FINAL
REMEDIAL INVESTIGATION REPORT

FORMER CAMP CROFT
SPARTANBURG, SOUTH CAROLINA

MRS 1, MRS 2, MRS 3, AoPI 3, AoPI 5, AoPI 8, AoPI 9E, AoPI 9G,
AoPI 10A, AoPI 10B, AoPI 11B, AoPI 11C, and AoPI 11D

Contract No.: W912DY-10-D-0028
Task Order No.: 0005

Prepared for:

UNITED STATES ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE

and

UNITED STATES ARMY CORPS OF ENGINEERS, SAVANNAH DISTRICT

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The views, opinions, and/or findings contained in the report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless designated by other documentation.

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ABBREVIATIONS AND ACRONYMS

°F.....degree Fahrenheit
AIR.....Analog Instrument-assisted Surface Reconnaissance
AoPI.....Area of Potential Interest
ARAR .....Applicable or Relevant and Appropriate Requirement
ASR.....Archives Search Report
BD.....Building Demolition
BD/DR .....Building Demolition and Debris Removal
bgs.....below ground surface
BIP .....Blow-In-Place
BKGD .....Background Soil Sample
cal.....caliber
CAR .....Corrective Action Request
CC .....Camp Croft
CD.....Cultural Debris
CERCLA.....Comprehensive Environmental Response, Compensation, and Liability Act
CESAS .....Corps of Engineers, South Atlantic Division, Savannah District
CFR.....Code of Federal Regulations
COPC.....Chemical Of Potential Concern
CRREL.....Cold Regions Research and Engineering Laboratory
CS.....2-Chlorobenzalmalononitrile
CSEM.....Conceptual Site Exposure Model
CSM.....Conceptual Site Model
CWA .....Clean Water Act
DDESB .....Department of Defense Explosives Safety Board
DGM .....Digital Geophysical Mapping
DHEC.....Department of Health and Environmental Control
DID .....Data Item Description
DMM.....Discarded Military Munitions
DNR.....Department of Natural Resources
DoD.....Department of Defense
DOI .....Department of the Interior
DQCR .....Data Quality Control Report
DQO.....Data Quality Objective
DR.....Debris Removal
DVD.....Digital Video Disc
EE/CA.....Engineering Evaluation/Cost Analysis
EP.....Engineer Pamphlet
EPA.....Environmental Protection Agency
ESA.....Endangered Species Act
ESV.....Ecological Screening Value
FCR.....Field Change Request
FDE.....Findings of Determination and Eligibility
FS .....Feasibility Study
ft. .....foot (feet)

FUDS .....Formerly Used Defense Site
GIS .....Geographic Information Systems
gpm .....gallons per minute
GPO.....Geophysical Prove-Out
GPS .....Global Positioning System
HA.....Hazard Assessment
HE .....High Explosive
HFD.....Hazardous Fragmentation Distance
HHRA .....Human Health Risk Assessment
HQ.....Hazard Quotient
HRS.....Hazard Ranking System
HTRW.....Hazardous, Toxic, and Radioactive Waste
IA .....Institutional Analysis
ICP .....Institutional Control Plan
IDW.....Investigative-Derived Waste
IEUBK .....Integrated Exposure Uptake Biokinetic
in. .....inch(es)
IRA.....Interim Removal Action
IRTC .....Infantry Replacement Training Center
ISO .....Industry Standard Object
IVS .....Instrument Verification Strip
kg.....kilogram
l .....liter
lb(s). .....pound(s)
LUC.....Land Use Control
m .....meter
mag-and-dig ...analog instrument-assisted intrusive investigation
MC .....Munitions Constituents
MD .....Munitions Debris
MDAS.....Material Documented As Safe
MDL.....Minimum Detection Limit
MEC.....Munitions and Explosives of Concern
µg .....microgram
µg/dL.....microgram per deciliter
mg .....milligram
Mk.....Mark
mm .....millimeter
MMRP.....Military Munitions Response Program
MPPEH .....Material Potentially Presenting an Explosive Hazard
MQO .....Measurement Quality Objective
MRS .....Munitions Response Site
MRSPP.....Munitions Response Site Prioritization Protocol
msl.....mean sea level
NAD83.....North American Datum 1983
NC.....No Contact
NCP.....National Oil and Hazardous Substances Pollution Contingency Plan

