefore, the purpose of the geophysical survey was to determine if buried metal objects existed in this study area.

The EM61 channel three and channel difference maps are presented as **Figures 3-1** and **3-2**, respectively. The earlier time gates of the EM61 (Channels 1 and 2) reveal the presence of a wide range of objects, and are most useful for locating all metallic objects within the study area. The last time gate (Channel 3) is a more selective view of metallic objects because it tends to indicate the locations of the most extensive and conductive objects. The additional measurement from the top coil (Channel 4) is used to filter out the effect of near-surface metallic materials, allowing for a distinction between deeper and shallower metallic objects. The filtering effect is obtained by subtracting the bottom coil response (Channel 3) from the top coil response (Channel 4) to yield the channel difference.

The EM61 maps from the EQM report indicate an irregularly shaped anomaly located at the western edge of the concrete test pad and extending to the west, this has been denoted as Anomaly A (**Figures 3-1** and **3-2**). The center of this anomaly is much lower in amplitude on the channel difference map (**Figure 3-2**), indicating that this area contains predominantly shallow metal compared to the northern and southern lobes of the anomaly.

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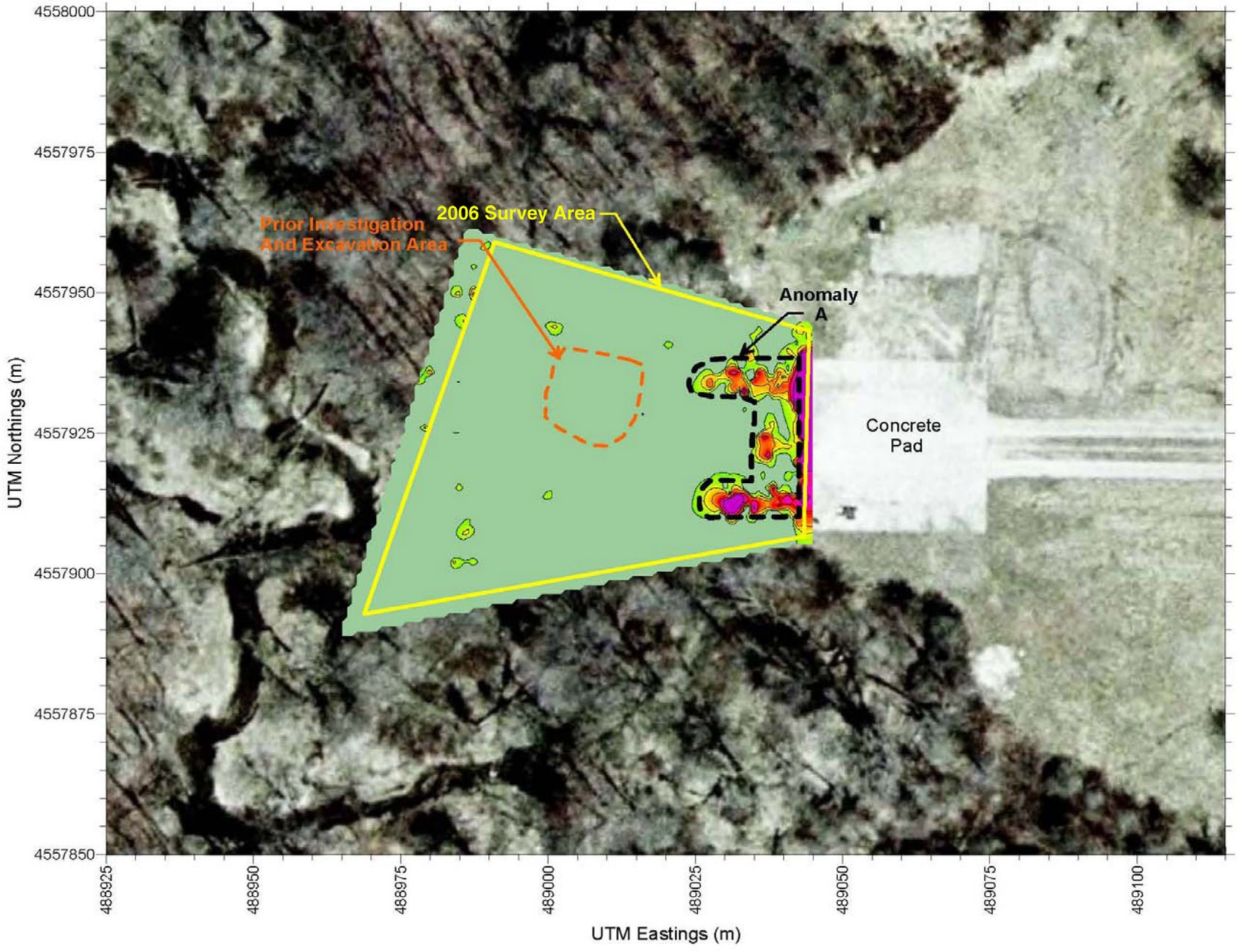

