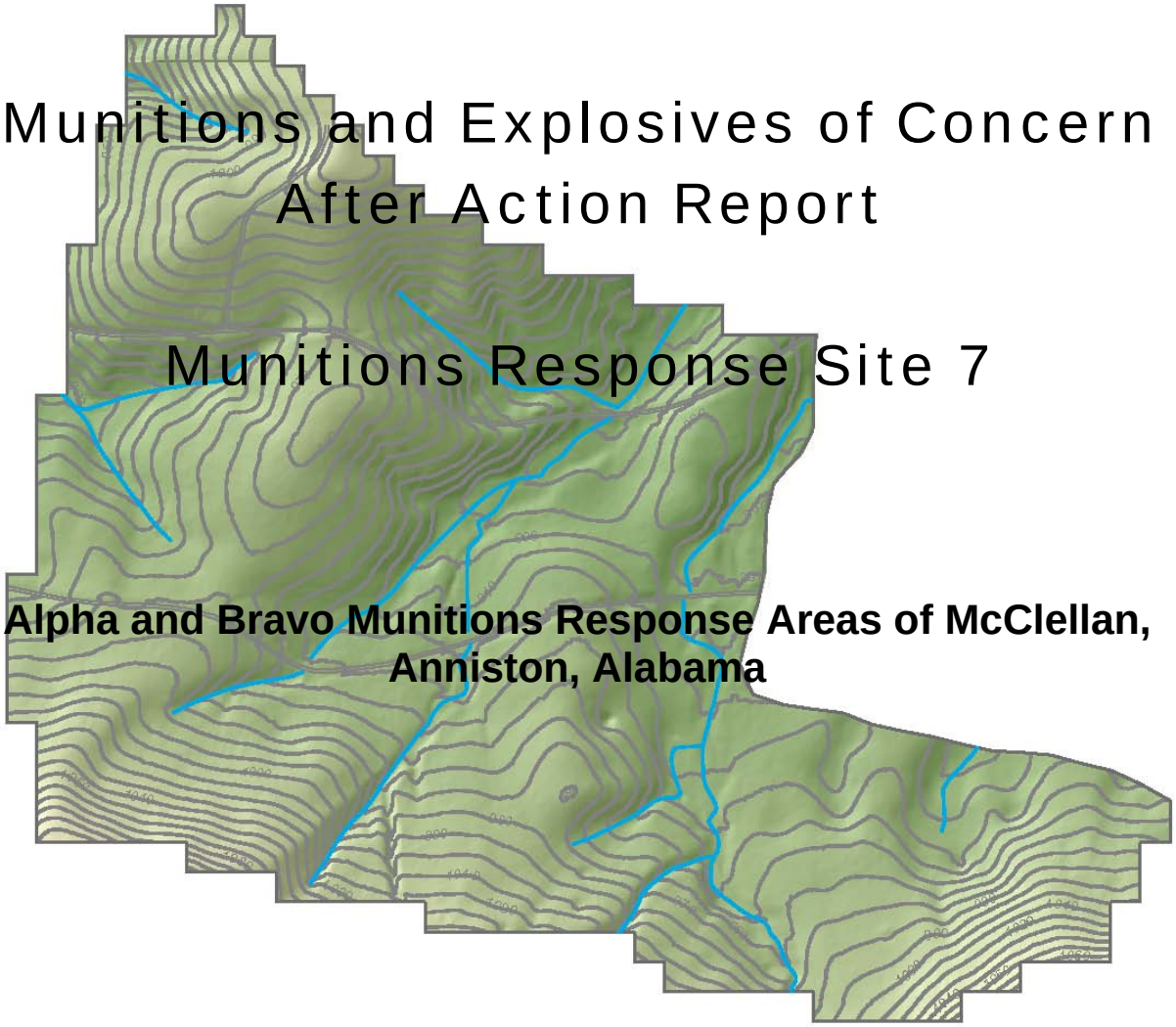
Munitions and Explosives of Concern After Action Report

Munitions Response Site 7



Alpha and Bravo Munitions Response Areas of McClellan, Anniston, Alabama

Prepared for:
McClellan Development Authority

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McCLELLAN
DEVELOPMENT AUTHORITY

Matrix ENVIRONMENTAL

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STATEMENT OF REMOVAL OF MUNITIONS AND EXPLOSIVES OF CONCERN

Munitions and Explosives of Concern (MEC) have been removed from Munitions Response Site 7 (MRS-7) and its associated step-outs in accordance with the *Revision 1 to the Final Program-Level Work Plan Munitions and Explosives of Concern Remediation, Alpha and Bravo Munitions Response Areas of McClellan, Anniston, Alabama* (PWP) dated September 2007and the *Munitions Response Site 7 (MRS-7) Site-Specific Work Plan* (SSWP) dated May 2012, and associated Field Change Requests (FCRs) as approved by the Alabama Department of Environmental Management (ADEM). This removal action was performed by contractors to the McClellan Development Authority (MDA) under the oversight of Matrix Environmental Services, LLC (MES).

This removal action for MRS-7 completes the required response for portions of the U.S. Army Sectors M3-1L 37mm Projectile Area – D and M3-1H Mixed Use Area – D under the Environmental Services Cooperative Agreement (ESCA) No. W9128F-07-2-0163 and ADEM Clean-up Agreement No. AL4 210 020 562. To increase operational efficiencies, the boundary of MRS-7 was adjusted to conform to the bordering MRS boundaries and the McClellan 100-foot state plane coordinate line grid, resulting in a baseline clearance area (without step outs) of approximately 162 acres.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Richard Satkin, PG

Vice President, MES

EXECUTIVE SUMMARY

This Munitions and Explosives of Concern (MEC) After Action Report prepared by Matrix Environmental Services, LLC (MES) documents MEC remediation at MRS-7 Munitions Response Site (MRS). MEC remediation was conducted in accordance with the *Revision 1 to the Final Program-Level Work Plan Munitions and Explosives of Concern Remediation, Alpha and Bravo Munitions Response Areas of McClellan, Anniston, Alabama* (PWP)(September 2007) and the *Munitions Response Site 7 (MRS-7) Site-Specific Work Plan* (SSWP) (May, 2012). The Alabama Department of Environmental Management (ADEM) concurred with the SSWP in June 2013. During the course of fieldwork, ADEM approved four Field Change Requests (FCRs) FCR-18, FCR-19, FCR-20 and FCR-21 to the SSWP addressing the clearance of step-outs.

The MEC remediation activities in MRS-7 occurred from June 2012 through May 2014 (two grids of MRS-7 were utilized as an intentional detonation area and were cleared at the end of the project). Approximately 150 acres of MRS-7 were designated as non-McClellan Park System future use and approximately 12 acres along the southern margin of MRS-7 were designated as McClellan Park System future use. Nonetheless, all portions of MRS-7 were cleared to the depth of detection. An additional 6.08 acres of step-outs were performed which extended south into the MRS-11 area. These areas were also cleared to the depth of detection – for a total clearance area of 168 acres. Step-outs were not performed into the adjacent MRS-3 and MRS-9 which were cleared under a separate removal action.

Clearance activities involved the following major tasks:

- Land surveying
- Surface sweep
- Brush clearing
- An aggressive (6-inch) surface clearance of MEC items and metallic non-MEC items in advance of digital geophysical mapping (DGM)
- DGM based clearance to depth of detection
- Mag and dig based clearance to depth of detection of all non-DGM areas
- Explosive demolition of material potentially presenting an explosive hazard (MPPEH)
- Clearance to depth of detection of step outs
- Site restoration activities
- Inspection, demilitarization, certification and disposal of munitions related debris

The MEC clearance was performed in accordance with a rigorous Quality Control (QC) and Quality Assurance (QA) program, which identified specific methods and procedures for measuring effectiveness of each task. Lessons learned were identified by the project team,

proposed as FCRs, reviewed by ADEM, and if approved, incorporated into the MEC remediation program.

In total, 168 acres were cleared to the depth of detection during MRS-7 remediation, including 6.08 acres of step-outs. The following totals of MEC and materials were removed during the clearance:

- 183 MEC items were recovered and destroyed.
- 16,441.5 pounds of non-MEC scrap (technically Material Documented as Safe (MDAS) per current Department of Defense (DoD) guidance, but "non-MEC scrap" terminology is used here for consistency with existing documents).
- 2,458 pounds of Munitions Debris (MD also referred to here, for consistency with previous documents, as "MEC scrap").

The 168-acre area was heavily seeded to test the clearance processes. The contractors recovered 586 of 589 (>99%) QC and QA blind seeds.

Survey and Geographical Information System (GIS) shape files for the MRS-7 boundary and clearance area boundary are presented in Appendix B. All areas were cleared to the depth of detection and are recommended for unrestricted land use. There are no exception areas requiring future land use controls or construction support.

This removal action for MRS-7 completes the required response for portions of the U.S. Army Sectors M3-1L 37mm Projectile Area – D and M3-1H Mixed Use Area – D under the Environmental Services Cooperative Agreement (ESCA) No. W9128F-07-2-0163 and ADEM Clean-up Agreement No. AL4 210 020 562. To increase operational efficiencies, the boundary of MRS-7 was adjusted to conform to the bordering MRS boundaries and the McClellan 100-foot state plane coordinate line grid, resulting in a baseline clearance area of 162 acres.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADEM	Alabama Department of Environmental Management
AMEC	AMEC Environment & Infrastructure, Inc.
ASR	Archives Search Report
BIP	Blow in place
DB	database
DFW	Definable Feature of Work
DGM	Digital Geophysical Mapping
DNR	Deficiency Notice Report
DoD	Department of Defense
DQO	Data Quality Objective
EM61-MK2	Geonics EM61-MK2 time domain electromagnetic metal detector
ERT	Earth Resources Technology Inc.
FCA	Function Check Area
FCR	Field Change Request
ft	foot/feet
FTP	File Transfer Protocol website
GeoQA	Geophysical Quality Assurance
GeoQCS	Geophysical QC Specialist
GPO	Geophysical Prove-Out
Harmon	Harmon Engineering & Contracting Co., Inc.
HE	High Explosive
in	inch
LI Smith	L.I. Smith and Associates, Inc.
McClellan	Former Fort McClellan
MDA	McClellan Development Authority
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MES	Matrix Environmental Services, LLC.
mm	millimeter
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
mV	millivolt
NAEVA	NAEVA Geophysics, Inc.
PDA	Personal Data Assistant
pdf	Adobe portable document format
PWP	Program-Level Work Plan
QA	Quality Assurance
QAP	Site-Wide DGM QA Plan
QC	Quality Control
RTS	Robotic Total Station
SGO	Sterling Global Operations (formerly EODT Inc.)
SOP	Standard Operating Procedure
SRA	Saturated Response Area
SUXOS	Senior Unexploded ordnance Supervisor
UoP	Unit of Production
U.S.	United States
USACE	U.S. Army Corps of Engineers
UXO	Unexploded ordnance
UXOQCS	UXO QC Specialist

1.0 INTRODUCTION

This Munitions and Explosives of Concern (MEC) After Action Report for MRS-7 Munitions Response Site (MRS) has been prepared by Matrix Environmental Services, LLC (MES) for the McClellan Development Authority (MDA). MEC remediation was conducted in accordance with the *Revision 1 to the Final Program-Level Work Plan Munitions and Explosives of Concern Remediation, Alpha and Bravo Munitions Response Areas of McClellan, Anniston, Alabama* (PWP)(September 2007) and the *Munitions Response Site 7 (MRS-7) Site-Specific Work Plan* (SSWP) (May, 2012). The Alabama Department of Environmental Management (ADEM) concurred with the SSWP in June 2013. Explosives safety was performed in accordance with the McClellan Alpha and Bravo Explosives Safety Submission (ESS)(ECC, 2006) as modified by ESS Amendment 12 for MRS-7 (MES, 2012).

The MEC remediation activities in the MRS-7 occurred from June 2012 through May 2014. In total, 168 acres including step-outs were cleared to the depth of detection and 183 MEC items were destroyed. A total of 16,441.5 pounds of non-MEC scrap[1] and 2,458 pounds of MEC-scrap were removed from the site. Of 589 QC and QA blind seeds, only three were missed – more than 99% were recovered.

These organizations performed the following tasks as part of this MEC remediation:

- MES – overall management, demolition activities, UXO quality control (QC), Geophysical and UXO quality assurance (QA), data management QA, and MEC remediation (all Tracts)
- NAEVA Geophysics (NAEVA) - digital geophysical mapping (DGM), Geophysical QC, and data/database management (all Tracts)
- MES – MEC surface sweep activities from June 2012 through August 2012 (all Tracts)
- MES – MEC aggressive surface clearance remediation activities prior to DGM from August 2012 through December 2012 (all Tracts)
- Sterling Global Operations (SGO – formerly EODT, Inc.) – MEC remediation activities from July 2013 through August 2013, October 2013 through November 2013 and May 2014 (Tracts 7A, 7C, and 7D)

[1] Current DOD terminology (DODI, 2008) is to refer to non-MEC scrap as Material Documented as Safe (MDAS). Material prior to determination of its explosives safety status, potentially contains explosives or munitions and is referred to as Material Potentially Presenting an Explosive Hazard (MPPEH). MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present and for which the chain of custody has been established and maintained is referred to as Material Documented as Explosive Hazard (MDEH) and is no longer considered MPPEH. In this report, to be consistent with existing plans and documents, we have continued to use MEC Scrap terminology.

- AMEC Environment & Infrastructure, Inc. (AMEC) – MEC remediation activities from September 2013 through October 2013 (Tract 7B)
- InfoPro – MEC remediation activities in January and March 2014 (step-outs)
- Earth Resources Technology, Inc. (ERT) provided geophysical remapping support for QA (all Tracts)
- Harmon Engineering & Contracting Co., Inc. performed brush clearing (all Tracts)
- L.I. Smith and Associates Inc. provided land surveying (all Tracts)
- Star Recycling provided destruction and recycling of scrap metal

This report presents the objectives of the remediation, the procedures used, the quality control/quality assurance methods used to verify effectiveness of the remediation activities, and the results of the remediation.

This report includes the following Appendices, which are included electronically on a compact disk (CD):

- Appendix A Geophysical Prove Out (GPO) Certifications
- Appendix B Survey and GIS Data
- Appendix C Project Database
- Appendix D DGM Data
- Appendix E Quality Control
- Appendix F Daily Reports
- Appendix G Field Change Requests
- Appendix H Waste Disposal Records
- Appendix I Photo Log
- Appendix J Quality Assurance

1.1 PROJECT DESCRIPTION AND OBJECTIVE

This MEC After Action Report describes the methods, activities, and results of the MEC remediation of MRS-7 at the former Fort McClellan (McClellan). McClellan, which is located in Anniston, Alabama, contains Alpha, Bravo, and Charlie Munitions Response Areas (MRAs) as shown in Figure 1-1. MRS-7 is located in the west central portion of the Bravo MRA as shown in Figure 1-2.

The work was completed in MRS-7 between June 2012 and May 2014 in accordance with Revision 1 of the PWP (MES 2007) and the MRS-7 Site Specific Work Plan (SSWP). During the course of fieldwork, ADEM approved four FCRs: FCR-18, FCR-19, FCR-20 and FCR-21 to the SSWP (Appendix G). Digital geophysical mapping-based clearance to depth of detection

was performed over the 167.08 acres comprising the original extent of the MRS and additional step-outs. An analog based clearance to depth of detection was performed over 0.92 acres that were too steep to clear by DGM methods.