NOAEL .....No Observed Adverse Effect Level
NPDES.....National Pollution Discharge Elimination System
OE .....Ordnance and Explosives
OOU.....Ordnance Operable Unit
PAL.....Project Action Limit
PDT.....Project Delivery Team
PIP.....Public Involvement Plan
PETN.....Pentaerythritol tetranitrate
P.G. .....Professional Geologist
PM.....Project Manager
ppm .....part per million
PRG.....Preliminary Remediation Goal
PWS .....Performance Work Statement
QA.....Quality Assurance
QAPP .....Quality Assurance Project Plan
QC.....Quality Control
RAB .....Restoration Advisory Board
RAC .....Risk Assessment Code
RAGS.....Risk Assessment Guidance for Superfund
RCRA.....Resource Conservation and Recovery Act
RDA .....Recommended Daily Allowance
RI.....Remedial Investigation
RI/FS .....Remedial Investigation and Feasibility Study
RIN.....Rinsate Sample
ROD .....Record Of Decision
ROE.....Right-Of-Entry
RSL .....Regional Screening Level
RTK.....Real-Time Kinetic
SAP .....Sampling and Analysis Plan
SC.....South Carolina
SCDEC.....South Carolina Department of Health and Environmental Control
SCPRT .....South Carolina Department of Parks, Recreation, and Tourism
SEDD .....Stage 2 Electronic Data Deliverable
SI.....Site Investigation
SLERA.....Screening Level Ecological Risk Assessment
SOP .....Standard Operating Procedure
SSL.....Soil Screening Level
SUXOS .....Senior Unexploded Ordnance (UXO) Supervisor
TBC.....To Be Considered
TCRA.....Time-Critical Removal Action
TP.....Target Practice
TPP.....Technical Project Planning
UFP-QAPP.....Uniform Federal Policy-Quality Assurance Project Plan
U.S. .....United States
USACE .....United States Army Corps of Engineers
USAESCH .....United States Army Engineering and Support Center, Huntsville

USC.....United States Code
USEPA.....United States Environmental Protection Agency
USFWS .....United States Fish and Wildlife Service
USGS .....United States Geological Survey
UTM.....Universal Transverse Mercator
UXO.....Unexploded Ordnance
UXOSO.....UXO Safety Officer
UXOQCS .....UXO Quality Control Specialist
WP.....White Phosphorous
WP.....Work Plan
WWII .....World War 2
XRF.....X-Ray Fluorescence
ZSB .....ZAPATA Soil Boring

1.0 EXECUTIVE SUMMARY

a. The former Camp Croft is located in the upstate of South Carolina, less than 10 miles southeast of downtown Spartanburg, SC (Exhibit 2-1). Officially activated in 1941, the training range impact areas comprised 16,929 acres; a 175-acre grenade court was also located at the camp. The entire installation (just over 19,000 acres) was declared surplus in November 1946 and excessed in 1947. The former Camp Croft has been designated a Formerly Used Defense Site (FUDS) within the United States Army Corps of Engineers (USACE) Savannah District; the designated FUDS number is I04SC001603.

b. This Remedial Investigation (RI) report will describe the methodologies used to characterize the property to support the development of the baseline risk assessment and follow-on Feasibility Study (FS). The format of the RI report presented in this document is based on the US Environmental Protection Agency's (EPA's) 1988 Guidance for Conducting an RI/FS Under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Engineer Pamphlet (EP) 1110-1-18. It is streamlined to address the specific characteristics associated with Military Munitions Response Program (MMRP) projects.

1.1 PROJECT OBJECTIVES

a. Three Munitions Response Sites (MRSs) and 11 other sites of varying sizes have been established at the former Camp Croft. The three MRSs include the Gas Chamber (MRS 1), the Grenade Court (MRS 2), and the Land Range Complex (MRS 3). Of the 11 other sites, 10 are defined as "Areas of Potential Interest" (AoPI), and one is associated with MRS 3, that being the Lake Craig and Lake Johnson Range Complex.

b. The MRSs and AoPIs included in the project scope were established based on historical range locations at Camp Croft (see Exhibit 2-2). The AoPIs correspond to areas previously referred to as Ordnance Operable Units (OOUs); those areas include AoPIs 3, 5, 8, 9E, 9G, 10A, 10B, 11B, 11C, and 11D. Eighteen previously defined OOUs exist within or partially within MRS 3; those include OOUs 1A, 1B, 2, 4, 6A, 6B, 7, 9A, 9B, 9C, 9D, 9F, 9H, 10C, 10D, 11A, 12A, and 12B (see Exhibit 2-2).

c. During the RI design phase, the Project Delivery Team (PDT) reviewed the existing MRS and AoPI boundaries that were provided in the Performance Work Statement (PWS), along with site-specific information from previous investigations and removal actions (some of which ZAPATA conducted). The PDT determined that some of those MRS and AoPI boundaries were misaligned and required adjustment. For example, information in the historic photographic analysis of MRS 1 indicates the primary building used as a gas chamber may actually have been located south of the designated boundary indicated in the PWS. Similarly, ZAPATA identified two AoPIs (AoPI 3 and 11C) where existing data indicate that the boundary may have been different than that described in the PWS. Based on our in-house investigation and removal action experience within and around the Wedgewood neighborhood, MEC contamination is believed to extend beyond the AoPI 3 boundary as defined in the PWS. Based on the historic photographic analysis and ZAPATA's removal action findings from 2010 (e.g., MEC beyond the eastern AoPI 11C boundary and foxholes between the AoPI 11C boundary and the ball fields), the likely location of the MEC-impacted area is east of AoPI 11C as defined in the PWS.

d. The PDT agreed to proceed with the RI within the refined boundaries. Both the PWS-defined AoPI boundaries and the RI-defined AoPI boundaries are provided in Exhibits 2-3

through 2-7. The acreages of the MRSs and AoPIs investigated during the RI were documented in the Conceptual Site Model (CSM) and are summarized below.