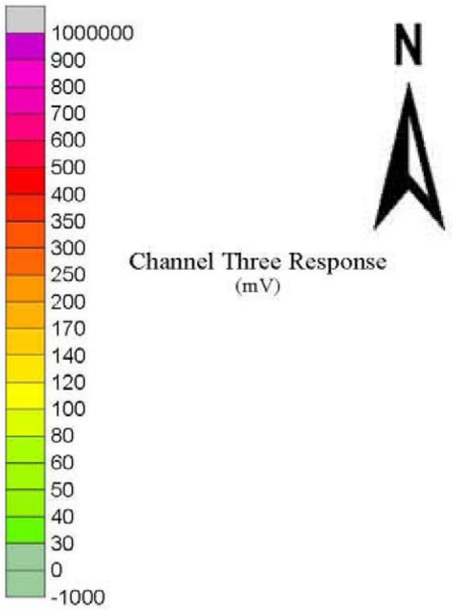

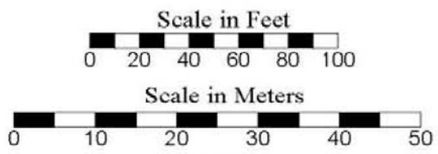

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FIGURE NUMBER 3-1

EM-61 CHANNEL THREE MAP
MUSTARD AGENT BURIAL SITE
RAVENNA ARMY AMMUNITION PLANT

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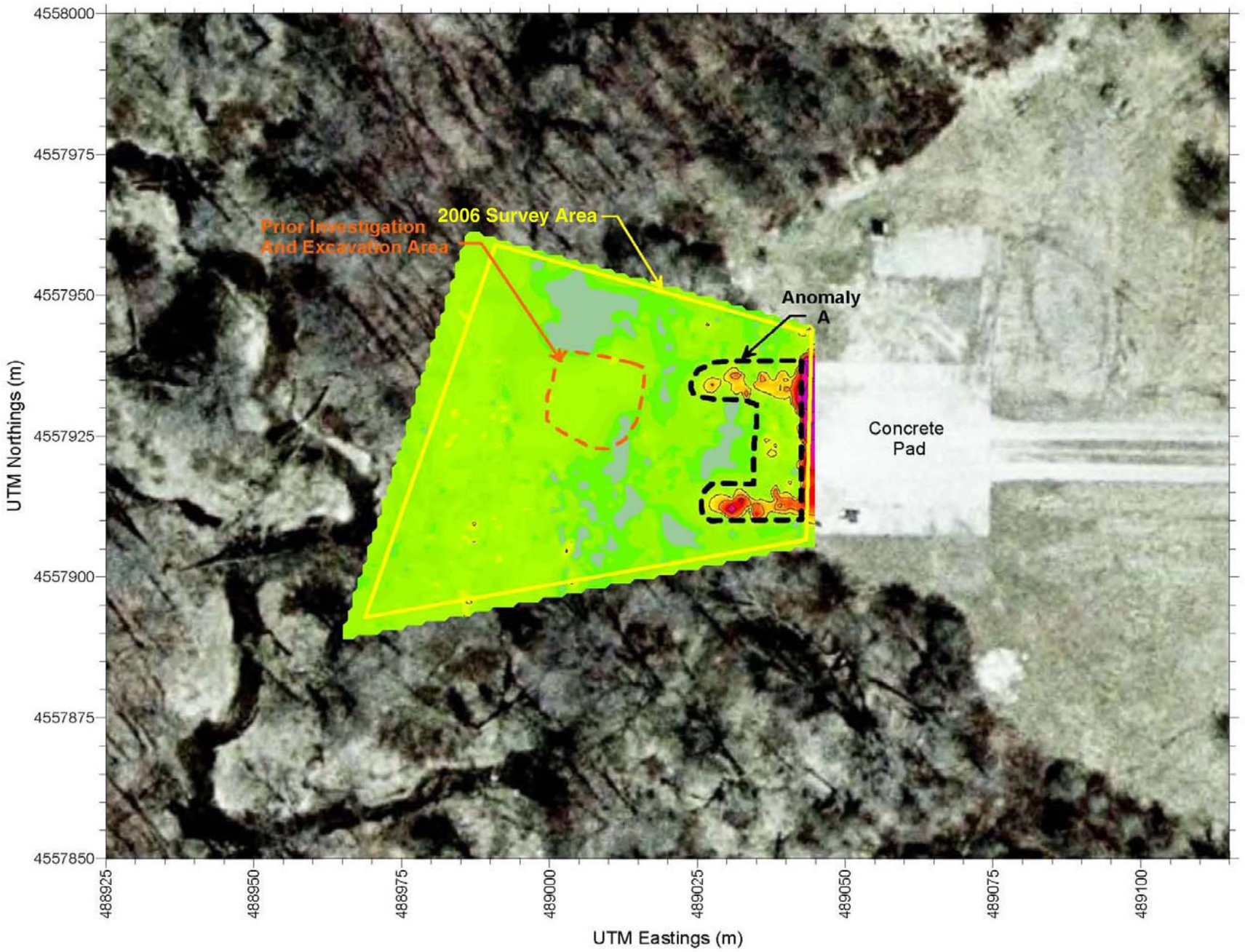

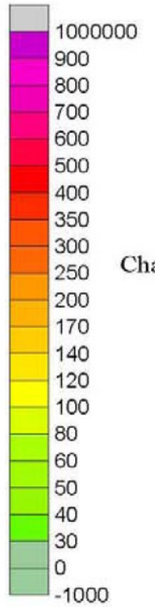

Channel Difference Calculation
(mV)

N

Scale in Feet
0 20 40 60 80 100

Scale in Meters
0 10 20 30 40 50

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FIGURE NUMBER
3-2

EM-61 CHANNEL DIFFERENCE MAP
MUSTARD AGENT BURIAL SITE
RAVENNA ARMY AMMUNITION PLANT

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4.0 Sample Design

This section summarizes evaluation of the EQM geophysical investigation as discussed in Section 3.0 and presents the rationale for additional investigation. The selection for the areas for biased sampling is based on the project DQOs, the conceptual site model described in Section 2.0, discussions with Ohio EPA and the direction as provided in the *SOW*.

4.1 Geophysical Investigation

4.1.1 Rationales

The EQM geophysical survey identified buried metallic objects adjacent to the west side of the concrete test pad that were interpreted to be possible CAIS mustard agent. Furthermore, interviews with former RVAAP workers indicated that NACA test pad may have been constructed over an area of buried CAIS mustard agent. An additional geophysical investigation will be required around the perimeter of the concrete test pad to assess the potential for buried metal anomalies.

4.1.2 Geophysical Investigation Location

An additional geophysical investigation will be performed in the areas north, south, and east of the NACA test pad, as shown in **Figure 4-1**, to further delineate the extent of the anomalies detected to the west of the test pad as identified in the *SOW*. In addition to the survey areas adjacent to the north and south of the test pad (115'x13'), the survey area extends an additional 115 feet along the NACA test strip to the east of the concrete pad. The width of the survey areas on both sides of the test strip and to the north and south of the concrete pad is approximately 4 meters (13 feet). This equates to approximately four passes with the geophysical instrumentation at approximately one meter width per pass. The total survey area is approximately 6,000 square feet to an approximate survey depth of five feet bgs.