1.2 BACKGROUND INFORMATION AND SITE HISTORY

1.2.1 SITE LOCATION AND DESCRIPTION

McClellan occupies 18,929 acres in the City of Anniston, Calhoun County, Alabama (Figure 1-1). To the west and southwest of McClellan are the commercial and residential areas of Anniston, the cities of Weaver and Blue Mountain, and the (active) Anniston Army Depot. The cities of Jacksonville and Oxford bound McClellan to the north and south, respectively. The eastern half of McClellan is minimally developed and is bounded by the Talladega Forest.

1.2.1.1 Site Description

MRS-7 is a 162 acre area in the west central portion of the MRA, corresponding to portions of the Environmental Evaluation/Cost Analysis (EE/CA) Sector M3-1L 37mm Projectile Area – D and M3-1H Mixed use Area-D (Figure 1-2). Site access is via east-west dirt/gravel roads off Rucker Street. There are no utilities or buildings in the MRS.

MRS-7 is heavily wooded and undeveloped. The adjacent areas surround the MRS are also heavily wooded and no residences or other buildings are located within 500 feet of the MRS boundary.

1.2.1.2 Geology, Hydrology, and Topography

The shallow geology in the area is characterized by colluvial deposits overlying the Paleozoic metamorphic rocks. Geo-magnetic (hot rock) response is locally present due to magnetic minerals from the metamorphic rocks and iron-bearing cements and weathering features within the soils and regolith.

Most of the site is moderately sloped, ranging from 860-1100 feet above mean sea level. Surface water flows northeast or northwest into unnamed drainages of Remount Creek and Cane Creek, away from the higher topography in MRS-11 to the south.

1.2.1.3 Climate

Calhoun County sits on 611 square miles in the foothills of the Appalachian Mountains in northeastern Alabama. The mean annual temperature is 61 degrees Fahrenheit, with seasonal averages of 38 in January and 80 in July. The average annual precipitation is 65 inches.

1.2.2 SITE HISTORY

1.2.2.1 McClellan

Military training has been documented in the McClellan area since 1912, when the Alabama National Guard used it for artillery training. However, units stationed at Camp Shipp in the Blue

Mountain Area during the Spanish American War could have used the Choccolocco Mountains for artillery training as early as 1898. The 29th Infantry Division also trained in this area prior to deployment to France during World War I. In 1917, Congress authorized the establishment of Camp McClellan. In 1929, the camp was officially designated Fort McClellan. Prior to World War II, the 27th Infantry Division assembled at Fort McClellan for training, and during the war, many other units used the site for various training purposes. Following World War II, in June 1947, Fort McClellan was placed in inactive status. Fort McClellan was reactivated in January 1950 and the site was used for National Guard training and was selected as the site for the Army's Chemical Corps School.

The history of the McClellan area, as described in the *Archives Search Report* (ASR) *Findings* (United States Army Corps of Engineers [USACE], 1999a) and *ASR Conclusions and Recommendations* (USACE, 1999b), includes training activities and demonstrations that used conventional weapons (i.e., mortars, anti-tank guns, and artillery pieces). Former ranges and training areas potentially containing MEC cover the majority of McClellan including the subject MRS. McClellan was recommended for closure under the 1995 BRAC Program. McClellan was officially closed in September of 1999 and the property was transferred to the MDA (formerly the Anniston-Calhoun County Fort McClellan Development Joint Powers Authority) and other federal entities.

1.2.3 BRAVO EE/CA

An EE/CA for the Bravo MRA was performed by Tetra Tech Foster Wheeler, Inc. (TTFW) in 2003. Grids and cluster transects were used to characterize the area corresponding to MRS-7 in the Draft Bravo EE/CA (which was never finalized) (TTFW, 2004). The Army designated sector M3-1L 37mm Projectile Area D which consists of approximately 180 acres in the north central area of the Bravo MRA overlaps approximately 80% of MRS-7. The M3-1H Mixed Use Area D sector is mostly on MRS-3 but overlaps the northwestern approximately 20% of MRS-7. The EE/CA characterization/risk sectors for the Bravo MRA are shown on Figure 1-2. The following MEC items were found on the surface and to depths of 4 inches during EE/CA field activities in the portions of these sectors lying within MRS-7 (all in the M3-1L Projectile Area – D Sector) : five Projectiles, 37mm MKII HE. One unidentified MEC item was previously reported by IT Corporation in this area.

Sector M3-1L 37mm Projectile Area – D is an approximately 180 acre area. The ASR shows the firing fans of 5 small arms ranges extending into this area – the machine gun range (OA-2), Range 12 (OA-48), Range 13 (OS-49), Range 19 (OA-50), and Old Range (OA-55). The sector also contained the westernmost portion of Range 16 (OA-45), but not any of the associated target/impact area. Small arms ammunition, 37mm projectiles, and lesser amounts of grenades and flares are expected in this area.

Sector M3-1H Mixed Use Area – D consists of 189 acres in MRS-3 and MRS-7. All of the known ranges in this sector (OA-49, 50, 51, and 52) lie in MRS-3. There are no known ranges or range fans in the portion of this sector within MRS-7, although infantry training activities are likely to have occurred in this area.

1.2.4 CURRENT AND FUTURE SITE USE

MRS-7 is currently undeveloped. The future land use for MRS-7 is shown on Figure 1-3. As all of the MRS, including the few McClellan Park System areas along the southern margin were cleared to the depth of detection, the future use will be unrestricted. No buildings or residences are present within 500 feet of MRS-7 boundary.

1.3 GENERAL OVERVIEW OF TECHNICAL APPROACH

1.3.1 INTRODUCTION

The general approach to the project was to perform brush clearing, land survey, and a DGM-based clearance to depth of the MRS. Due to its size (162-acres), the MRS was divided into four smaller Tracts, 7A through 7D. A DGM-based clearance to depth of detection was performed over the entire MRS, including the McClellan Park System areas of Tract 7D which were originally planned for clearance to one foot. Analog based clearance to depth was performed on four grids that were too steep to conduct DGM operations and in other non-DGM sub-areas where obstructions or steep slopes were encountered. Clearance to depth of detection step-outs were performed into MRS-11 to the south to ensure a 200-foot MEC-free buffer around the MRS.

Quality Control (QC) was performed to ensure that the MEC clearance was executed in accordance with the SSWP (Section 4 and Appendix E). Quality assurance (QA) was performed to verify QC and to document the acceptability of the clearance (Section 5 and Appendix J).

1.3.2 CLEARANCE GRIDS

To facilitate organization of work activities, safety zones, and data management, the site was divided into standard units of clearance area called grids - which are 100 ft x 100 ft in size (except for partial grids truncated by the step-out boundaries). The grid network for MRS-7 is shown on Figure 1-4. The north-south and east-west grid boundary lines are coincident with the 100-foot Alabama State Plane coordinate system. Each grid has a unique name indicting its position in the grid system. The leading digit is a grid zone indicator. Northing and easting position are described by a numeric sequence incrementing to the east. For example, grid N161E078 is the northern-most grid in MRS-7. Additional grids or partial grids were added as required for step-outs. As successive step-outs may have covered different partial portions of grids, step-out grid data are associated with grids via a trailing “S” and an iteration indicator. For example N130E0901S indicates grid N130E090, first iteration step-out data.

1.3.3 UNITS OF PRODUCTION (UoPs)

Each grid is associated with a UoP to facilitate QC testing. Each UoP consists of a group of approximately 4 to 9 contiguous grids. UoPs were initially assigned in the SSWP. Additional UoPs were established for each set of step-out grids. The UoPs for MRS-7 are presented in Figure 1-5. UoPs are named by their end use and use a sequential numbering system for the entire McClellan area. The UoP's begin with the letter "P" designating the grids fall in the Park System of McClellan or an "N" designating the grids fall in the Non-Park System of McClellan, for example N0034 is the northern-most UoP. Subsequent step-out UoPs were designated with an "S" preceding the UoP number, for example SN0098.

1.3.4 DEFINABLE FEATURES OF WORK (DFW)

DFWs for the remediation are as follows:

- Prepare Plans and Reports
- GPO Establishment and Certification
- UXO Surface Sweep prior to vegetation removal
- Brush Clearing
- UXO Surface/Near Surface Clearance after vegetation is removed
- Surveying
- UXO Surveyor Support
- Geophysical Investigation/Confirmation Remapping
- Intrusive Investigation Clearance to Depth of Detection
- MEC-Related Scrap Inspection/Certification
- Data Management
- Backfill and Site Restoration

1.3.5 DATA QUALITY OBJECTIVES (DQO)

DQOs are the performance criteria for the remediation. The DQOs used for this project focus on specific elements of the definable features of work and are discussed in detail in Section 4.1.

1.3.6 DESCRIPTION AND OPERATION OF DATABASE (DB)

A comprehensive site DB was established to:

- Ensure that all project data were properly captured
- Ensure conformity of nomenclature and reporting standards
- Track project progress
- Create forms, tables and reports
- Enable use and synchronization of handheld personal data assistants (PDAs) for field data entry
- Assist in performing systematic QC and QA

A site database (DB) for the MRS data was implemented in Microsoft Access 2000 and managed by NAEVA. The DB is included in this report as Appendix C.

1.3.7 USE OF PERSONAL DATA ASSISTANTS

Electronic personal data assistants (PDAs) were used to record major aspects of data collection including: geophysical mapping, target reacquisition, surface sweep operations, aggressive clearance to six inches, mag and dig operations, intrusive investigations, data gap clearances, demolitions operations and blind seed placement. PDA drop-down menus were used to ensure all personnel used consistent terminology and that all data was properly recorded and transcription errors were minimized. Operational results were recorded on the PDAs and synchronized with the site DB daily.

2.0 FIELD OPERATIONS

2.1 FIELD CHANGE REQUESTS

Field work was conducted in accordance with the approved SSWP. When situations arose that made strict compliance with the SSWP unsafe and/or a more effective method was developed through lessons learned, MES would submit a field change request to ADEM for their review and approval. FCR's are presented in Appendix G. The following table summarizes the FCRs for MRS-7 MEC remediation.

TABLE 2-1: FCR LOG

FCR	Description of Change	Date Initiated	Status	Effective Date
18	Approving the Garrett Recon Pro for use as a hand held detector for clearance to one foot and clearance to depth ops.	09/20/12	Approved by ADEM	12/03/12
19	To clarify the contractor guidance for the work sequence for intrusive clearance of anomalies and excavations.	03/21/13	Approved by ADEM	06/06/13
20	Change backfill requirement to only large excavations which pose a trip/fall hazard.	11/05/13	Approved by ADEM	12/13/13
21	Allow the use of a non-mechanical sifting table where large quantities of small metallic debris is present in spoils.	11/05/13	Approved by ADEM	12/13/13

2.2 GEOPHYSICAL PROVE OUT (GPO) AREA

The GPO test grid was constructed to demonstrate the EM61-MK2's ability to locate MEC at the site and to document that field teams were successful in locating MEC in a controlled environment.

2.2.1 GEOPHYSICAL PROVE OUT REPORT

A Geophysical Prove Out (GPO) was performed in 2006. The final GPO report was included as Appendix A to the *Munitions and Explosives of Concern After Action Report Munitions*

Response Site 1 and Southern Alpha, Alpha and Bravo Munitions Response Areas of McClellan, Anniston, Alabama, (MES, 2009). Applicable personnel and instrument certifications for MRS-7 are included in Appendix A.

2.2.2 INSTRUMENT AND OPERATOR CERTIFICATION

The GPO was used to test and document detection equipment and operator performance. Before and throughout the fieldwork, the GPO was utilized to confirm that detection systems operated within expected parameters. Previous GPO certifications of equipment and operators at McClellan were carried forward provided there was no demobilization or change in employer.

The only sensor used for DGM and reacquisition was the Geonics EM61-MK2 metal detector.

The following handheld detectors were approved for use in the various work tasks as follows:

- Surface Sweep and Aggressive Surface Clearance:
  Vallon VMH (large & small head)
  Schonstedt GA-92XT/52CX
  Whites DFX 300/XLT
  Garrett Recon Pro AML-1000 (regular and UXO head)
- Clearance of DGM Data Gaps:
  Vallon VMH (large & small head)
  Schonstedt GA-92XT/52CX
  Garrett Recon Pro AML-1000 (UXO head)
- Clearance to Depth:
  Vallon VMH (large & small head)
  Schonstedt GA-92XT/52CX
  Garrett Recon Pro AML-1000 (UXO head)

2.2.3 FUNCTION CHECK AREA

A permanent FCA near the GPO was established to allow UXO personnel to perform daily function tests of handheld (analog) equipment. Inert munitions items were buried with location and depth known to field crews so they could verify their handheld instrument's operability/battery condition daily prior to use.

Daily pre- and post-data collection function tests of DGM sensors (static, static-spike with a calibration jig, and cable shake tests) were performed in grid.

2.3 SURFACE SWEEP

A magnetometer assisted surface sweep was conducted by MES to identify and remove surficial MEC hazards and metallic debris prior to brush clearing operations. In addition to the safety

function, removal of metallic objects was performed to eliminate or reduce the number of anomalies for subsequent clearance activities. UXO personnel swept in advance of the brush cutters to identify, remove, eliminate MEC, and/or reduce metallic objects. Large pieces of debris were flagged and moved prior to brush clearing.

2.4 BRUSH CLEARING

Brush clearing was performed by Harmon Engineering and Contracting Co., Inc. to allow access for DGM and intrusive activities in accordance with the SSWP. UXO personnel also provided oversight and MEC avoidance support during brush clearing operations. The UXO escort walked ahead of the brush cutters and performed an additional visual and hand-held magnetometer assisted surface sweep to identify and remove all MEC and non-MEC hazards. In addition, the escort acted as a safety observer to insure compliance with prescribed procedures.

2.5 LAND SURVEYING

Surveying of boundaries and grid corners was performed by L.I. Smith and Associates, Inc. an Alabama licensed professional land surveyor, in Alabama State Plane East Zone coordinates (1983) in U.S. Survey Feet in accordance with the SSWP. An MES UXO Technician escorted the survey crew and provided anomaly avoidance support. Survey data and reports are included in Appendix B.

A 100 ft by 100 ft grid system was established throughout the work site. A six inch survey nail was placed to identify the southwest corner of each grid. A 3-foot wooden stake was used as a visual reference for each corner point and was marked with the corresponding grid number.

Step-out boundaries comprising 200-foot radius arcs from MEC find locations were established as needed. The surveyors emplaced additional survey nails and witness stakes at included grid corners, intersection points of the grid lines and the boundary arcs, and approximately every 20-feet along the boundary arc.

2.6 AGGRESSIVE SURFACE/NEAR-SURFACE CLEARANCE

In accordance with the SSWP, an additional aggressive surface/near-surface (0 – 6 inch) clearance was conducted by MES to identify and remove MEC and non-MEC scrap after brush cutting and before conducting DGM. This operation was not a final product; its objective was to reduce the number of near surface metallic anomalies that could interfere with DGM. This operation is referred to as “UXO surface and near surface clearance after vegetation is removed” in Table 10-3 of the SSWP.

This operation was conducted utilizing the industry standard mag/dig procedures. Teams would delineate five-foot lanes using ropes and search the area using hand-held magnetometers. This

proved to be effective in reducing the overall number of DGM anomalies, which improved production rates and directed focus on clearance of subsurface items.

Aggressive Near-Surface Clearance Operations

2.7 DIGITAL GEOPHYSICAL MAPPING

NAEVA performed all DGM tasks in MRS-7 using two-person teams operating Geonics EM61-MK2s in accordance with the SSWP. The second EM61-MK2 time gate (Channel 2), was the primary data channel used for geophysical mapping and interpretation. A custom electronic odometer built into one of the wheels triggered the recording of geophysical data at a rate of one reading every 10 cm (approximately 3 readings per foot, twice the standard EM61-MK2 wheel-mode sampling rate).