MRS/AoPI	CSM Acreage
MRS 1	23.8
MRS 2	24.9
MRS 3 (Land)	12,102.4
MRS 3 (Lakes)	185.6
AoPI 3	11
AoPI 5	5.5
AoPI 8	23.9
AoPI 9E	7.6
AoPI 9G	6.6
AoPI 10A	171.5
AoPI 10B	33.6
AoPI 11B	34.7
AoPI 11C	23
AoPI 11D	15.1
	Sum = 12,669.2

e. For purposes of the RI investigation, MRS 3 was divided into two sub-areas. Sub-Area 1 represents all areas within former range fans where Mk II grenades, 37mm, rifle grenades or 60mm mortars have been found. Sub-Area 2 represents all remaining portions of MRS 3 and areas beyond documented range fans (i.e., the areas previously identified as OOU 9A, OOU 9F, OOU 9H, and OOU 11A), where only sporadic and small quantities of munitions have been found. These sub-areas, along with the AoPIs, were investigated using different general methodologies (see Section 1.2 and Exhibit 3-1).

f. Croft State Natural Area occupies 7,054 acres of the 19,044-acre FUDS property. Land used for the remainder of the FUDS property (approximately 11,990 acres) is composed of industrial, agricultural, commercial, and residential.

g. The purpose of the RI is to determine the nature and extent of possible contamination of munitions and explosives of concern and munitions constituents due to previous usage by the Department of Defense. The RI Report presents the results from the sampling and provides information to assess potential risks to human health and the environment. In addition, the RI focuses on collecting information to support the subsequent FS.

1.2 INVESTIGATION METHODOLOGY

a. RI fieldwork was conducted at the former Camp Croft between January 2012 and October 2012. The investigation involved characterizing the nature and extent of munitions and explosives of concern (MEC) and munitions constituents (MC) and performing an ecological and human health risk assessment to support developing and evaluating effective remedial alternatives in the FS.

1.2.1 Munitions and Explosives of Concern

a. A combination of analog instrument-assisted intrusive investigation (mag-and-dig), analog instrument-assisted surface reconnaissance (AIR), and digital geophysical mapping

(DGM) was used to characterize the nature, density, and extent of MEC, MD, and anomalies (see Exhibits 4-1 through 4-6). The transect spacings selected for this investigation were based on an Mk II grenade, 37mm projectile, rifle grenade, or 60mm mortar, depending upon the specific range use and findings from previous site characterizations/removals. Where transect data were collected using a mag-and-dig method, estimated MD distribution maps were developed; MEC were not factored into the estimation. Where transect data were collected using an AIR method, estimated anomaly distribution maps were developed; these anomalies may include MEC, MD, and cultural debris. Estimated MD and anomaly distribution maps were developed following the transect investigations to place grids at high, medium, and low estimated MD or anomaly distribution locations (see Exhibits 5-1 through 5-6). Grid investigations were conducted using DGM or mag-and-dig methods; grids placed in areas where mag-and-dig was performed along transects were evaluated using DGM in grids, and grids placed in areas where AIR was performed along transects were evaluated using mag-and-dig in grids.

b. The MEC items and MD identified throughout this investigation can be classified into one of five categories (i.e., grenade, landmine, mortar, projectile, or rocket). The MD items found that could not be classified into one of these categories is simply referred to as "Undifferentiated MD"; these fragments were recognized as fragments from a type of munitions, but they were too small or too deteriorated to make a positive identification. A list of items discovered during the RI field investigation, associated with the appropriate category, is provided below:

- Grenade – Mk I hand grenade (practice), Mk II hand grenade, M15 hand grenade (smoke), and M19 rifle grenade (illumination);
- Landmine – M1 anti-tank;
- Mortar – 60mm (training, illumination, HE) , 81mm (training, HE);
- Projectile – 37mm, 57mm, 105mm HE, 105mm Illumination; and
- Rocket – 2.36" Bazooka.

c. Over the investigation areas, small arms, low quantities of MD and one MEC item were discovered in areas apparently disconnected from former ranges. These findings indicate that southern parts of the former Camp Croft were used sporadically for various training exercises, but none apparently heavily used. However, eight areas are identified as containing MEC and/or very high MD concentrations that are directly accessible to humans; seven of those areas are in MRS 3. In these areas, a total of 39 MEC, one DMM, and thousands of pounds of MD were removed during the RI investigation. Those eight areas are listed below and are shown on Exhibits 5-4 and 5-6.