4.1.3 Geophysical Investigation

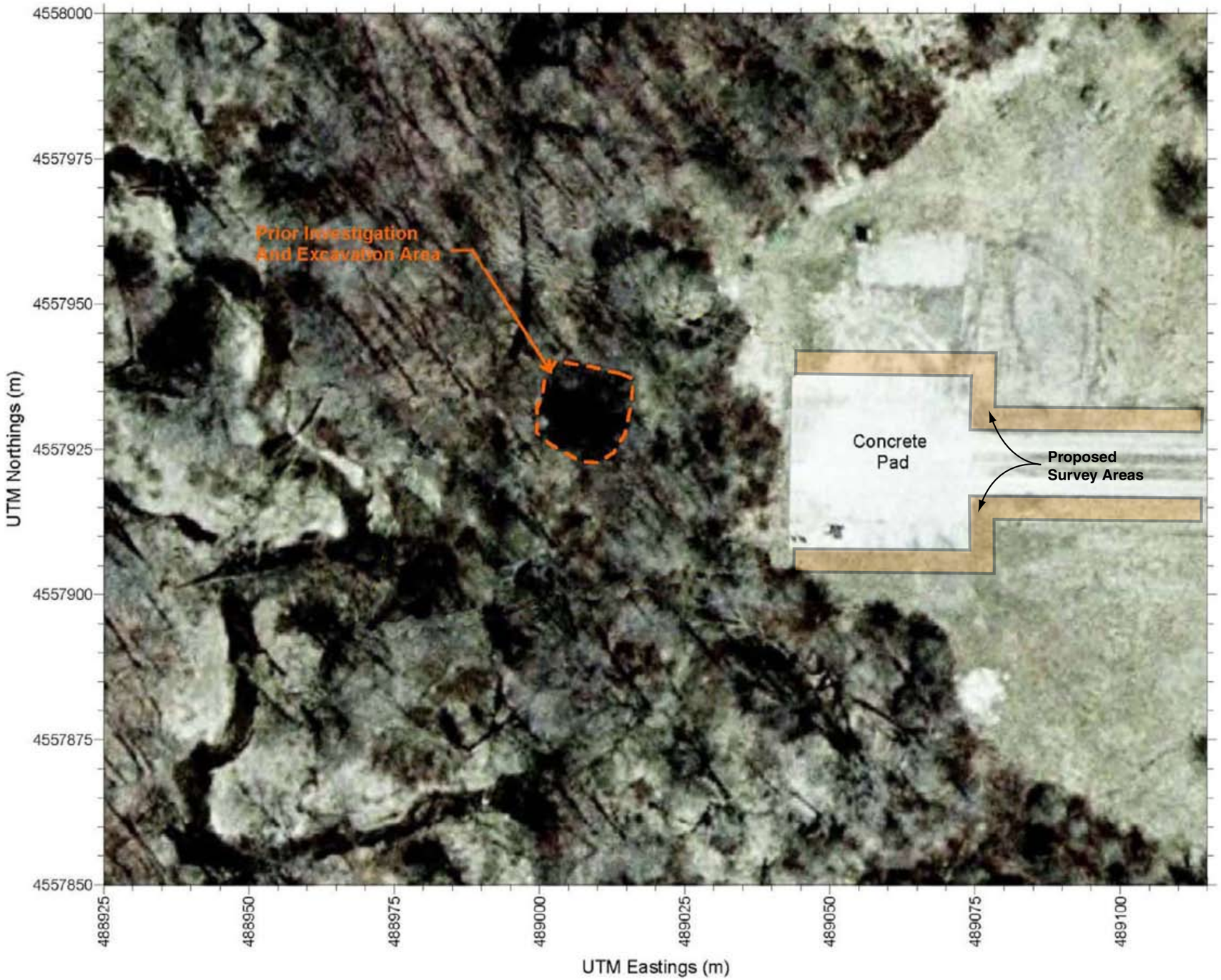
For the MABS, a Geonics EM61-MK2 metal detector will most likely be deployed based on the results of the Geophysical Prove-Out (GPO) that will be used to assess and document the performance of the geophysical instrumentation, navigation system, and field deployment form-factor. The GPO will also be used to assess the most optimal data processing techniques and anomaly selection criteria given the local soil, site conditions, and targets of interest at RVAAP. The EM61-MKII will be deployed along with a Real-Time Kinematic (RTK) global positioning system (GPS) in open areas, which is ideal for the MABS.