2.7.1 GEOLOCATION USING FIDUCIAL METHODS

The use of GPS was precluded due to the presence of heavy woods with dense tree canopy conditions throughout the area of investigation. The use of local (fiducial) coordinates relative to the surveyed grid corners was selected in the GPO as the most appropriate means of achieving accurate data positioning. NAEVA's data acquisition teams pulled tape measures between the grid corner stakes. Survey ropes were laid perpendicular to the tape measures at 25 foot

intervals and were marked with alternating paint dots every 2.5 feet to facilitate straight-line data collection paths. Geophysical data was collected every 10 cm along these data collection lines using the EM61-MK2's integrated survey wheel.

In addition to providing lateral control marks, the ropes also allowed the insertion of distance control fiducial marks into the dataset as the EM61-MK2 crossed the 25 foot increments. During pre-processing of the data, those marks were used to adjust the along-line locations of the data points.

2.7.2 IDENTIFICATION OF NON-DGM AREAS DURING DATA COLLECTION

The use of the DGM methods described above requires that all data be collected along straight, parallel transects to maintain accurate positioning. Obstacles encountered along the transects frequently required the field teams to pause data collection, maneuver around the obstacle, and then resume data collection along the same line. At each of the line breaks (data gaps), the field team recorded the end point of the line segment, the start point of the new segment, and the reason for the gap in a specially designed drop down menu on the team PDA. The majority of data gaps were caused by trees, but other obstacles included creeks, steep slopes, and standing water. These data gaps, called non-DGM (clearance) areas, were identified on the DGM grid maps (Appendix D) for separate clearance using hand held instruments.

2.8 DATA PROCESSING

NAEVA utilized qualified geophysicists to perform all data processing tasks for MRS-7. The raw and processed data files, contour maps, and target lists were posted to the project file transfer protocol (FTP) site for review by project QC and MES QA personnel.

2.8.1 PRE-PROCESSING

Digital geophysical data was reviewed to ensure complete coverage and data quality by a qualified geophysicist. Data was edited for line ends and fiducial positions using Geonics DAT61-MK2 software, and then exported to an ASCII file format to allow for initial contouring and evaluation. If any data was found to be missing or unacceptable, the data collection team would be directed to return to the grid for recollection. Once the data was prepared, evaluated, and determined to be complete and accurate, raw Geosoft XYZ files were generated and electronically transferred to the FTP site.

2.8.2 INITIAL PROCESSING

Upon completion of pre-processing and a review of the acceptability of the associated DGM team QC data, the digital geophysical data was further evaluated and processed to generate the final processed data files and associated maps using Geosoft's Oasis Montaj processing software with the UX-Detect module. The data processing procedures include:

- Data evaluation for down-line data density and coverage

- Auto-leveling of four bottom coil channels, with additional leveling refinement of Channel 2 data
- Lag correction
- Gridding of data
- Additional filtering and data enhancement, as necessary
- Generation of polygon files to clip gridded data at line breaks
- Spatial referencing of culture features noted during data collection
- Target selection and evaluation of anomalies at or above the designated 7 mV threshold
- Conversion of data from local coordinates to State Plane coordinates
- Generation of final geophysical maps (local and State Plane coordinates), target lists and XYZ files

The data processing methods and parameters for each grid are documented in the Data Processing tables of the project DB (Appendix C). A mosaic of the DGM results is shown in Figure 2-1.

2.8.2.1 Target Selection

Initial target selections were made using automated processing routines within UX-Detect software. In areas exhibiting low target density and discrete features initial target selections were made from the profile data. Within high target density target areas where anomaly footprints overlapped, the initial target selections were made based on the gridded data. Data and targets were evaluated by qualified geophysicists as to their validity and position. Targets found to be invalid or incorrectly located were removed or adjusted. Additionally, anomalies that were not selected by the UX-Detect module, yet deemed to represent a potential target, were manually selected. Each target list provides a unique Target ID, x and y location for each target (in local grid coordinates and state plane coordinate), the recorded peak response, and any appropriate comments (i.e. culture, suspected utility, possible geologic response, or relationships with adjacent anomalies/targets). The target selection threshold based on the approved GPO results was 7 mV on Channel 2. The targets selected for each grid are documented and tracked in the Anomaly Tracking Sheet table of the project DB (Appendix C).

2.8.2.2 DELINEATION OF NON-DGM AND SPECIAL CASE AREAS

In some areas, digital geophysical data could not be collected due to the presence of trees, creeks, steep slopes or other obstructions. In such cases, polygon files were generated based on the line paths to show breaks in the data collection line. The polygon files were drawn on the geophysical maps and used to mask areas in which no DGM actually occurred. Field notes collected during DGM were imported into Oasis Montaj and noted culture was placed on the map. It was agreed prior to the start of the project that any unlabeled data gaps shown on the grid maps would be assumed to be the result of single trees.

No saturated response areas, where overlapping strong responses precluding picking of discrete targets, were identified for MRS-7. A special case area identified was one high density target areas (HDTAs) where discrete point targets were present and fringe metallic response areas associated with the metallic cultural features such as the boundary fence, two small concrete slabs, and a culvert. Individual point targets were selected within each of these areas as appropriate and boundaries for follow-on mag and dig clearance were placed around each of these areas.

2.9 REACQUISITION

All targets selected by NAEVA's data processors as well as any QA/QC picks made by the QC Geophysicist or the QA Geophysicist, were reacquired in the field by NEAVE DGM teams using an EM61-MK2. Although targets were selected using a 7mV threshold from the DGM data, the DGM measurement locations generally did not fall exactly over the center of the buried metallic items sourcing the anomalies such that the exact location and peak response of the target was not targeted. During reacquisition, each DGM target was interrogated using the EM61-MK2 operated in analog mode and the location of peak response was located and the peak response was measured over each target. All targets with a (channel 2) reacquisition peak response of at least 10 mV were intrusively investigated and cleared. The reacquisition data for each target was documented and tracked in the Anomaly Tracking Sheet table of the project DB (Appendix C). In addition, the reacquisition teams marked the boundaries of the special case areas noted in Section 2.8.2.2 with spray paint.

2.9.1 FIELD METHODS

Upon arriving at the grid, the team located the targets based on the geophysical maps and marked each target with a uniquely numbered pin flag in accordance with the SSWP. Each flagged location was interrogated with an EM61-MK2 to find the peak response location. The peak response, offset, and any comments from the instrument operator were entered into the PDA.

The benefit of reacquiring selected targets with the original mapping instrument comes in the reduced time and effort required of the dig teams. In addition to adjusting the target location directly over the peak value, the reacquisition teams had the ability to add or remove (merge) targets as necessary (which were fully documented on the team PDAs). If any related or adjacent sub-peaks above the targeting threshold were identified in the field, they were flagged and added (daughter anomalies) to the dig list by the reacquisition team. Occasionally, rough terrain or other outside interference will result in elevated instrument response and the selection of a target where none is necessary. Reacquisition teams searched a minimum of 2.5 ft around each target. If they could not locate a peak response above the target threshold, the flag would not be placed and an appropriate comment recorded in their PDA.

2.10 UXO INTRUSIVE INVESTIGATIONS

2.10.1 INTRUSIVE OPERATIONS

Intrusive teams were provided a grid information package containing DGM grid maps and target lists with mV readings and comments. The basic tactical approach to intrusive operations remained consistent throughout the clearance phases. All targeted locations were excavated until the geophysical response was below the 10mV reacquisition threshold criteria or the dig was inspected and approved by QC.

2.10.2 NON-DGM AREAS

UXO teams were required to check their DGM maps and identify any data gaps present in the grid. UXO teams used a Vallon, Schonstedt or Garrett detector or an EM-61 MK2 in analog mode to clear around obstructed data gaps (trees, deadfall, fences, etc.) and 100% of the area of non-obstructed data gaps (such as creeks and steep slopes).

2.10.2.1 TREE GAPS

The MRS is heavily wooded. The Vallon, Schonstedt or Garrett detector or an EM-61 MK2 in analog mode was required to be used to clear to the depth of detection all data gaps around trees to a radius of 2 feet using mag and dig methodology.

2.10.2.2 STEEP SLOPES

In some isolated areas and drainages, the terrain was too steep to be safely mapped using an EM61-MK2. These non-DGM areas were marked in the field during reacquisition and were subsequently cleared using mag and dig methods with approved clearance to depth instruments.

2.10.2.3 STRUCTURES

There were no structures found in MRS-7 except for one temporary magazine associated with the intentional detonation area which was removed (and cleared under) at the end of the project.

2.10.2.4 OTHER NON-DGM AREAS

Downfall, logs, trenches, swamps, gullies, mounds, rocks, etc. were also identified on the DGM maps. UXO teams used a Vallon, Schonstedt or Garrett detector or an EM-61 MK2 in analog mode to clear obstruction-caused data gaps (downfall, logs, rocks, etc.) and to clear 100% of other data gaps (trenches, swamps, gullies, mounds, etc.).

2.10.2.5 SRAS and HDTAs

Saturated Response Areas (SRAs), consisting of dense, overlapping geophysical anomalies that made prosecuting individual targets impractical, were not identified for MRS-7.

A high-density target area (HDTA) where discrete point targets were present was identified in grids N146E096 and N146E097. Individual point targets were selected and cleared within this

area as appropriate and a follow-on mag and dig clearance was then performed to the identified boundary of this area.

2.11 STEP-OUTS

The Step-Out approach was performed in accordance with the SSWP. If a MEC item was identified within 200 feet of the boundary of the MRS, a step-out was performed to ensure a 200-foot buffer free of any MEC. Multiple step-outs were performed into MRS-11, which were cleared to the depth of detection. Step-outs were not extended into MRS-3 (previously cleared) or MRS-9 (subsequently cleared in 2014).

2.12 DEMOLITION OPERATIONS

Demolition operations were conducted throughout all phases of the MRS-7 remediation in accordance with the SSWP. For items determined to be safe to move, consolidated demolition operations were conducted within the grid. Items deemed not safe to move were rendered safe by blow in place (BIP) demolition procedures. Positive identification, location, and condition of the MEC item determined whether blast mitigation was required. For BIP intentional detonations where blast mitigation was required (adjacent to roads, buildings, workers) procedures in *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions*, August 1998 HNC-ED-CS-S-98-7 were used. No unintentional detonations occurred.

The 183 MPPEH items were determined to be MEC by explosive investigation or x-ray operations as summarized below in Table 2-2.

TABLE 2-2: MEC ITEMS

MEC Item	Total
37mm (HE)	139
60mm Mortar (HE)	1
40mm Grenade (HE)	3
Grenade (HE)	27
Grenade (Various)	2
Rifle Grenade (Various)	3
2.36-in Rocket	3
3.5-in Rocket	1
66mm Rocket	4
Totals	**183**

2.13 WASTE DISPOSAL[2]

MEC-related scrap and non–MEC-related scrap were sorted and inspected in accordance with the SSWP and DODI 4140.62 *Material Potentially Presenting an Explosive Hazard,* November 2008. This inspection process insured that MEC and non-MEC-scrap were properly identified and did not present an explosive hazard. The process included sorting, 100 % inspection and 100% re-inspection, demilitarization as needed, and securing in separate locked containers. Following this inspection program, non-MEC scrap and demilitarized MEC scrap was released to Star Recycling (a scrap recycler in Birmingham, AL) with a signed 1348-1A custody document. The containers of all scrap remained secured until they were processed and a certificate of disposition issued. MEC certification and disposal documents are included in Appendix H.

Scrap weights recycled were as follows:

- MEC Scrap – 2,458 lbs.
- Non-MEC scrap – 16,441.5 lbs.

3.0 MEC REMEDIATION RESULTS

Clearance to the depth of detection was performed during the remediation of the 161.92 acres of MRS-7 and 6.08 acres of step-outs. Step-outs were performed to ensure a 200-ft MEC-free buffer around the MRS.

3.1 MEC ITEMS RECOVERED

A total of 183 MEC items were recovered from MRS-7 as itemized in Table 2-2 – 76% 37mm (HE), 19% various grenades, and 5% miscellaneous rockets and mortars. These are consistent with the previous use the area as a 37mm projectile range and infantry maneuver training and bivouac area. The MEC density is 1.09 MEC/acre. The MEC items were recovered from the clearance operations as follows:

- 14 MEC items (7-37mm HE, 3 grenade HE, 2-66mm rockets, 1-2.36” rocket and 1 60mm mortar HE) were recovered during the surface sweep

[2] Current DOD terminology (DODI, 2008) is to refer to non-MEC scrap as Material Documented as Safe (MDAS). Material prior to determination of its explosives safety status, potentially contains explosives or munitions and is referred to as Material Potentially Presenting an Explosive Hazard (MPPEH). MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present and for which the chain of custody has been established and maintained is referred to as Material Documented as Explosive Hazard (MDEH) and is no longer considered MPPEH. In this report, to be consistent with existing plans and documents, we have continued to use MEC Scrap terminology.

- 138 MEC items (3 various rifle grenades, 2-2.36” rockets, 1-3.5” rocket, 2-40mm grenade HE, 2-66mm rockets, 1 grenade practice (live), 9 grenade HE and 118-37mm HE) were found during the near surface (6 inch) clearance operation
- 31 MEC items (14-37mm HE, 15 grenade HE, 1-40mm grenade HE and 1 grenade fuze) were found during the clearance to depth operations

The locations of all MEC found are shown in Figure 3-1.

3.2 ANOMALY TRACKING

A total of 8530 DGM anomalies were tracked during the DGM-based clearance (Table 3-1). The DGM target density for the MRS is 50.7 per acre. Of these, only 0.2% were MEC, 8.5% were MEC-scrap, 11.6% were identified as MEC fragmentation, and 46.7% were SAA. Of the MEC-scrap recovered, 96% was various flares, grenades, fuzes, and 37mm debris (Table 3-2).