- AoPI 10A (Exhibit 5-4) – an area located within the eastern half of the AoPI;
- Area Alpha (Exhibit 5-6) – southeast of AoPI 9G and Dairy Ridge Road, within the area formerly known as OOU12A;
- Area Bravo (Exhibit 5-6) – along Henningston Road, just inside Croft State Natural Area property and east of AoPI 10B;
- Area Charlie (Exhibit 5-6) – an area west of and adjacent to Highway 176, centrally-located within the area formerly known as OOU6A/B;
- Areas Delta/Echo (Exhibit 5-6) – two areas along Whitestone Road, one centered near the intersection with Cow Ford Bridge Road (Delta) and another further south, at the southern extent of MRS 3 (Echo);

- Area Foxtrot (Exhibit 5-6) – along Croft State Park Road, within the area formerly known as OOU1A; and
- Area Golf (Exhibit 5-6) – north of Croft State Park Road, within the area formerly known as OOU7.

1.2.2 Munitions Constituents

a. Discrete surface soil samples, defined as 0-2 inches bgs, were collected from grids defined during the MEC investigation and determined to have a high density of anomalies (see Exhibits 5-7 through 5-13). In addition, post-BIP composite surface soil samples were collected using CRREL's 7-point wheel method. Background samples were collected to determine chemical concentrations in soil from background locations (i.e., locations unaffected by historical munitions use). The following parameters were analyzed in soil to characterize the nature and extent of potential contaminants and to develop human health and ecological risk assessments:

- Explosives, plus nitroglycerin and PETN using USEPA Method 8330A; and
- Selected metals (antimony, copper, lead, and zinc) using USEPA Methods 6020A.

b. For the former Camp Croft sites, constituent concentrations reported in chemical analyses will be compared to Resident Soil levels from EPA Regional Screening Levels (RSLs) (EPA, November 2012). Lead was the only MC detected above its corresponding RSL in surface soil samples collected from the former Camp Croft. These samples were collected from grids MRS3-A and A4718 located in MRS 3. As shown by subsequent samples and XRF field testing performed on samples collected from areas outside the grids, lead contamination appears to be localized and limited to these grids and the areas immediately surrounding them.

1.3 SUMMARY OF RISK

1.3.1 Munitions and Explosives of Concern Hazard Assessment (MEC HA)

a. As described in Section 5, MEC and MD were discovered in numerous areas; eight of those areas were specified and given temporary identifying name (e.g., Area Alpha, Bravo, etc.). Of the existing MRSs and these special areas with MEC and/or high MD, seven areas contained MEC and thus, required inclusion in the MEC HA. As per the PWS, we have suggested proposed MRS realignment, in coordination with the PDT. MEC data from previous activities were considered along with data collected during this RI to complete the MEC HA. The corresponding resulting Hazard Level Category and associated Score for each area containing MEC are summarized below; details are provided in Appendix H.

Current Designation	Proposed Designation	Hazard Level Category	Score
MRS 3 (Area Charlie/Delta)	Proposed 105mm Area	1	950
MRS 3 (Area Foxtrot)	Proposed Maneuver Area	1	1000
MRS 3 (Area Echo)	Proposed 60mm Mortar Area	3	705
MRS 3 (Area Bravo)	Proposed 60/81mm Mortar Area	1	965
MRS 3 (Area Alpha)	Proposed Rocket & Rifle Grenade Area	1	905
MRS 3	Proposed Rocket/Grenade Maneuver Area	2	760
AoPI 10B/11B	Proposed Grenade Maneuver Area	2	755

b. Hazard Level Categories are ranked 1 through 4, with 1 representing the highest potential explosive hazard conditions, 2 representing a high potential explosive hazard condition, and 3 representing a moderate potential explosive hazard condition. Hazard Level Categories are based on the Score; Hazard Level 1 is 1,000 to 840, Hazard Level 2 is 835 to 725, and Hazard Level 3 is 720 to 530.

1.3.2 Munitions Response Site Prioritization Protocol (MRSPP)

a. The MRSPP score was calculated for existing and proposed MRSs at the former Camp Croft. The MRSPP score for MRS 1 was based on the lower Priority score calculated in the CHE module. The MRSPP score for MRS 2 as well as for all of the Proposed MRSs was based on the lower Priority score calculated in the EHE module. The MRSs and their corresponding MRSPP scores are summarized below. Refer to Appendix H for complete MRSPP scoring tables.