4.1.3.1 General Geophysical Survey Procedures

Full coverage mode will be utilized at MABS and is discussed further in the *Geophysical Investigation Plan for RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area 1 and RVAAP-28 Mustard Agent Burial Site* (Shaw 2009). Full coverage will be achieved through deployment of the sensor system through the collection of sub-parallel survey lines or swaths with sensor separations of 3.0 feet. The general survey procedures include the following:

- Review the site. The area requiring full coverage will be reviewed through a site walk-over during which the geophysical survey conditions will be reviewed by the site geophysicist.
- Set up the navigational system chosen by the geophysicist at a convenient control point of known location. Confirm location control via checkshots to at least one other control point of known location.
- Place temporary location control QC items in the survey area using the Robotic Total Station (RTS) as needed to document navigation precision. At least one location QC item (either temporary items or semi-permanent grid hubs) will be present in each data set.
- Set up a replicate data line location and collect the pre- and post-survey data line. These data will be compared to insure repeatability of the data collection method.
- The sensors are towed, pulled or pushed at a mean speed less than 3 miles per hour (mph) in the GPO (to be verified by analysis of the navigation data for each data set) to minimize sensor bounce and sway.
- Collect and maintain field logs to document the conditions of the data collections. The field logs will include information and observations of the data collection area, field conditions, data acquisition parameters, and QC performed.
- Field geophysical data and navigation data will be downloaded to a field personal computer (PC). The electronic files will be organized on an office PC dedicated to geophysical investigation management. Data will be backed-up daily.
- Review all traverse data and overlay on the survey grid layout or planned traverse lines as QC and to identify any missed areas.

Following the completion of the geophysical investigation and data processing activities at the prescribed locations at MABS, the data will be incorporated into a geophysical investigation report that will convey explanations and pertinent information, and will include maps, QC reports, summaries, and supporting data.



N

Scale in Feet

0 20 40 60 80 100

Scale in Meters

0 10 20 30 40 50

U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

FIGURE NUMBER	
4-1	PROPOSED GEOPHYSICAL SURVEY LOCATIONS MUSTARD AGENT BURIAL SITE RAVENNA ARMY AMMUNITION PLANT

Shaw Shaw Environmental, Inc.

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5.0 Summary of Conclusions

This *DQO Report* has utilized the DQO process provided in the *FSAP* (SAIC 2001) to identify additional areas that will require geophysical investigation at the MABS. A previous geophysical investigation showed anomalies immediate west of the NACA test pad that may represent where CAIS mustard agent were buried. Furthermore, interviews with former RVAAP workers indicated that concrete test pad may have been constructed over an area of buried CAIS mustard agent. Therefore, an additional geophysical investigation should be conducted north, south, and east of the NACA test pad to delineate the potential burial area to a maximum depth of five feet bgs.

The Geonics EM61-MKII metal detector is the preferred geophysical instrument for the proposed geophysical investigation because it can detect buried metal objects reliably to the required depth and is ideal for the open area conditions at MABS. This metal detector will most likely be deployed by Shaw based on the results of the GPO. Further details of the additional geophysical investigation is presented in the *Geophysical Investigation Plan for RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area 1 and RVAAP-28 Mustard Agent Burial Site* (Shaw 2009).

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6.0 References

Science Applications International Corporation (SAIC) 2001. Final Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Final. March 2001.

Environmental Quality Management, Inc. (EQM) 2008. Report on the Geophysical Investigation, Suspected Mustard Agent Burial Site, Ravenna Army Ammunition Plant, Ravenna, Ohio. Final. May 21, 2008.

Shaw Environmental & Infrastructure, Inc. (Shaw) 2009. Geophysical Investigation Plan for RVAAP-34 Sand Creek Disposal Road Landfill, RVAAP-03 Open Demolition Area 1 and RVAAP-28 Mustard Agent Burial Site at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Draft. January 2009.

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