Table 3-1 DGM Target Resolution

DGM Targets	%	Type	Comments
1,660	19.5%	Removed in Reac.	<10mV, same as adjacent target, or checked survey pins
144[1]	1.6%	Not Reacquired	Within HTDA/QA Mapping No Target Grids
17	0.2%	MEC	37mm (HE), Grenade (HE), 40mm Grenade (HE)
721	8.5%	MEC Scrap	37mm APT, 3.5 Inch Rocket, 66mm Rocket
986	11.6%	MEC Fragmentation	37mm (HE), 60mm Mortar, Grenade (HE)
668	7.8%	Non-MEC Scrap	Metal spikes, nails, barbed wire
3,981	46.7%	SAA	
255	3.0%	Seeds	
90	1.1%	Geologic	
0	0%	No Finds	
8	0.1%	Other	
8,530	100%	Totals	

1. Includes 14 MEC items recovered in HTDA.

Table 3-2 DGM Target MEC Scrap/MEC Fragmentation

Quantity Recovered	%	Depth(in)	Type	Items
726	22.6%	0-36	MEC Fragmentation	37mm (HE)
638	19.9%	1-12	MEC Fragmentation	Grenade (HE);Fuze
603	18.8%	0-24	MEC Fragmentation	75mm (HE);60mm Mortar (HE);Grenade (HE)
224	7.0%	6-9	MEC Fragmentation	Grenade (HE); Fuze
26	0.8%	9-24	MEC Fragmentation	Grenade (HE);Grenade (Practice);Fuze
20	0.6%	4-18	MEC Fragmentation	37mm (HE);Grenade (HE)
9	0.3%	14	MEC Fragmentation	37mm APT; Grenade (HE);2.36 Inch Rocket; Fuze
8	0.2%	6	MEC Fragmentation	37mm (HE);75mm (HE);40mm Grenade (HE);Grenade (HE);Fuze
7	0.2%	6-18	MEC Fragmentation	37mm (HE);Fuze
6	0.2%	24	MEC Fragmentation	37mm (HE);37mm APT;2.36 Inch Rocket; Grenade (HE);Fuze
4	0.1%	4	MEC Fragmentation	Fuze;60mm Mortar (HE);Grenade (HE); 3.5 Inch Rocket
4	0.1%	5	MEC Fragmentation	Grenade (HE);3.5 Inch Rocket; Small Arms Ammo
4	0.1%	10	MEC Fragmentation	60mm Mortar (HE);3.5 Inch Rocket
4	0.1%	1-4	MEC Fragmentation	60mm Mortar (HE);3.5 Inch Rocket
4	0.1%	7-18	MEC Fragmentation	60mm Mortar (HE);3.5 Inch Rocket
2	0.06%	0-2	MEC Fragmentation	Rifle Grenade (HE)
1	0.03%	17	MEC Fragmentation	Fuze;75mm (HE)
225	7.0%	1-24	MEC Scrap/MEC Fragmentation	37mm (HE);37mm APT; Small Arms Ammo; Fuze
5	0.2%	3	MEC Scrap/MEC Fragmentation	40mm Grenade (Practice);66mm Rocket; Grenade (HE)
3	0.1%	12	MEC Scrap/MEC Fragmentation	37mm (HE);75mm (HE);60mm Mortar (HE)
551	17.2%	0-48	MEC Scrap	37mm APT
76	2.4%	0-18	MEC Scrap	2.36 Inch Rocket;3.5 Inch Rocket
20	0.6%	0-24	MEC Scrap	66mm Rocket
14	0.4%	0-7	MEC Scrap	Grenade (Practice)
7	0.2%	18-24	MEC Scrap	Fuze;2.36 Inch Rocket
6	0.2%	1-15	MEC Scrap	75mm Shrapnel
5	0.2%	6	MEC Scrap	81mm Mortar;3 Inch Stokes Mortar; Rifle Grenade (Illum.);Small Arms Ammo
4	0.1%	2-16	MEC Scrap	Slap Flare
3	0.1%	2-24	MEC Scrap	3.8 Inch Shrapnel
2	0.06%	15	MEC Scrap	Fuze;75mm Shrapnel
2	0.06%	36	MEC Scrap	3.5 Inch Rocket; Small Arms Ammo
3213	100.0%	Note: Includes HDTA, multiple (up to 16) items in many target excavations		

3.3 EXCEPTION AREAS

No exception areas requiring future construction support are present within MRS-7.

4.0 QUALITY CONTROL (QC) TESTING

This section discusses the QC program that was implemented during the remediation of MRS-7. This section summarizes the DQOs and discusses the three phases of (quality) control, and the results of the QC program.

4.1 DATA QUALITY OBJECTIVES

Per the SSWP, the following approved DQOs were used for this project. All DQOs were met except as noted and the data was of acceptable quality and utility for decision making.

4.1.1 LAND SURVEYING

- Survey/positional accuracy – due to canopy cover, conventional survey methods were used to survey boundaries and grid corners, by L.I. Smith & Associates, an Alabama licensed professional land surveyor (PLS). Accuracy of these systems was within +/- 1 in. per the DQO.

4.1.2 GEOPHYSICAL INVESTIGATION

- Each geophysical contractor team/equipment was certified as qualified after demonstrating location and detection of 95% of seed items in the GPO test grid.
- Daily function checks of the geophysical instruments were performed and were within tolerances specified in the PWP and finalized in the GPO.
- Continuous recording of geophysical data (no unexplained sensor data gaps) was achieved.
- Continuous recording of positional data (no unexplained positional data gaps) was achieved.
- Over 99% of all DGM target anomalies were relocated to within a critical radius of 2.5 ft.
- All blind seed items in DGM areas (except intentional data gap seeds) were detected and targeted by DGM mapping.
- The DGM contractor used 10cm survey wheel logging on 2.5 foot spaced survey lines to exceed the DQO of along track sample density of at least 20 cm and an across track spatial density of 2.5 feet for DGM, excepting obstacles.
- The DGM data for a minimum of one grid per UoP was reprocessed by QC staff to verify accuracy and repeatability of data processing and target selection.
- Geophysical data and databases were backed up daily to NAEVA's offsite servers.

4.1.3 INTRUSIVE INVESTIGATION

- All hand-held detectors and data collection and positioning systems were performance checked daily in accordance with SOPs or manufacturer's specifications.

- Each UXO clearance team performed a daily instrument functional check at a FCA to verify that the instruments are working properly.
- UXO personnel and equipment were certified as being able to find 95% of applicable seed items in the GPO test area.
- The same DGM sensor (Geonics EM61-MK2) was used for reacquisition of all DGM targets and to interrogate all no-find locations. In addition, 100% of all DGM targets excavations were checked for completeness with an EM61-MK2.
- 520 blind QC seeds were placed in MRS-6 (1.38 per acre) to test UXO operations. 517 (99.4%) of the seeds were recovered during UXO operations just missing the 100% recovery goal. Root cause analyses and corrective actions were performed for the three missed QC seed events. The 99.4% recovery rate indicates that the clearance exceeded acceptable quality standards.
- During QC inspection of completed grids, QC personnel investigated and interrogated target anomaly locations with an EM61-MK2 at rates exceeding the requirements of work plan Table 10-3.
- Geophysical remapping was performed on over 10% of the DGM area. No MEC or MPPEH was found in the remapping grids and no DGM discrepancies were identified.
- All MEC items were positively identified as to type, fuze, condition, and filler based on knowledge/training/reference material.
- The UXOQCS or his designate (UXOSO) verified the identification of all MEC items.

4.1.4 MEC ITEM PERFORMANCE CLEARANCE DEPTHS

Performance clearance depths specified in the PWP are presented in Table 4-1.

TABLE 4-1: Performance Clearance Depths For MEC Items

MEC Item	Clearance Depth
Mk II Hand Grenade	0 – 14 in.
37mm Projectile	0 – 14 in.
M9 Rifle Grenade	0 – 18 in.
2.36-in. Rocket	0 – 24 in.
3.5-in. Rocket	0 – 24 in.
75mm Projectile	0 – 30 in.
3-in. Stokes Mortar	0 – 32 in.
60mm Mortar Projectile	0 – 24 in.
81mm Mortar Projectile	0 – 30 in.
3.8-in. Projectile Shrapnel	0 – 24 in
4.2-in. Mortar Projectile	0 – 36 in.
105mm Projectile	0 – 36 in.
155mm Projectile	0 – 48 in.
AT Mine	0 – 6 in.

4.2 THREE PHASE QC PROGRAM

A three-phase QC program was implemented as a means to verify accomplishment of the Definable Features of Work. This program consisted of Preparatory, Initial, and Follow-up QC inspections. QC inspections are documented in Appendix E (QC Surveillances).

4.2.1 PREPARATORY PHASE INSPECTION

The Preparatory Phase was a pre-operational briefing and training prior to production start. It consisted of a briefing by the QC team for specific tasks. The briefing covered QC check sheet specifics and any SOPs relating to the task. During the briefing, the QC team and operations personnel identified specific procedures, and equipment needed to accomplish the task. Because many of the MRS-7 tasks were performed by contractor teams moved from performing the identical work tasks in previous MRS clearances, (legacy) initial inspections were used as appropriate.

4.2.2 INITIAL PHASE INSPECTION

The QC team conducted an initial phase inspection the first time a DFW was performed. This inspection checked that preliminary work met contract specifications, was safely executed, and that an acceptable level of workmanship was achieved. Because many of the MRS-7 tasks were performed by contractor teams moved from performing the identical work tasks in previous MRS clearances, (legacy) initial inspections were used as appropriate.

4.2.3 FOLLOW-UP PHASE INSPECTION

Follow-up inspections ensured continued PWP compliance, workmanship quality, and safety. The QC team observed specific portions of the task in progress while on site. Established procedures briefed at the QC preparatory briefings and initial inspections were observed.

4.3 UOP CERTIFICATION PROCESS

The UoP certification process was implemented in accordance with the PWP and incorporates the major QC steps. Verification of these steps are documented in the UoP Certification Process Spreadsheet Log and Certification Packages in Appendix E.

4.3.1 QC STEP 1: GPO, FCA, PREPARATORY AND INITIAL QC INSPECTION

The FCA and GPO were used to certify operators and instruments prior to commencing field operations. Operators were tested for their ability to detect buried seed items with specified equipment. GPO and FCA certifications are included in Appendix A. The preparatory phase inspection was conducted by QC personnel prior to contractor work team field deployment. The initial QC inspection was performed the first time selected DFWs were performed. Preparatory and Initial inspections are documented on the QC Surveillance Reports by DFW in Appendix E. (QC Surveillances).

4.3.2 QC STEP 2: FOLLOW-UP QC PHASE INSPECTION

Follow-up QC Phase Inspections for each DFW were conducted in accordance with Table 10-3 of the PWP in accordance with the QC state (normal, relaxed or tightened) to ensure the tasks were being performed to the required PWP standards.

4.3.3 QC STEP 3: GEOPHYSICAL DATA REPROCESSING

The GeoQCS independently reprocessed the geophysical data for on average one grid in each UoP and developed maps and target lists which were compared to the grid maps and target lists [Appendix E (GeoQC Review)]. Minor discrepancies in target selection existed due to the interpretative nature of geophysical target selection. If discrepancies between the grid maps and target lists existed, the GeoQCS and the geophysical data processor compared processing techniques and agreed to standard processing procedures. At this time, the GeoQCS also checked the blind QC seed items against the DGM results and target lists for this UoP. If any QC issues were identified, the QC team would conduct a root cause analysis documenting what, when and where the problem occurred and who was involved and recommend potential solutions and corrective actions.

4.3.4 QC STEP 4: BLIND QC SEEDS

QC seed items were placed by the QC team at a minimum density of one seed item per UoP to monitor the Aggressive Surface/Near Surface Clearance Operations. A subsequent set of QC seeds were also installed at a minimum density of one seed item per UoP to monitor the Clearance to Depth Operations. Seed items consisted of inert munitions items placed below the vegetative mat for surface operations and to the maximum depth of detection for subsurface operations. QC seeding results are discussed in Section 4.8. Seeding data is in Appendix E (QC Seeding).

4.3.5 QC STEP 5: EXCAVATION SAMPLING REPORTS

Step 5 of the QC process consisted of post excavation dig checks and data gap checks to verify workmanship. This QC step utilized MIL-STD-1916, verification level III. The PWP specified three levels of QC state (tightened 35%, normal 25%, or relaxed 15%) which determined the minimum percentage of targets in a UoP that QC was required to check. The QC state for each team was based on its work history and quality performance. All teams started at the normal QC state. The QC state for each grid is recorded on each QC/QA Inspection report contained in Appendix E (QC Acceptance).

4.3.6 QC STEP 6: TARGET DATA MV COMPARISON TO EXCAVATION RESULTS

This step was actually performed prior to QC Step 5. Upon completion of all excavations in a UoP, the GeoQCS would compare the reacquisition team's target mV reading with intrusive results. If a mV response was inconsistent with the excavation results (based on GPO and intrusive history), GeoQCS selected that target for QC Step 5 inspection by the UXOQCS.

These comparisons are documented on the GeoQC mV Comparison Tracking Sheets in Appendix E (GeoQC Review).

4.4 UOP CERTIFICATION

The UoP Certification Packages document each UoP successfully passing the six QC steps and are included in Appendix E. Part of the UoP certification process required that at least one grid from a UoP be selected and reprocessed by GeoQC. Initially, grids were selected randomly from a UoP. However, as work progressed, grids with blind QC seed items were preferentially selected because the blind QC seed locations (but known to the GeoQC) were useful for confirming both positional accuracy and anomaly targeting in the data during QC data evaluation and reprocessing.

4.4.1 UOP CERTIFICATION REQUIREMENTS

All UoPs passed the certification requirements as indicated on Table 4-2. All raw and processed geophysical data and associated geophysical field QC data is included in Appendix D. UoP certification data is presented in Appendix E**,** and includes:

- GeoQC grid data reports with checklists and reprocessed data (GeoQC Review)
- GeoQC mV comparison tracking sheet (GeoQC Review)
- QC remapping data (GeoQC Review)
- QC surveillances (QC Surveillances)
- QC acceptance reports (QC Acceptance)
- QA/QC grid tracking tables (QC Tracking Sheets)
- QC Seeding tables (QC Seeding)

MES QC grid inspections (Step 5 and Step 6) checked at least 25%-35% of all DGM targets and data gaps in the DGM-based clearance grids, depending on the QC state, in accordance with work plan Table 10-3. All grid QC inspections are documented in the QC acceptance report in Appendix E (QC Acceptance).

4.5 QC FUNCTION TESTS

To ensure quality DGM data, NAEVA conducted daily QC tests, which were evaluated on a daily basis to ensure that both personnel and equipment were functioning at optimal levels. Each NAEVA DGM team conducted daily morning and end of day (AM and PM) Static tests and Lag tests to document proper instrument function. In addition, a set of repeat data lines were collected for every grid dataset. All QC function tests were reviewed by the GeoQCS as part of

the QC Process. The QC test data and results are included in Appendices D (DGM data) and E (Quality Control).

TABLE 4-2 UoP QC Verification

UoP	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	QC Complete	Verified By
	FCA, GPO Prep, Init.	Follow-up Inspection	Data Rep-rocessing	Blind QC Seeding	QC Grid Inspection	Target mV Comparison	Date	QC
N0001	Yes	Yes	Yes	Yes	25%	8/12/2013	8/15/2013	HEW
N0002	Yes	Yes	Yes	Yes	25%	8/13/2013	8/22/2013	HEW
N0003	Yes	Yes	Yes	Yes	25%	8/12/2013	8/22/2013	HEW
N0004	Yes	Yes	Yes	Yes	25%	8/2/2013	8/12/2013	HEW
N0005	Yes	Yes	Yes	Yes	25%	8/2/2013	8/12/2013	HEW
N0006	Yes	Yes	Yes	Yes	25%	8/7/2013	8/22/2013	HEW
N0007	Yes	Yes	Yes	Yes	25%	8/6/2013	8/12/2013	HEW
N0008	Yes	Yes	Yes	Yes	25%	8/6/2013	8/12/2013	HEW
N0009	Yes	Yes	Yes	Yes	25%	8/7/2013	8/12/2013	HEW
N0010	Yes	Yes	Yes	Yes	25%	8/12/2013	8/25/2013	HEW
N0011	Yes	Yes	Yes	Yes	25%	8/13/2013	8/25/2013	HEW
N0012	Yes	Yes	Yes	Yes	25%	8/12/2013	8/25/2013	HEW
N0013	Yes	Yes	Yes	Yes	25%	8/12/2013	8/25/2013	HEW
N0014	Yes	Yes	Yes	Yes	25%	8/12/2013	8/25/2013	HEW
N0015	Yes	Yes	Yes	Yes	25%	8/12/2013	8/25/2013	HEW
N0016	Yes	Yes	Yes	Yes	25%	8/2/2013	8/21/2013	HEW
N0017	Yes	Yes	Yes	Yes	25%	8/6/2013	8/21/2013	HEW
N0018	Yes	Yes	Yes	Yes	25%	8/7/2013	8/21/2013	HEW
N0019	Yes	Yes	Yes	Yes	25%	8/7/2013	8/21/2013	HEW
N0020	Yes	Yes	Yes	Yes	25%	8/12/2013	8/21/2013	HEW
N0021	Yes	Yes	Yes	Yes	25%	8/12/2013	8/19/2013	HEW
N0022	Yes	Yes	Yes	Yes	25%	8/12/2013	8/19/2013	HEW
N0023	Yes	Yes	Yes	Yes	25%	8/12/2013	8/19/2013	HEW
N0024	Yes	Yes	Yes	Yes	25%	8/7/2013	8/19/2013	HEW
N0025	Yes	Yes	Yes	Yes	25%	8/7/2013	8/19/2013	HEW
N0026	Yes	Yes	Yes	Yes	25%	7/31/2013	8/5/2013	HEW
N0027	Yes	Yes	Yes	Yes	25%	7/31/2013	8/5/2013	HEW
N0028	Yes	Yes	Yes	Yes	25%	8/1/2013	8/7/2013	HEW
N0029	Yes	Yes	Yes	Yes	25%	8/2/2013	8/7/2013	HEW
N0030	Yes	Yes	Yes	Yes	25%	8/2/2013	8/7/2013	HEW