Current Designation	Proposed Designation	MRSPP Score
MRS 1	MRS 1	7
MRS 2	MRS 2	4
MRS 3 (Area Charlie/Delta)	Proposed 105mm Area	3
MRS 3 (Area Foxtrot)	Proposed Maneuver Area	3
MRS 3 (Area Echo)	Proposed 60mm Mortar Area	4
MRS 3 (Area Bravo)	Proposed 60/81mm Mortar Area	4
MRS 3 (Area Alpha)	Proposed Rocket & Rifle Grenade Area	3
MRS 3	Proposed Rocket/Grenade Maneuver Area	4
MRS 3	Proposed Remaining Lands	6
AoPI 3	Proposed Grenade Area	5
AoPI 10A	Proposed Rocket Area	4
AoPI 10B/11B	Proposed Grenade Maneuver Area	4
AoPI 11C	Proposed Practice Grenade Area	4
AoPI 11D	Proposed Mortar/Rifle Grenade Area	4

1.3.3 Human Health Risk Assessment

a. Maximum and average exposure concentrations of the COPCs were used to compare to conservative residential screening levels. Except for lead, the maximum exposure concentrations were below residential screening levels. Since the dominant exposure scenario would be recreational, potential risks are considered negligible and are not quantified further in the risk assessment process.

b. Lead occurs above its screening level at two locations within the MRS. Based on the output from EPA's IEUBK model for lead in children that assumes residential exposure assumptions, lead is not a concern at these concentrations. In conclusion, there are no threats from concentrations of MC to human health at the MRS 3 at the former Camp Croft FUDS.

1.3.4 Ecological Risk Assessment

a. At a few grid locations, most notably at A4718, MRS3-A, 12A-196, and the post-BIP samples, the metal COPC concentrations exceed conservative screening levels protective of

insectivorous birds and mammals with hazard quotients generally less than 6.0. Exposure to metal fragments that are not readily bioavailable suggests an overestimation of potential risks. In addition, these small affected areas comprise only a tiny fraction of overall habitat and home ranges of the receptors. Given the existing data, it is not anticipated that significant adverse risks would occur to local populations of wildlife.

1.4 CONCLUSIONS

a. Munitions-related items are present in many locations across the former Camp Croft. Historical evidence collected from previous investigations and removal actions were combined with findings from this RI to present a comprehensive understanding of the nature and extent of MEC and MC at many of the areas included in this investigation. Some areas were inaccessible; the potential for MEC and MC to exist at those parcels is unknown (e.g., MRS 2 and AoPIs 3). Notwithstanding those inaccessible areas, much of the former camp was accessible and conclusions can be drawn from available data. MRS 1 and AoPIs 8, 9E, and 11C appear to be well characterized. Considering the findings in MRS 1, it is recommended for No Further Action and will not require inclusion in the Feasibility Study; however, it will be included in subsequent Decision Documents. MRS 2 should maintain its current status and, assuming rights-of-entry can be obtained at some point in the future, the property should be investigated. Based on the findings of the RI, it is not recommended that AoPI 5, AoPI 8, AoPI 9E, and AoPI 9G be retained for further consideration and will not require inclusion in the Feasibility Study.

b. MRS 3 and five AoPIs are recommended for potential boundary realignment. It is recommended that MRS 3 be subdivided into nine MRSs. Slight adjustments to the total acreage are necessary based on RI findings (see Table 8-1). AoPIs 3, 10A, 10B, 11B, 11C, and 11D are recommended for realignment as five MRSs (AoPIs 10B and 11B are combined into one Proposed MRS). Refer to Exhibits 8-1 through 8-19 for proposed boundary realignment details.

Current Designation	Current Acreage	Proposed Designation	Proposed Acreage	Recommendation*
MRS 1	23.8	MRS 1	23.8	Proceed to FS
MRS 2	24.9	MRS 2	24.9	RI/FS, pending ROE allowance
MRS 3 (Land)	12,102.4	105mm Area	1,399.7	Proceed to FS
		Maneuver Area	1,276.5	Proceed to FS
		60mm Mortar Area	303.4	Proceed to FS
		60/81mm Mortar Area	301.3	Proceed to FS
		Rocket & Rifle Grenade Area	108.5	Proceed to FS
		Rocket/Grenade Maneuver Area	126.3	Proceed to FS
		Remaining Lands (Land)	9,093.4	Proceed to FS
MRS 3 (Water)	185.6	Remaining Lands (Water)	185.6	Proceed to FS
AoPI 3	11	Grenade Area	19.2	Proceed to FS
AoPI 5	5.5	AoPI 5	5.5	NFA; Address in DD
AoPI 8	23.9	AoPI 8	23.9	NFA; Address in DD
AoPI 9E	7.6	AoPI 9E	7.6	NFA; Address in DD
AoPI 9G	6.6	AoPI 9G	6.6	NFA; Address in DD
AoPI 10A	171.5	Rocket Area	93.9	Proceed to FS
AoPI 10B	33.6	Grenade Maneuver Area	450.5	Proceed to FS
AoPI 11B	343.7			
AoPI 11C	23	Practice Grenade Area	6.4	Proceed to FS
AoPI 11D	15.1	Mortar/Rifle Grenade Area	22.9	Proceed to FS
SUM =	12,669.2	SUM =	13,479.9	

* Notes:
FS – Feasibility Study;
NFA – No Further Action
DD – Decision Document

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2.0 INTRODUCTION

2.1 PURPOSE OF THE REMEDIAL INVESTIGATION

a. The RI is one of the steps in the remedial process of MMRP projects under CERCLA. The intent of the RI is to adequately characterize the property (i.e., determine the nature and extent of MEC/MC contamination due to historical Department of Defense usage) for the purpose of developing and evaluating effective remedial alternatives [40 Code of Federal Regulations (CFR) 300.430(d)(2)]. The primary purpose of this report is to present the results from the RI and provide information to assess the potential risks to human health, safety, and the environment. In addition, the RI focuses on collecting information to support the subsequent Feasibility Study (FS). The analysis and design of potential response actions include assessing the following factors:

- Physical characteristics of the property;
- Characteristics/classification of soil, sediment, surface water, and groundwater;
- Characteristics of the MEC/MC (e.g., quantities, concentrations, toxicity, persistence, mobility, depth, nature and extent, etc.);
- The extent to which the source can be characterized;
- Actual and potential exposure pathways;
- Actual and potential exposure routes; and
- Other relevant factors such as sensitive populations that may affect analysis of potential remedial action alternatives.

b. The project team designed the RI approach based on data from previous investigations and removal actions. Data were gathered in a manner to support the analysis and design of a comprehensive list of potential response actions and preparation of an FS.

2.2 PROPERTY DESCRIPTION AND PROBLEM IDENTIFICATION

2.2.1 Property Description

a. The project site is located in the upstate of South Carolina, less than 10 miles southeast of downtown Spartanburg, SC. The site is roughly bound to the north by SC Highway 295, to the east by US Highway 176, to the south by SC Highway 150 and to the west by SC Highway 56. The site can be accessed by taking US Highway 176 south at Exit 72 along US Interstate 85 (Exhibit 2-1).

b. The surrounding landscape is consistent with the Piedmont physiographic province, with rolling hills, many tributary channels, and iron-rich clay overburden soils. The FUDS property occupies approximately 19,044 acres, the majority of which includes Croft State Natural Area. Much of the land surface is wooded. The highest elevation is approximately 800 feet above mean sea level (msl). Topography varies by only several hundred feet.

2.2.1.1 Man-Made Features

a. Croft State Natural Area occupies 7,054 acres of the 19,044-acre FUDS property. Facilities associated with the park include campgrounds (both primitive and for recreational vehicles), horse stables and a show ring, picnic shelters, restrooms, a comfort station, a dump station, a boat ramp, and park office. Lake Tom Moore Craig, a 150-acre impoundment, and Lake Edwin Johnson, a 40-acre impoundment, are also located within the park. These lakes total

186 acres and were constructed after the FUDS was transferred to state ownership. The earthen dams constructed to create the lakes used soil from onsite.

b. Red Hill landfill is privately-owned land in the eastern portion of the former Camp Croft. Formerly known as OOU6, several investigations have taken place at the site, resulting in multiple removal actions. The site is designated in the RI/FS PWS as a portion MRS 3, and has been subdivided into an area known as Sub-Area 1. A second, unnamed (non-active) landfill exists in the western portion of MRS 3 at the end of Gibson Road. This landfill straddles the boundaries of Sub-Areas 1 and 2.

c. Residential areas are concentrated in the north end of the former Camp Croft. AoPI 3 is the location of Wedgewood Subdivision, which has been the site of several investigations and removals prior to this RI. However, residential property (small and large parcels) exists across much of the former camp, outside the Croft State Natural Area boundaries.

d. The Creek Golf Course is located on the north end of Camp Croft. Unexploded Ordnance (UXO) has reportedly been found and disposed of by golf course personnel in the past. Area of Potential Interest (AoPI) 11D is located on the golf course, and open areas of the site were geophysically mapped in 2001.

2.2.1.2 Physical Characteristics

a. Spartanburg County is located in the northwestern part of the state, in what has come to be known as the "Piedmont Crescent." The county lies just southeast of the Blue Ridge Mountains in the piedmont plateau, which is characterized by subdued topographic features and moderate relief. The land surface is inclined to elevations exceeding 1,000 feet in the northwest section of the county to less than 600 feet in the southeast. Hills have a well-rounded appearance with no conspicuously prominent ridges or peaks. Valley floors are generally about 100 feet deep with well-developed water courses. There are few swamp-like areas. The general slope of the county is southeastward, which is the general direction of the main drainage features. The land ranges from nearly level to steep, but most areas are gently sloping to moderately steep. The highest point is Bird Mountain in the northwestern part of the county at 1,480 feet above msl. In the central portion of the county, elevations range from 750 to 900 feet above msl. In the northern part of the county, a series of hills rises about 200 feet above the surrounding land and does not conform to the general pattern of relief. The lowest elevation is on the Enoree River in the extreme southeastern part of the county near the Union County line (Spartanburg County, 1998).