UoP	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	QC Complete	Verified By
	FCA, GPO Prep, Init.	Follow-up Inspection	Data Rep-rocessing	Blind QC Seeding	QC Grid Inspection	Target mV Comparison	Date	QC
N0031	Yes	Yes	Yes	Yes	25%	8/1/2013	8/20/2013	HEW
N0032	Yes	Yes	Yes	Yes	25%	8/2/2013	8/20/2013	HEW
N0033	Yes	Yes	Yes	Yes	25%	8/6/2013	8/20/2013	HEW
N0034	Yes	Yes	Yes	Yes	25%	7/31/2013	8/5/2013	HEW
N0035	Yes	Yes	Yes	Yes	25%	9/25/2013	9/30/2013	HEW
N0036	Yes	Yes	Yes	Yes	25%	9/24/2013	9/30/2013	HEW
N0037	Yes	Yes	Yes	Yes	25%	9/24/2013	9/30/2013	HEW
N0038	Yes	Yes	Yes	Yes	25%	9/23/2013	9/25/2013	HEW
N0039	Yes	Yes	Yes	Yes	25%	9/19/2013	9/25/2013	HEW
N0040	Yes	Yes	Yes	Yes	25%	9/19/2013	9/25/2013	HEW
N0041	Yes	Yes	Yes	Yes	25%	9/18/2013	9/23/2013	HEW
N0042	Yes	Yes	Yes	Yes	25%	9/18/2013	5/28/2014	HEW
N0043	Yes	Yes	Yes	Yes	25%	9/25/2013	9/30/2013	HEW
N0044	Yes	Yes	Yes	Yes	25%	9/27/2013	10/11/2013	HEW
N0045	Yes	Yes	Yes	Yes	25%	9/27/2013	10/2/2013	HEW
N0046	Yes	Yes	Yes	Yes	25%	9/27/2013	10/2/2013	HEW
N0047	Yes	Yes	Yes	Yes	25%	10/3/2013	10/8/2013	HEW
N0048	Yes	Yes	Yes	Yes	25%	10/1/2013	10/31/2013	HEW
N0049	Yes	Yes	Yes	Yes	25%	10/9/2013	10/9/2013	HEW
N0050	Yes	Yes	Yes	Yes	25%	10/9/2013	10/9/2013	HEW
N0051	Yes	Yes	Yes	Yes	25%	10/9/2013	10/9/2013	HEW
N0052	Yes	Yes	Yes	Yes	25%	10/9/2013	10/9/2013	HEW
N0053	Yes	Yes	Yes	Yes	25%	10/9/2013	10/9/2013	HEW
N0054	Yes	Yes	Yes	Yes	25%	10/9/2013	10/10/2013	HEW
N0055	Yes	Yes	Yes	Yes	25%	9/25/2013	9/30/2013	HEW
N0056	Yes	Yes	Yes	Yes	25%	9/24/2013	9/30/2013	HEW
N0057	Yes	Yes	Yes	Yes	25%	9/24/2013	9/30/2013	HEW
N0058	Yes	Yes	Yes	Yes	25%	9/23/2013	9/25/2013	HEW
N0059	Yes	Yes	Yes	Yes	25%	9/19/2013	9/25/2013	HEW
N0060	Yes	Yes	Yes	Yes	25%	9/19/2013	9/25/2013	HEW
N0061	Yes	Yes	Yes	Yes	25%	10/24/2013	10/28/2013	HEW

UoP	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	QC Complete	Verified By
	FCA, GPO Prep, Init.	Follow-up Inspection	Data Rep-rocessing	Blind QC Seeding	QC Grid Inspection	Target mV Comparison	Date	QC
N0062	Yes	Yes	Yes	Yes	25%	9/25/2013	10/1/2013	HEW
N0063	Yes	Yes	Yes	Yes	25%	9/27/2013	10/7/2013	HEW
N0064	Yes	Yes	Yes	Yes	25%	9/27/2013	10/7/2013	HEW
N0065	Yes	Yes	Yes	Yes	25%	10/16/2013	10/17/2013	HEW
N0066	Yes	Yes	Yes	Yes	25%	10/15/2013	10/16/2013	HEW
N0067	Yes	Yes	Yes	Yes	25%	10/15/2013	10/17/2013	HEW
N0068	Yes	Yes	Yes	Yes	25%	10/15/2013	10/17/2013	HEW
N0069	Yes	Yes	Yes	Yes	25%	10/9/2013	10/10/2013	HEW
N0070	Yes	Yes	Yes	Yes	25%	10/15/2013	10/14/2013	HEW
N0071	Yes	Yes	Yes	Yes	25%	10/10/2013	10/14/2013	HEW
N0072	Yes	Yes	Yes	Yes	25%	11/15/2013	12/4/2013	HEW
N0073	Yes	Yes	Yes	Yes	25%	11/15/2013	12/4/2013	HEW
N0074	Yes	Yes	Yes	Yes	25%	11/15/2013	11/25/2013	HEW
N0075	Yes	Yes	Yes	Yes	25%	11/15/2013	11/25/2013	HEW
N0076	Yes	Yes	Yes	Yes	25%	11/15/2013	11/25/2013	HEW
N0077	Yes	Yes	Yes	Yes	25%	11/15/2013	11/25/2013	HEW
N0078	Yes	Yes	Yes	Yes	25%	11/12/2013	12/3/2013	HEW
N0079	Yes	Yes	Yes	Yes	25%	11/14/2013	11/14/2013	HEW
N0080	Yes	Yes	Yes	Yes	25%	11/4/2013	12/3/2013	HEW
N0081	Yes	Yes	Yes	Yes	25%	11/5/2013	11/24/2013	HEW
N0082	Yes	Yes	Yes	Yes	25%	11/5/2013	11/14/2013	HEW
N0083	Yes	Yes	Yes	Yes	25%	11/8/2013	11/14/2013	HEW
N0084	Yes	Yes	Yes	Yes	25%	11/8/2013	11/25/2013	HEW
N0085	Yes	Yes	Yes	Yes	25%	11/7/2013	12/11/2013	HEW
N0086	Yes	Yes	Yes	Yes	25%	11/15/2013	11/24/2013	HEW
N0087	Yes	Yes	Yes	Yes	25%	11/12/2013	11/14/2013	HEW
N0088	Yes	Yes	Yes	Yes	25%	11/8/2013	11/14/2013	HEW
N0089	Yes	Yes	Yes	Yes	25%	11/6/2013	5/28/2014	HEW
N0090	Yes	Yes	Yes	Yes	25%	10/31/2013	5/28/2014	HEW
N0091	Yes	Yes	Yes	Yes	25%	10/31/2013	11/5/2013	HEW
N0092	Yes	Yes	Yes	Yes	25%	10/31/2013	10/31/2013	HEW

UoP	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	QC Complete	Verified By
	FCA, GPO Prep, Init.	Follow-up Inspection	Data Rep-rocessing	Blind QC Seeding	QC Grid Inspection	Target mV Comparison	Date	QC
N0093	Yes	Yes	Yes	Yes	25%	10/29/2013	10/30/2013	HEW
N0094	Yes	Yes	Yes	Yes	25%	10/25/2013	11/4/2013	HEW
N0095	Yes	Yes	Yes	Yes	25%	10/29/2013	10/31/2013	HEW
N0096	Yes	Yes	Yes	Yes	25%	10/29/2013	10/31/2013	HEW
N0097	Yes	Yes	Yes	Yes	25%	11/19/2013	11/5/2013	HEW
N0098	Yes	Yes	Yes	Yes	25%	11/19/2013	11/24/2013	HEW
N0099	Yes	Yes	Yes	Yes	25%	11/19/2013	11/21/2013	HEW
N0100	Yes	Yes	Yes	Yes	25%	11/14/2013	11/21/2013	HEW
N0101	Yes	Yes	Yes	Yes	25%	11/14/2013	11/24/2013	HEW
N0102	Yes	Yes	Yes	Yes	25%	11/5/2013	11/24/2013	HEW
N0103	Yes	Yes	Yes	Yes	25%	10/29/2013	10/30/2013	HEW
N0104	Yes	Yes	Yes	Yes	25%	10/24/2013	10/29/2013	HEW
N0105	Yes	Yes	Yes	Yes	25%	10/25/2013	10/30/2013	HEW
P0001	Yes	Yes	Yes	Yes	25%	11/19/2013	12/17/2013	HEW
P0002	Yes	Yes	Yes	Yes	25%	11/7/2013	12/17/2013	HEW
P0003	Yes	Yes	Yes	Yes	25%	10/25/2013	11/24/2013	HEW
P0004	Yes	Yes	Yes	Yes	25%	11/4/2013	12/11/2013	HEW
P0005	Yes	Yes	Yes	Yes	25%	11/4/2013	12/11/2013	HEW
P0006	Yes	Yes	Yes	Yes	25%	10/24/2013	11/6/2013	HEW
P0007	Yes	Yes	Yes	Yes	25%	10/25/2013	12/11/2013	HEW
SN0095	Yes	Yes	Yes	Yes	25%	1/16/2014	1/20/2014	JBS
SN0096	Yes	Yes	Yes	Yes	25%	1/16/2014	1/20/2014	JBS
SN0097	Yes	Yes	Yes	Yes	25%	1/16/2014	1/20/2014	JBS
SN0098	Yes	Yes	Yes	Yes	25%	3/12/2014	4/3/2014	JBS
SP0004	Yes	Yes	Yes	Yes	25%	1/16/2014	1/20/2014	JBS
SP0007	Yes	Yes	Yes	Yes	25%	1/17/2014	1/23/2014	JBS
SP0001	Yes	Yes	Yes	Yes	25%	1/17/2014	2/19/2014	JBS

Note: UoP IDs beginning with "S" indicate step-outs.

4.6 QC CONFIRMATION MAPPING

After a UoP successfully passed the UoP certification (QC) process, it was then eligible for geophysical confirmation mapping and intrusive reinvestigation if needed.

The primary goal of confirmation mapping was to provide a means of assessing the effectiveness of the grid clearance process by providing a "snapshot" of the geophysical conditions within the grids following intrusive operations. The project team recognized that at any site some residual response will remain after the first remediation pass, primarily in the spoils of the initial digs. With this in mind, the secondary goal of the confirmation mapping process was to assess the nature of the residual geophysical anomalies and whether any MEC remained. NAEVA performed QC confirmation remapping on 45 of 768 grids, and the residual anomalies were targeted and investigated (additional remapping was performed in the QA phase such that total remapping exceeded 10% of the DGM area). QC confirmation remapping data is included in Appendix E.

4.6.1 SELECTION OF CONFIRMATION MAPPING GRIDS

MES took into account several factors when selecting grids for confirmation mapping. These included:

- Spatial distribution
- Including as many UoPs as practical
- Representing the full range of vegetation and terrain conditions
- Presence of MEC
- Field efficiency/team spacing considerations

A remapping plan for MRS-7 and MRS-9A, which is included in Appendix E, for 12 QA pre-dig grids (1.7% of area) and 64 post dig QC and QA remapping grids (9.1% of area), to be allocated based on field considerations, was concurred on by ADEM in June 2013. Total remapping acreage is 10.8% of the DGM area for this MRS.

4.6.2 CONFIRMATION MAPPING PROCEDURES

QC confirmation mapping was performed using the same methods and equipment as the initial DGM phase. QA confirmation mapping was performed using the EM61MK2 and the robotic total station (RTS) for positioning. The labels for all data files generated during QC confirmation mapping were preceded by the letter "C" standing for confirmation. The labels for all data files generated during QA confirmation mapping were preceded by the letters "QA" standing for quality assurance.

4.6.3 CONFIRMATION MAPPING RESULTS

Table 4-3 illustrates the intrusive results of the QC remapping for 45 QC remapping grids conducted in MRS-7. The results of the confirmation mapping were acceptable. No MEC was found. Residual targets were mostly small 37mm and grenade fragmentation and SAA. The largest piece of scrap was a horseshoe. We note that remapping was made more difficult by the presence of open excavations and spoils piles from the initial prosecution of the grids. In many cases, small bits of metal in spoils piles which were previously buried, showed higher geophysical response during remapping because they were now located above the original ground surface and closer to the EM61-MK2 sensor coils.

Table 4-3 QC Post Dig Remapping Results

Tract	Grid ID	Targets	MEC	Quantity	Weight (lbs)	Comments
7D	CN130E097	2	0	1	0.5	SAA
7C	CN130E098	0	0	0	0	
7C	CN131E091	3	0	1	0.5	SAA
7D	CN131E092	10	0	7	2	37mm frag and wire
7C	CN132E105	3	0	0	0	no targets after reac
7C	CN132E106	3	0	0	0	geologic
7C	CN133E099	2	0	1	0.5	SAA
7D	CN134E078	21	0	31	9	SAA
7C	CN134E099	2	0	2	2.5	37mm frag/scrap
7C	CN135E078	7	0	8	4	SAA, 37mm frag
7C	CN135E082	7	0	2	1	37mm frag
7C	CN135E083	8	0	5	2	SAA
7C	CN136E088	0	0	0	0	
7C	CN136E096	2	0	1	0.5	3.5-in rocket
7B	CN137E088	0	0	0	0	
7B	CN137E096	1	0	0	0	no targets after reac
7B	CN139E085	8	0	2	1	SAA
7B	CN139E090	3	0	0	0	no targets after reac
7A	CN140E076	7	0	5	2.5	SAA, 37mm frag
Tract	**Grid ID**	**Targets**	**MEC**	**Quantity**	**Weight (lbs)**	**Comments**
7B	CN140E085	4	0	0	0	no targets after reac
7B	CN140E090	1	0	1	0.5	Nails
7B	CN141E093	2	0	0	0	no targets after reac
7B	CN141E094	4	0	0	0	no targets after reac
7B	CN143E087	3	0	0	0	no targets after reac
7B	CN143E088	0	0	0	0	
7A	CN147E073	4	0	4	1.5	SAA, 37mm frag
7B	CN147E085	0	0	0	0	
7B	CN147E086	3	0	1	1.5	SAA
7A	CN148E073	11	0	6	3.5	SAA, horseshoe

7B	CN149E093	2	0	0	0	no targets after reac
7B	CN149E094	8	0	3	1	Nails
7A	CN150E076	3	0	1	0.5	SAA
7A	CN150E077	4	0	2	1	37mm frag
7B	CN150E089	0	0	0	0	
7B	CN150E090	4	0	0	0	Geologic
7B	CN151E086	2	0	0	0	no targets after reac
7A	CN152E083	1	0	0	0	no targets after reac
7B	CN152E084	0	0	0	0	
7B	CN152E086	5	0	2	1	Wire, nails
7A	CN153E074	2	0	1	0.5	SAA
7A	CN154E074	2	0	1	0.5	37mm frag
7A	CN156E077	1	0	4	0.5	SAA
7A	CN156E078	1	0	0	0	no targets after reac
7A	CN158E076	9	0	4	1	SAA
7A	CN158E077	2	0	2	0.5	37mm frag

4.7 DEFICIENCY NOTICE REPORTS

The QC staff identified, documented, and tracked deficiencies during the course of field activities. In addition, they were tasked to recommend corrective actions, through a "root cause analysis" approach, and verify corrective actions were implemented and any rework satisfactorily accomplished. During the work in MRS-7 a total of 168 acres, including 6.08 acres of step outs, were surveyed, brush cut, surface cleared, digitally mapped (DGM), targets processed and reacquired then intrusively investigated. The QC staff issued three DNRs (Table 4-4) for preparatory work (not final product) which are included in Appendix E. No DNRs were issued for clearance work.