2.2.1.3 Geology

a. Thirteen geologic formations are found in Spartanburg County, but over 95 percent of the county is in five major formations. These formations are made up of alluvium, fine-grained rocks, medium-grained rocks, fine-grained to coarse-grained rocks, and coarse-grained rocks. Alluvium consists of material recently deposited on flood plains. The fine-grained rocks are quartzite, diabase, taluca quartz monzonite, and sericite schist. The medium-grained rocks are granite, biotite gneiss, and migmatite. The fine-grained to coarse-grained rocks are biotite schist, Yorkville quartz monzonite, and hornblende schist. The coarse-grained rocks are hornblende gneiss, coarse-grained granite, and muscovite pegmatite dikes (Spartanburg County, 1998).

b. Nearly all of Spartanburg County, except for some small areas in the southeastern part bordering Union County, lies within the Inner Piedmont belt, a major subdivision of crystalline

rocks in the Piedmont province. The small area in the southeastern part of the county contains rocks typical of the Kings Mountain belt. In much of the county, the hard crystalline rock has weathered to a soft clayey or sandy material (saprolite), which maintains many of the original rock structures and extends from ground surface to depths of as much as 140 feet (Spartanburg County, 1998).

2.2.1.4 Meteorology

a. The county is characterized by a humid, temperate climate. Spartanburg County is located on the lee side of the Appalachian Mountains, which provide protection from the cold air masses that move southeastward during the winter. At Spartanburg, temperatures usually are between 32 degrees Fahrenheit (°F) and 90°F for eight months of the year; the average daily temperature for the county is about 60°F.

b. Average annual rainfall is about 50 inches (in.), an amount that exceeds the national average by 20 in. Rainfall is usually well distributed throughout the year. Depending upon location, accumulations may vary from 30 in. in a dry year to over 80 in. in a wet year. Prevailing winds are from the southwest most of the year, but are from the northeast late in summer and early fall. Average relative humidity ranges from 57 percent in winter to 47 percent in April and May. The average relative humidity for the year is approximately 70 percent. Warm weather generally lasts from May into September with few breaks from the heat during midsummer. Temperatures of 90°F or higher are recorded on an average of 50 days. About 25 percent of the annual rainfall occurs in summer, chiefly in local thundershowers. Fall generally is the most pleasant season, especially from late September to early November. During this period, rainfall is light, the percentage of sunshine is high, and the temperature is generally moderate. About 23 percent of the total annual rainfall is in fall. Winters are mild and relatively short, though about 60 days have temperatures at freezing or below. About 26 percent of the annual rainfall occurs in winter, mainly in steady rains. Spring is the most changeable season. March is frequently cold and windy, but May is generally warm and pleasant. Severe thunderstorms and tornadoes are most likely in spring. About 26 percent of the total annual rainfall occurs in spring (Spartanburg County, 1998).

2.2.1.5 Hydrology and Hydrogeology

a. About 40 percent of the average rainfall in Spartanburg County becomes streamflow, or surface water, having excellent quality for domestic, industrial, and agricultural uses. The water is soft and has low concentrations of individual dissolved substances. Some streams in the central part of the county, however, receive waste discharges that increase dissolved solids content and deplete dissolved oxygen. The effect of these wastes is pronounced on Fairforest Creek (which drains the Croft State Natural Area), particularly at low flow. Temperatures of surface water throughout the county are fairly uniform; changes in temperature at most locations are in response to seasonal weather conditions (Spartanburg County, 1998).

b. The term wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, bogs, and similar areas. In the northern portion of the FUDS boundary, there are numerous small wetlands and riparian areas identified; those types include Freshwater Emergent, Freshwater Forested/Shrub, Freshwater Pond, Riparian Forested/Shrub (http://www.fws.gov/wetlands/data). Those areas range in size from a 4.79-acre

Freshwater Forested/Shrub located south of AoPI 3 to a 0.10-acre Freshwater Pond located north of AoPI 11D, near the FUDS boundary. The southern portion of the FUDS boundary is dominated by numerous larger wetlands, primarily the Freshwater Forested/Shrub type, along Fairforest Creek. The largest wetland in southern portion of the FUDS is 82.85 acres and is located southwest of Lake Craig.

c. Groundwater is the principal source of water for rural homes and farms, some small to medium sized industries, and some supplemental irrigation. The quantity of water available from ground sources is usually less than that which may be obtained from surface water sources. However, the importance of ground water lies in the fact that it is generally of good quality and available in most parts of the county. No conclusive existing information regarding groundwater quality within the former Camp Croft boundary was found. As a result, groundwater can satisfy the requirements for most domestic, agricultural, and small industrial uses. The consistency of groundwater quality and temperature are additional factors that enhance its utility and economic value. On average, groundwater is soft, slightly acidic, and low in dissolved solids. Well yields range from 1 to 250 gallons per minute (gpm) and average 20 gpm. The average well yield is 53 gpm. Wells in topographically low areas, such as draws and gentle slopes, generally have the highest yields. Wells located on topographically high areas or on steep slopes generally have the lowest yields.