TABLE 4-4 QC Deficiency Notice Reports

DNR	Description	Root Cause Analysis	Corrective Action Taken
1	MES Team 1, UXO Surface and Near Surface Clearance, UoP N0058 Grid N147E091. Missed QC seed #102, a 37mm at a depth of 5 inches.	Failure to fully investigate and prosecute all anomalies indicated by the instrument.	All team personnel reviewed clearance procedures and the grid was reworked.
2	MES Team 1, UXO Surface and Near Surface Clearance, UoP N0074 Grid N138E075. Missed QC seed #149, a 37mm at a depth of 4 inches.	After finding 1 seed in this location, the team failed to thoroughly recheck the area and missed the second seed.	All team personnel reviewed clearance procedures and the grid was reworked. Team leader will monitor who clears each lane.
3	MES Team 1, UXO Surface and Near	Failure to ensure complete coverage	All team personnel reviewed

	Surface Clearance, UoP N0079 Grid N136E083. Missed QC seed #115, a 37mm at a depth of 4 inches.	of the sweep area.	clearance procedures and the grid was reworked. Team leader will monitor who clears each lane. SUXOS spot checked the rest of the UoP. Team will be reorganized before future work is performed.

4.8 QC SEEDING

QC blind seeds were systematically placed in advance of DGM and UXO operations (Table 4-5). One hundred sixty-eight QC seeds were placed to test the aggressive near surface clearance operation performed in advance of DGM. All but 3 seeds were recovered (98.2%) resulting in three DNR's being issued. A total of 352 QC seeds (2.11 per acre) were placed to test clearance to depth operations. Both DGM and non-DGM areas (data gaps) were seeded. The contractor dig teams recovered all 352 seeds during initial prosecution of the grids.

TABLE 4-5: QC Seeding Results

Operation	Number of Seeds	Seeds Recovered	Seeds Missed	Acres/Seeding Density
Surface/Near Surface Clearance	168	165	3 (1.79%)	161.1 (1.04/acre)
Clearance to Depth of Detection	352	352	0 (0%)	167.04 (2.11/acre)
Totals	**520**	**517**	**3 (.58%)**	**328.14 (1.58/acre)**

4.8.1 QC CONCLUSIONS

MES QC was implemented as required by the PWP and SSWP to ensure that a quality MEC clearance work product was performed. MES QC signed off on all work products and clearance grids as being of acceptable quality.

5.0 QUALITY ASSURANCE (QA)

MES was responsible for both UXO QA and DGM QA, which are discussed separately as most DGM QA related to pre-dig activities and most UXO QA related to post-dig activities. DGM QA was performed in accordance with the *Site-Wide Digital Geophysical Mapping Quality Assurance Plan, McClellan, Anniston, Alabama* dated November 2004 (QAP). ERT provided DGM QA remapping support for MES. QA documentation is presented in Appendix J.

5.1 DGM QA

DGM QA was performed in accordance with the requirements stipulated in the QAP. The goal of the geophysical QA program is to ensure that the type and quantity of geophysical data collected are useable and sufficient to support the clearance of all detectable MEC from the removal action areas. The DGM QA process and results are summarized below.

The DGM related portions of the MEC Removal Action for MRS-7 were performed from March 2013 through December 2013. As outlined in the QAP, DGM QA measures performed are organized and discussed as follows:

- Review of work plan and GPO results
- Review of pre-dig DGM data packages
- Reprocessing of raw data
- Review of QC measures and reports
- Review of reacquisition and post-dig DGM DB
- DGM targeting of blind QA seeds
- QA remapping and confirmation sampling

5.1.1 DGM QA REVIEW

All SSWP changes were reviewed by GeoQA for technical acceptability and conformance with the project goals. FCR-18 and FCR-19, both dealing with clearance to depth of detection, were reviewed for technical acceptability before submission to ADEM and ADEM approval (Table 2-1).

All contractor geophysical teams and equipment were certified for field operations in the existing GPO Plot. As most teams and equipment had been in continuous use at McClellan, previously certified teams and equipment were not required to be recertified unless new personnel or equipment were utilized. GPO certifications are included in Appendix A.

The GPO was originally performed and approved by ADEM as part of the *MEC Remediation After Action Report, MRS-1 and Southern Alpha* (MES, 2009 Appendix A). Metrics for the ten critical Contractor DGM QC measures identified in the QAP were evaluated and finalized after review of the GPO data as follows:

Table 5-1 Contractor Critical DGM QC Measures and Metrics

Critical QC Measures	Metric
Blind Seeded QA Items	Target and recover all QA seeds
Background Noise	3.5mV peak-to-peak (Ch2) in static tests and "normal" histograms
Along Track Sampling	0.31 feet
Across Track Sampling	2.5 feet
Latency Correction	No visible "herring bones"
Data Leveling	Geosoft leveling - rolling window ≥ 100 points to baseline response
Signal to Noise Ratio Variance	Static noise 3.5mV peak-to-peak (Ch2) and standard static response variance ≤20%
Anomaly Selection	Geosoft UX-Detect threshold selection: 7mV (Ch2). Acceptable targeting of compound anomalies and delineation of SRAs. Flagging of special case targets (HDTAs, by fence, etc.).
Positioning Errors	Total error ≤2.5 feet for DGM data/targets
Reacquisition	Comparable mV response, position <2.5 feet

A total of 122 (14.7%) of the 809 DGM grid data and accompanying DGM QC packages (including step-out grids) for MRS-7 underwent QA review (Table 5-2). Over 50% of this data was reprocessed, compared to the DGM data package, and found to be of acceptable quality. Additionally the daily geophysical function test data were reviewed and determined to be of acceptable quality. Systematic discrepancies were not found. During QA review of 122 grid data packages, 120 data packages passed, 2 passed with minor edits, and 0 failed. Background noise levels, along track and across track sampling densities, latency corrections, data leveling, and anomaly selection and positioning were found to be of acceptable quality with respect to the established QC metrics.

TABLE 5-2: QA Review of DGM Data Packages

		DGM Grid Packs Selected for QA			
Tract	Grids	Pass	Check/Edit Pass	Fail	QA Targets
MRS-7	809	120	2	0	13
Note: 4 grids were too steep for DGM and did not have DGM data packs.					

All QA seeds in mapped DGM areas were successfully targeted (and later recovered). There were no DGM targets which were not reacquired, although 1.1% were determined to be due to geologic response. The false alarm rate was acceptable (0%). No MEC or MEC-like items were

found in 13 additional QA targets which were selected for intrusive investigation, although 5 were SAA and 2 were 37mm MD. The reviews and QC-QA acceptances tracking of the DGM grid data packages and anomaly targeting are included in Appendix J.

Anomaly reacquisition data was found to be of acceptable quality for spatial offset and correspondence of anomaly amplitude. All anomalies were found during reacquisition. Substantially less than 1% of targets reacquired greater than 2.5 feet from the targeted location and the maximum offset was not greater than 2.5 feet in any direction. The QC mV comparison data was reviewed and it was confirmed that dig results with a disparate size difference to their targeted mV levels were identified and referred to the MES UXOQCS for intrusive QC investigation.

5.1.2 REMAPPING

Independent (third party) QA verification (pre-dig) and (post-dig) confirmation DGM remapping was performed by ERT on a limited number of grids to demonstrate consistency of NAEVA's DGM results and the overall quality of the removal process. QA remapping data are included in Appendix J. Remapping was performed in accordance with the ADEM approved remapping plan in Appendix E.

Verification (pre-dig) remapping was performed by ERT on 12 grids to assess the adequacy and repeatability of NAEVA's DGM results.

QAN154E080	QAN141E083	QAN147E091
QAN153E080	QAN141E084	QAN147E092
QAN146E075	QAN136E074	QAN132E102
QAN146E076	QAN135E074	QAN133E102

Verification remapping results were compared to the original NAEVA DGM data and target lists. The DGM survey data, anomaly detection/delineation, target selection, location of non-DGM areas, and data quality were acceptably similar in all data sets.

QA confirmation (post dig) remapping was performed on 19 grids in MRS-7 after completion of Contractor clearance and QC release, to demonstrate that the objectives of the grid clearance were achieved and that no MEC or MEC-like items remain. Confirmation sampling of the confirmation mapping targets was performed by the MES UXO QA. Confirmation mapping and sampling results indicated that the residual anomalies in the grids were primarily due to metallic scrap and (Table 5-3). No MEC or MEC-like items were found during QA confirmation sampling, and GeoQA and UXOQA signed off on all grid clearances.

In summary, the DGM QA program results for MRS-7 indicate that the Contractor data quality and QC performance goals for the removal action were met. No critical or systematic DGM performance discrepancies were found.

Table 5-3 QA (Post-Dig) Remapping and Dig Results

Tract	Grid ID	Targets	MEC	Quantity	Weight (lbs)	Comments
7A	QAN141E073	1	0	11	1.5	SAA
7A	QAN141E081	5	0	0	0	no targets after reac
7A	QAN142E073	0	0	0	0	
7A	QAN142E081	0	0	0	0	
7A	QAN144E077	1	0	1	0.5	SAA
7A	QAN144E078	1	0	1	0.5	SAA
7A	QAN147E077	1	0	0	0	
7A	QAN147E078	0	0	0	0	
7A	QAN147E082	0	0	0	0	
7A	QAN148E082	0	0	0	0	
7B	QAN146E095	4	0	8	3	grenade frag
7B	QAN146E096	78	0	115	25	grenade frag/scrap, wire
7C	QAN129E102	1	0	1	0.5	37mm frag
7C	QAN131E087	0	0	0	0	
7C	QAN131E088	0	0	0	0	
7C	QAN135E106	0	0	0	0	
7C	QAN135E107	1	0	1	0.5	Survey pin
7C	QAN139E076	1	0	1	0.5	37mm frag
7D	QAN128E102	0	0	0	0	

5.1.3 DEFICIENCY NOTICE REPORTS

No QA DNR's were issued. DGM grid data for the MRS was reviewed and all anomalies were targeted per the targeting criteria prior to intrusive activities.

5.2 UXO QA

The goal of the UXO QA program is to ensure that the procedures and field operations were sufficient to support the clearance and removal of all detectable MEC in accordance with the removal depths specified in the project DQOs.

The UXO QA personnel conducted routine and random visits to each grid to ensure that procedures and processes were being performed in accordance with the SSWP and approved FCRs.

The UXO QA activities measures included the following tasks:

- Review of work plans and GPO Report
- QA blind seeding program
- Review of processes and procedures used by field crews
- Review of the QC process and reports
- Intrusive investigation of QA remapping targets, and
- Post-dig QA sweeps of grids.

5.2.1 UXO QA BLIND SEEDING PROGRAM

A total of 69 QA seed items were placed in MRS-7 by the UXOQA to test MEC clearance results (Table 5-4). All 69 QA seeds were recovered resulting in a 100% recovery rate.

Table 5-4 QA Seeding

Tract	Tract Type	No. of QA Seeds	QA Seeds Recovered	Notes
7-A: SGO	Clearance to Depth of Detection	20	20	
7-B: AMEC	Clearance to Depth of Detection	20	20	
7-C: SGO/IPC	Clearance to Depth of Detection	25	25	
7-D SGO	Clearance to Depth of Detection	4	4	
Totals		69	69 (100%)	

5.2.2 UXOQA ASSESSMENT

The UXOQA physically inspected a minimum of 25% of all DGM targets and 25% of all non-DGM areas in each grid using handheld sensors. QA inspection reports and grid sign-offs are included in Appendix J.

5.3 QA CONCLUSIONS

The results and conclusions of the UXOQA and geophysical QA programs can be summarized as follows: with minor exceptions, which were documented and corrected during the QC/QA process:

- GeoQA did not identify any critical or systematic deficiencies and concluded that the geophysical data collected for the remediation was useable and sufficient to support the clearance of MEC.

- Geophysical remapping results for over 10% of the area confirmed and verified DGM mapping and clearance results.
- 69 of 69 QA blind seeds were recovered.
- UXOQA did not identify any critical or systematic deficiencies and signed off on the clearance of all grids and UoPs.
- UXOQA and GeoQA concurred that the remediation met the quality objectives set forth in the QAP and the SSWP.

6.0 CONCLUSIONS

The MEC clearance to the depth of detection for MRS-7 has been successfully accomplished in accordance with the PWP, SSWP and associated FCRs. The entirety of the MRS was cleared of MEC to the depth of detection and step-outs were cleared as needed to establish a 200-foot MEC-free buffer zone around the MRS.

In total, 168 acres were cleared to the depth of detection during the MRS-7 remediation, including 6.08 acres of step-outs. The following totals of MEC and materials were removed during the clearance:

- 183 MEC items were recovered and destroyed
- 16,441.5 pounds of non-MEC scrap
- 2,458 pounds of MEC scrap (munitions debris)

The 168-acre area was seeded in excess of SSWP requirements to test the clearance process. The contractors recovered 517 of 520 QC blind seeds and 69 of 69 QA blind seeds. Contractor performance of blind seed recovery was greater than 99% which is an outstanding performance.

QC was implemented as required by the SSWP to ensure that a quality MEC clearance work product was performed. MES QC signed off on all work products and clearance grids as being of acceptable quality.

MES QA inspected the work products and concurred that the MEC clearance product met the required performance standards specified in the SSWP and QAP.

Unrestricted future use is recommended for the entire area. There are no exception areas requiring future construction support.

7.0 REFERENCES

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Figures

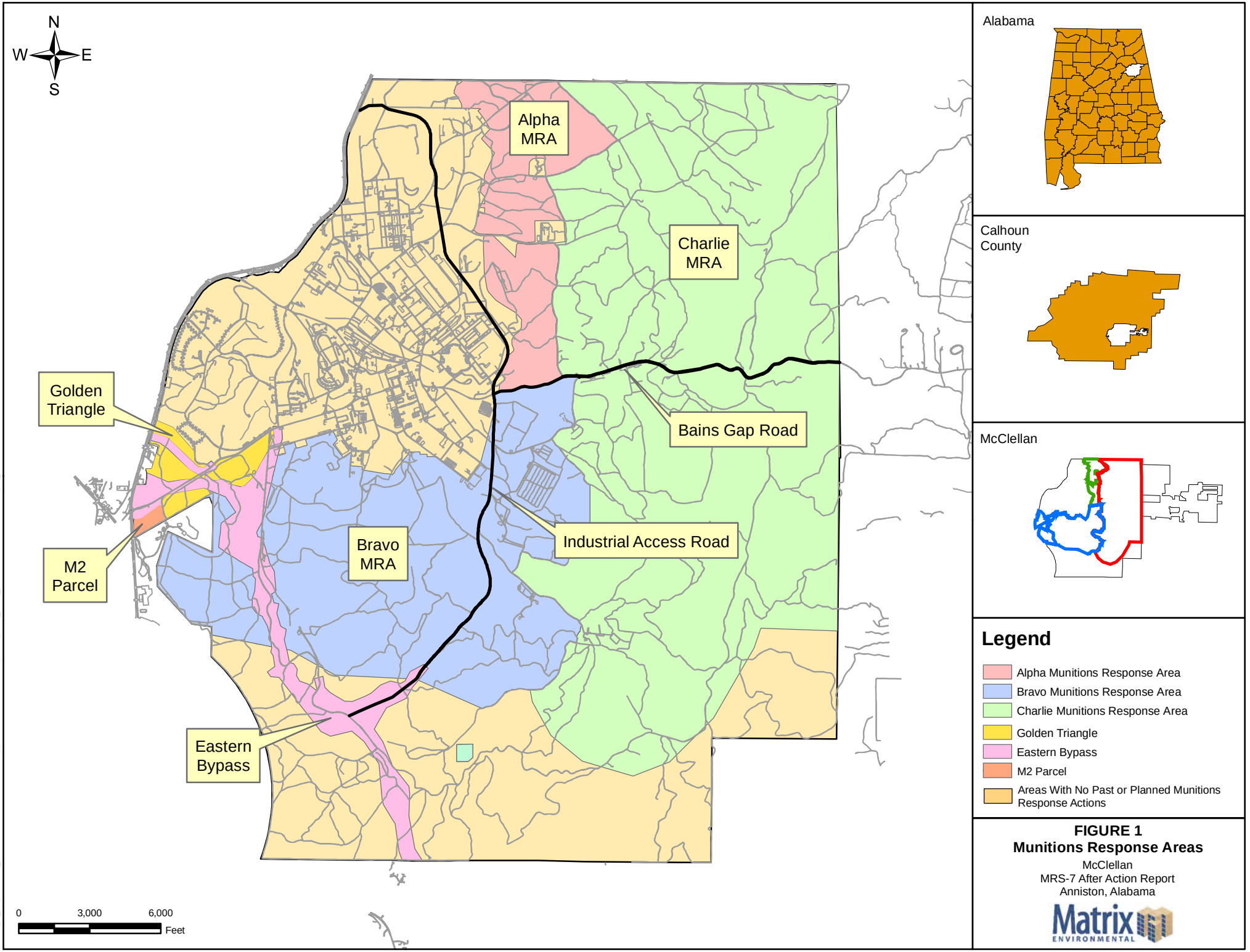
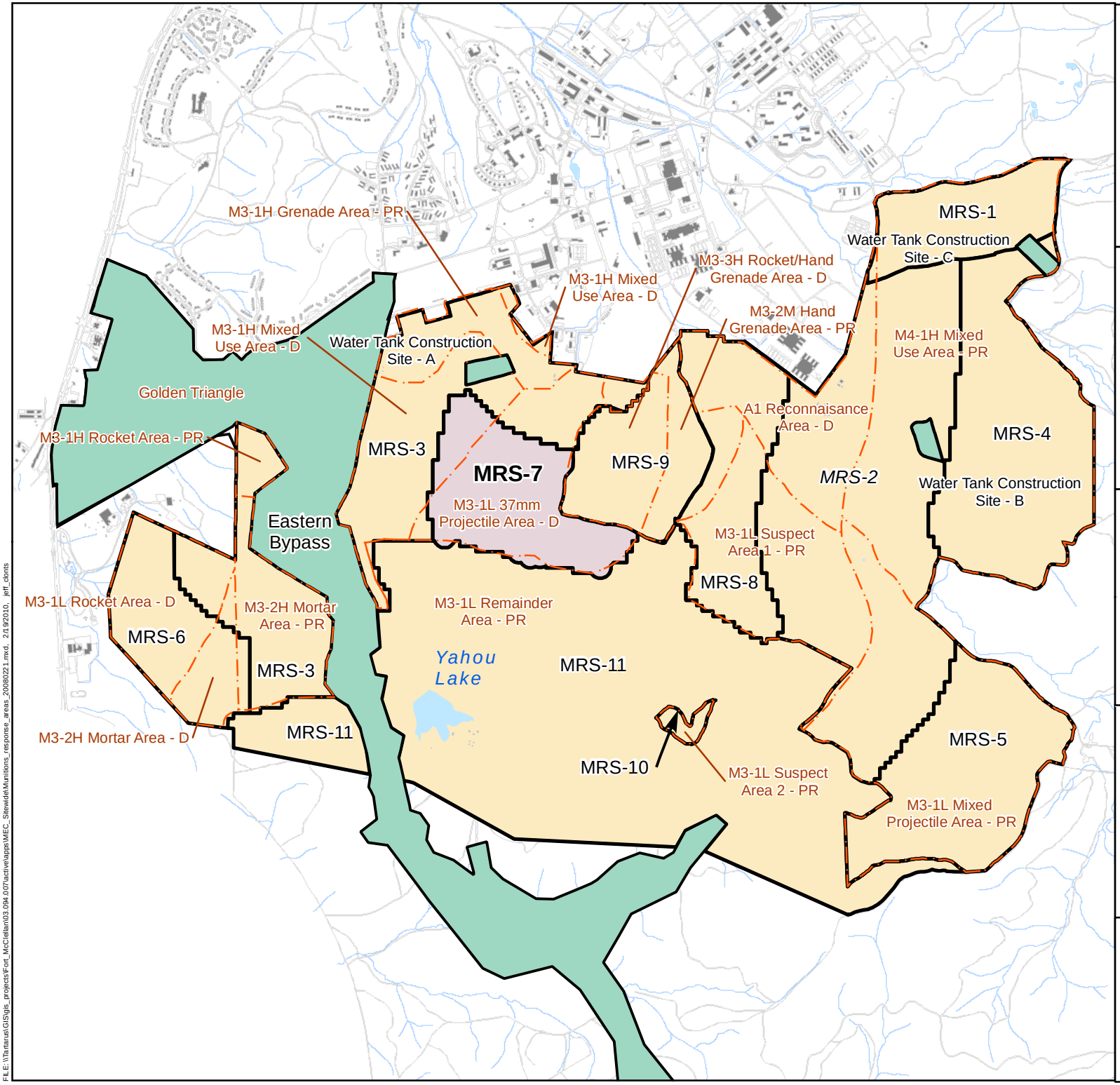


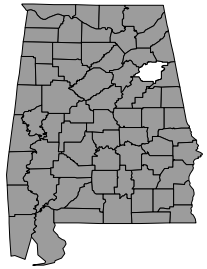
FIGURE 1
Munitions Response Areas
McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

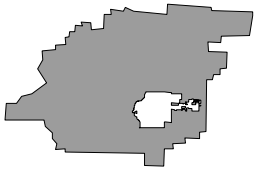
FILE: G:\gis_projects\For_McClellan\03.094.007\active\apps\MRS7\AfterActionReport\Figure1_MRA_20141201.mxd, 12/1/2014, jeff_clonts

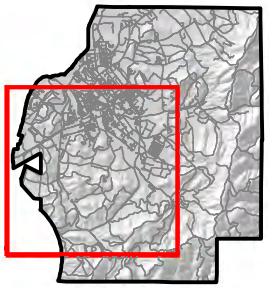


Alabama



Calhoun County





Legend

- MRS-7
- Previously Cleared Parcels by U.S. Army
- Bravo Munitions Response Area
- Army EE/CA Sector Boundary
- Buildings
- Lakes
- Roads
- Streams

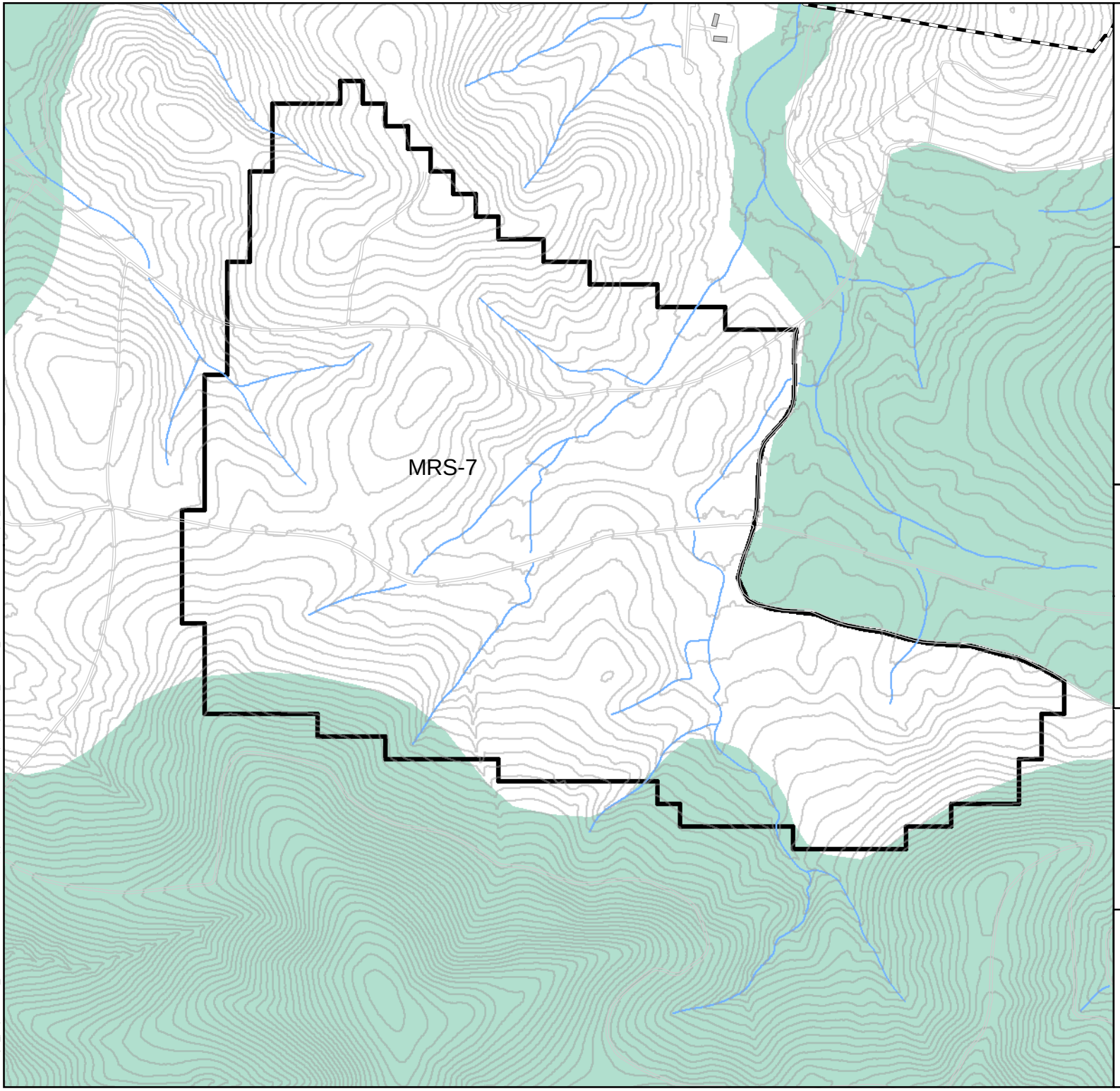
0 1,250 2,500 Feet

FIGURE 1-2
Bravo Munitions Response Area

McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

FILE: \\Tatarus\GIS\gis_projects\Fort_McClellan\03.094.007\active\apps\MEC_Sitewide\Munitions_response_areas_20080221.mxd, 2/19/2010, jeff_clonts



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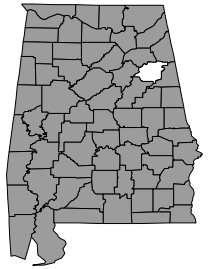

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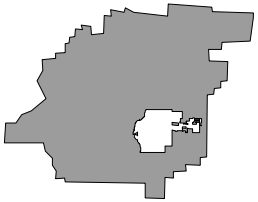
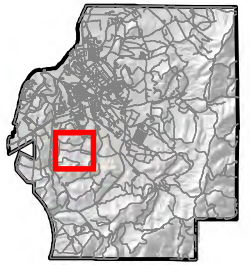




Legend

- MRS-7 Boundary
- Bravo Munitions Response Area
- McClellan Park Boundary
- Buildings
- Streams
- Roads
- Index Contour (10 ft)

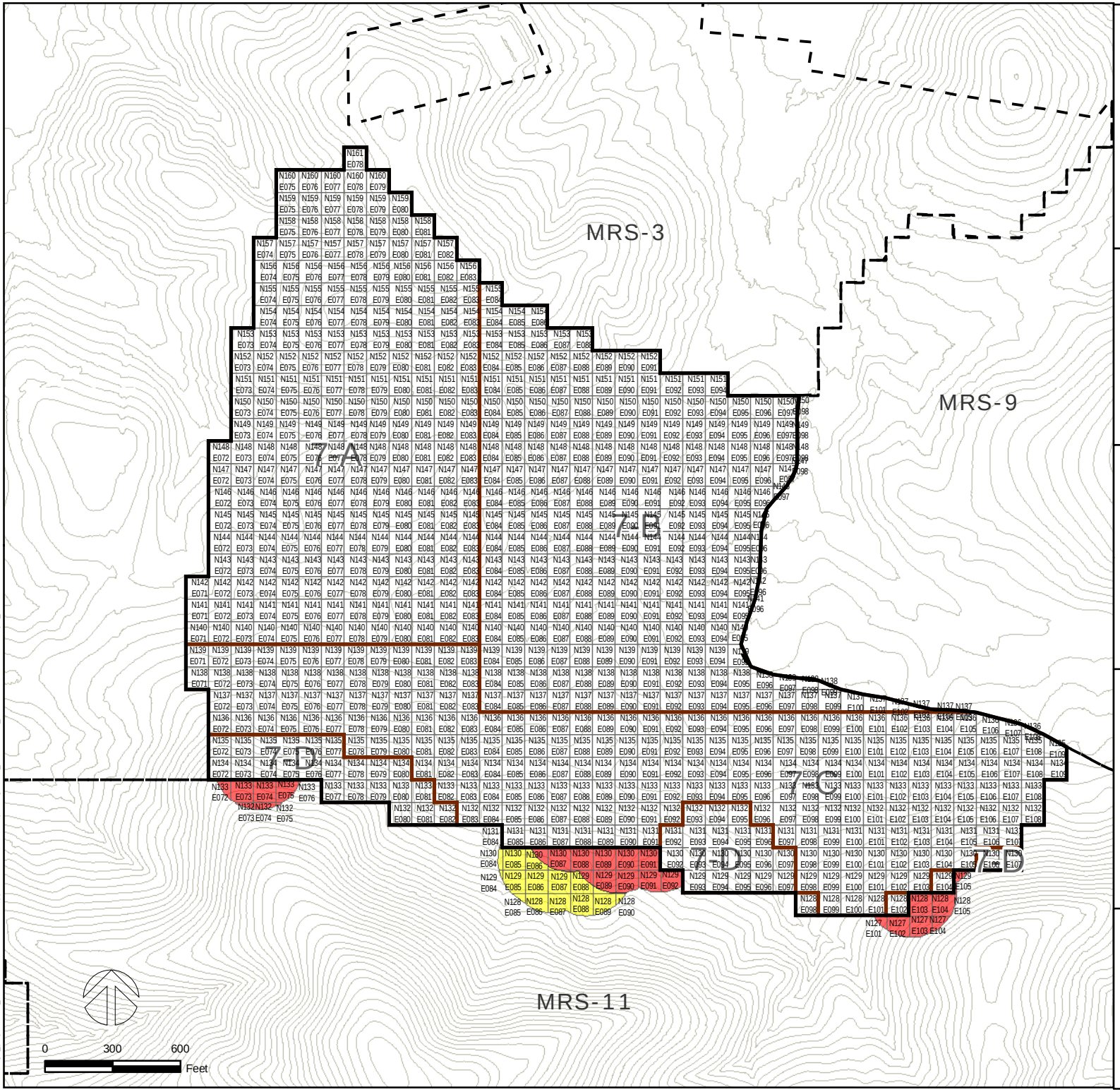
0 300 600 Feet

FIGURE 1-3
Future Land Use

McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

FILE: G:\gis_projects\Fort_McClellan\03.094.007\active\apps\MRS7\AfterActionReport\Figure1-3_LandUse_20141124.mxd, 12/1/2014, jeff_clonts



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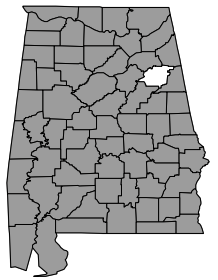
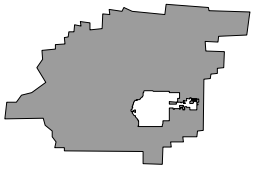


Calhoun County



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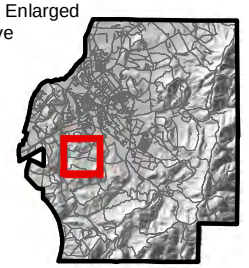

Legend

- MRS-7 Boundary
- Tracts
- Grid Network
- Step Out 1
- Step Out 2
- Contour Lines (10 foot interval)

FIGURE 1-4
Grid Network

McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

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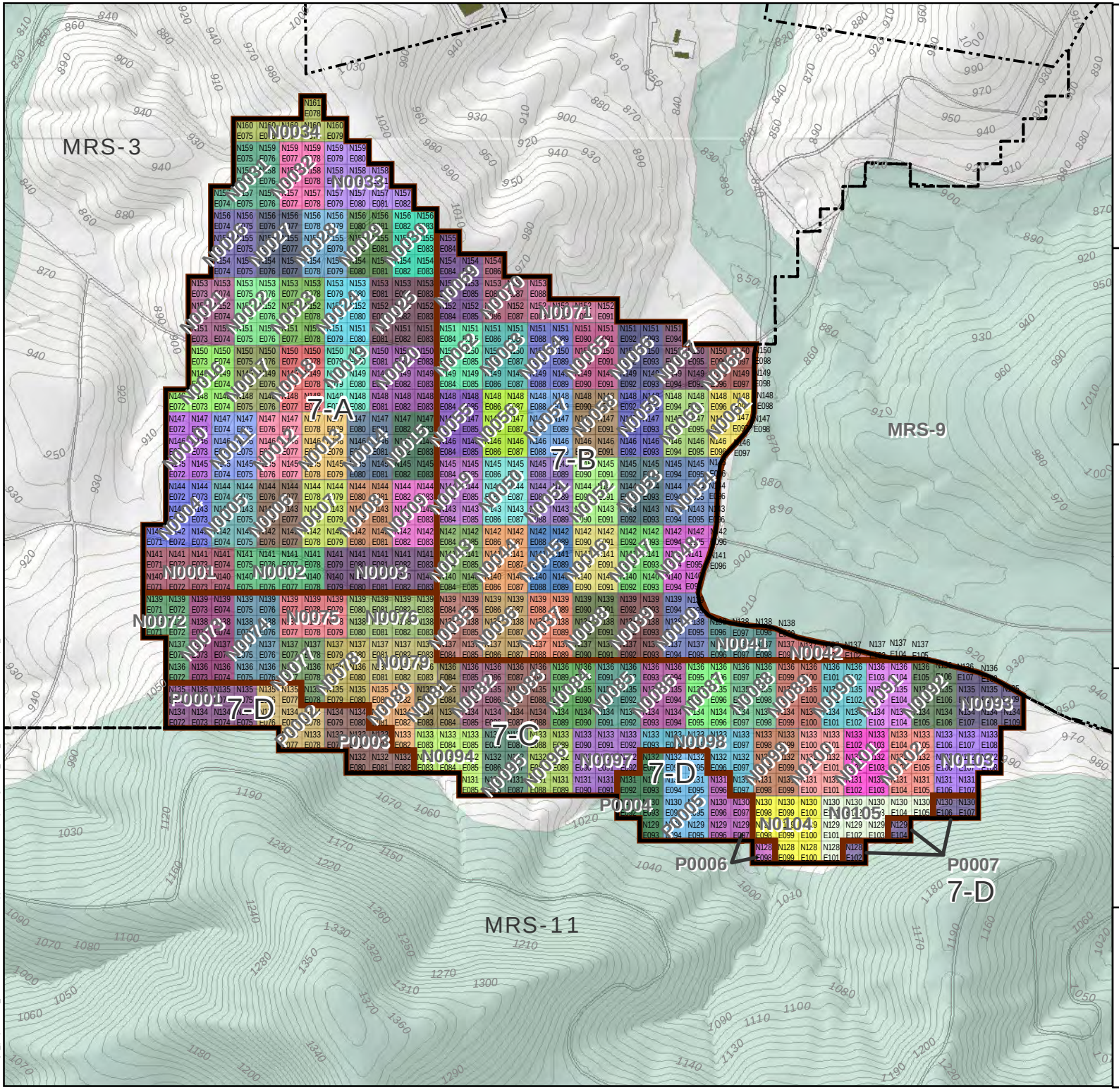

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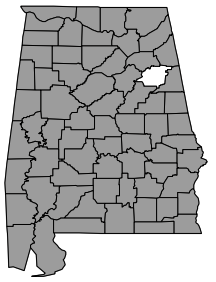
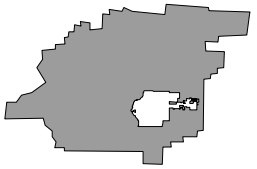


Calhoun County



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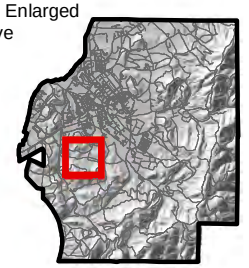


Legend

- MRS-7 Boundary
- UOP Designation
- Tracts
- Buildings
- Contour Lines (10 foot interval)
- Roads
- McClellan Park System

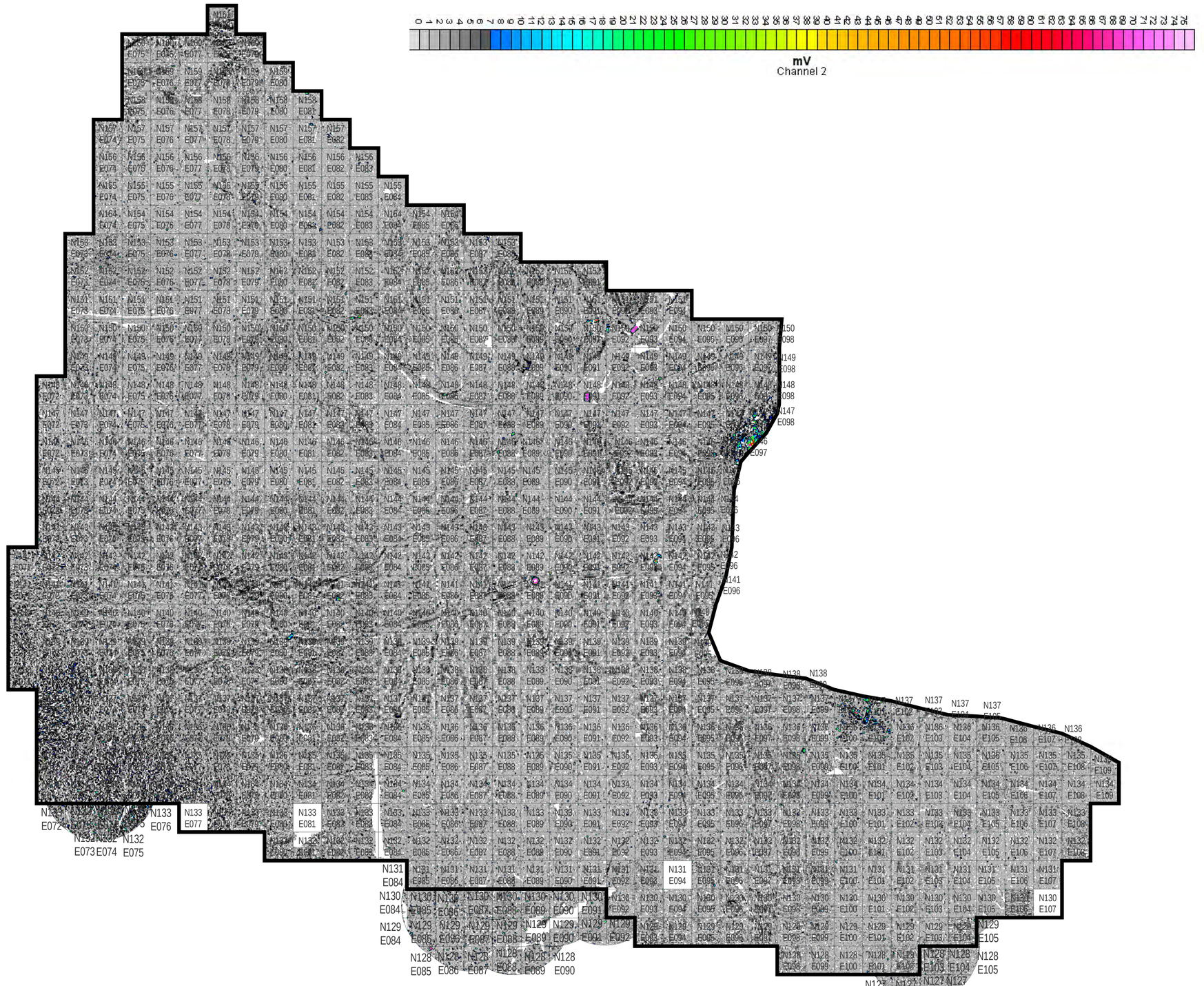
0 300 600 Feet

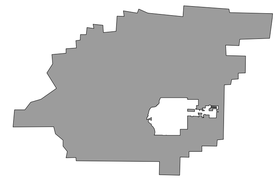
FIGURE 1-5
Units of Production (UOP) Layout

McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

FILE: G:\gis_projects\Fort_McClellan\03.094.007\active\apps\MRS7\AfterActionReport\Figure1-5_UOP_20141201.mxd, 12/1/2014, jeff_clonts





Legend

- MRS-7 Boundary
- Grid Network

Note: Unmapped grids too steep to safely perform DGM

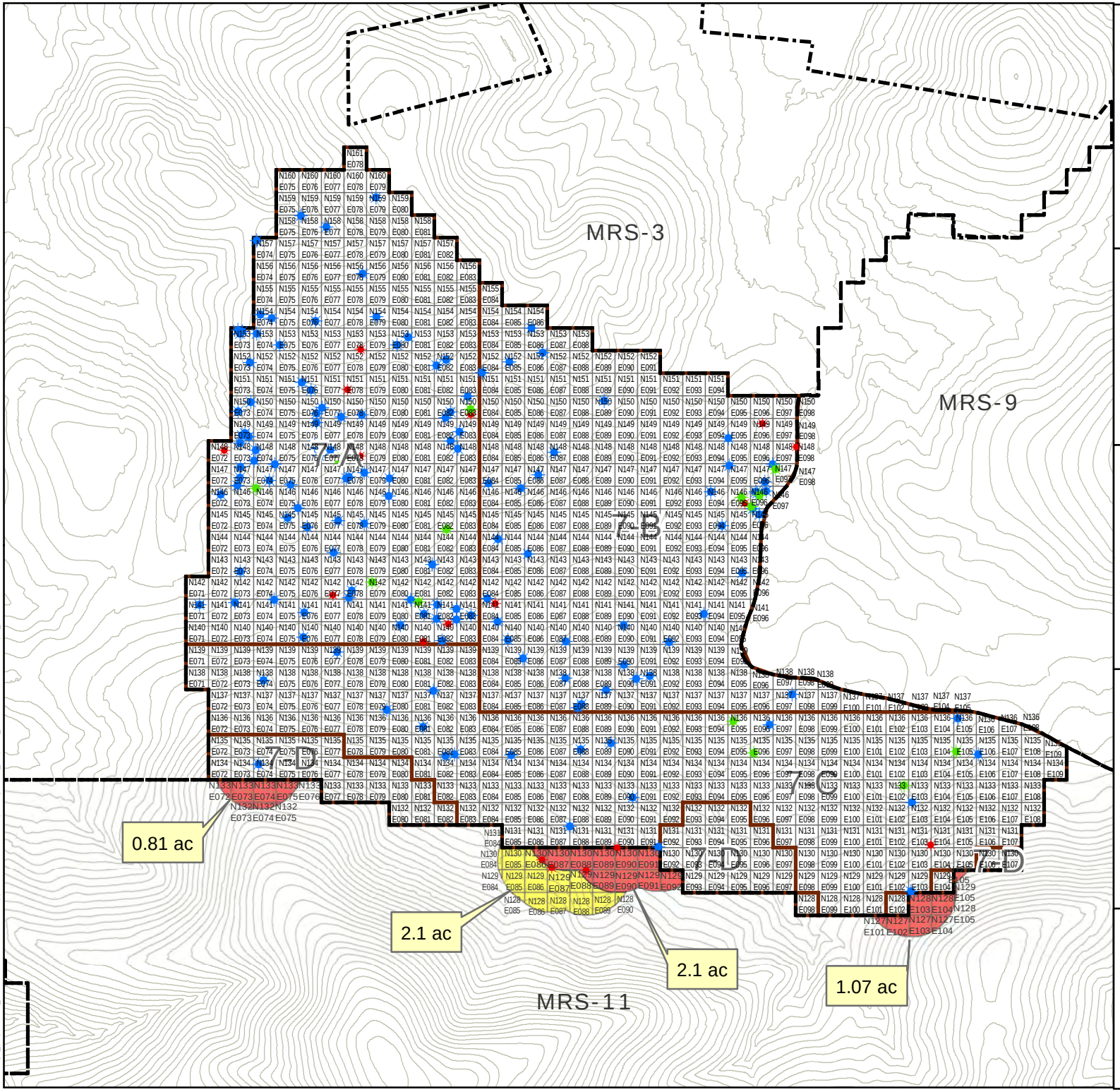
0 100 200 400 Feet

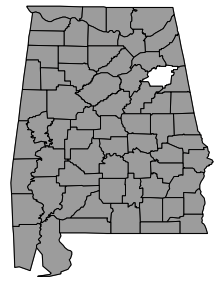
FIGURE 2-1
DGM Results

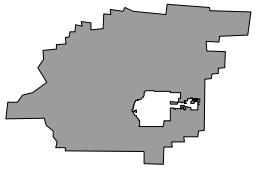
McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

FILE: G:\gis_projects\Fort_McClellan\03.094.007\active\apps\MRS7\AfterActionReport\Figure2-1_DGM_20141202a.mxd, 12/2/2014, jeff_clonts







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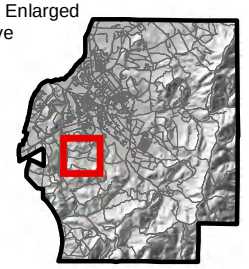

Legend

- Surface Clearance (Live)
- Surface Sweep (Live)
- Intrusive (Live)
- Tracts
- Grid Network
- Step Out 1
- Step Out 2
- Contour Lines (10 foot interval)

0 300 600 Feet

Data Derived December 16, 2013

FIGURE 3-1
MEC Finds

McClellan
MRS-7 After Action Report
Anniston, Alabama

Matrix ENVIRONMENTAL

FILE: G:\gis_projects\Fort_McClellan\03.094.007\active\apps\MRS7\AfterActionReport\Figure3-1_StepOuts_20141201.mxd, 12/8/2014, jeff_clonts