2.2.1.6 Wildlife

a. Wildlife habitats contribute greatly to the overall environmental and economic health of the county. They provide cover for animals and recreational opportunity to resident and nonresident hunters and outdoor enthusiasts. Wildlife habitats display natural beauty and provide educational opportunities and places for scientific research. Habitats also provide other important benefits, such as water and air filtration and serve to harbor many rare and unique plants and animals. The number, quality, and geographic extent of game, fish, and plant species is directly related to the extent and quality of their habitats. Habitats are impacted by agriculture, forestry, industrial development and urban expansion. These activities over time have taken a toll on certain plants and animals in Spartanburg County. From species reported to the Heritage Trust Program as occurring in Spartanburg County, the South Carolina Department of Natural Resources (DNR) has compiled a list of indigenous plants and animals considered to be rare, threatened or endangered. The most current list of Rare, Threatened, and Endangered Species and Communities Known to Occur in Spartanburg County dated 13 March 2012 was obtained from the SC DNR and is provided in Final Work Plans (ZAPATA, 2011). Of the different species of plants, only the Dwarf-flowered Heartleaf (*Hexastylis naniflora*) is classified as federally threatened. The global and state ranks for the dwarf-flowered heartleaf are vulnerable, meaning that it is at moderate risk for extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors. The only animal on the list is the Meadow Vole (*Microtus pennsylvanicus*), a small field mouse. While rare in the county, this species is secure globally. The state conservation status has not been assessed. The list of species and occurrences identified herein is derived from a data base which DNR does not assume to be complete. There are areas not yet inventoried which may contain significant species or occurrences. As a result, care should be exercised in developing natural areas where such information is not available, particularly south of Spartanburg, where there is little evidence of documented occurrences (Spartanburg County, 1998).

2.2.2 Cultural Resources

a. A soapstone quarry, which is considered an archaeological site, is located on AoPI 10A (QST, 1998). The site is not listed on the National Register of Historic Places.

2.2.3 Land Use

a. Spartanburg County categorizes land use by major type (i.e., residential, commercial, industrial, agricultural, woodland, etc.). As of the late 1990s, over 50 percent of Spartanburg County was woodlands; approximately one-quarter of the county was farmland, and nearly one-quarter urban/built-up. South Carolina DNR prepared a digital land cover map of the state in 1992. Land cover in Spartanburg County generally is divided into four broad categories including agricultural/ cropland, urban/built up land, mixed forest (woodland), and deciduous forest (woodland). From an aerial perspective, these four land use groups present a physical form. The urban/built up land form represents a continually changing land mass, running into agricultural, grasslands and forested areas, continually altering its boundaries in response to changes wrought by growth and development (Spartanburg County, 1998).

b. Croft State Natural Area occupies 7,054 acres of the 19,044-acre FUDS property. The primary activities conducted at the park include hiking, mountain biking, camping, fishing, boating, and horseback riding. The park hosts a horse shows on the third Saturday of each month between February and November. Bow hunting is allowed during three two-day sessions between September and November. It is not anticipated that land use at Croft State Natural Area would change unless RI/FS findings indicate an immediate need to do so. Land use for the remainder of the FUDS property (approximately 11,990 acres) is composed of industrial, agricultural, commercial, and residential. It is likely those types of land use will continue in the future.

2.2.4 Potential Human and Ecological Receptors

2.2.4.1 Human Receptors

a. From site to site, receptors vary at the former Camp Croft since land use across the property varies. Potential human receptors include the general public, residents, landowners, employees, recreational users, golfers, and golf course maintenance personnel. Some commercial property exists at MRS 1 and employees are potential receptors at this site. Residents and/or private landowners apply to MRS 1, MRS 2, MRS 3 (landowners), AoPI 3 (residents), AoPI 5 (residents), AoPI 9G (residents), AoPI 11B (residents), and AoPI 11C. Recreational users include visitors to Croft State Natural Area such as hikers, campers, mountain bikers, fisherman/boaters, hunters, and equestrians. Golfers and golf course maintenance personnel are potential receptors at AoPIs 3 and 11D.

2.2.4.2 Ecological Receptors

a. Soil organisms, plants, and ground-dwelling small mammals (e.g., the meadow vole) and birds are potential receptors if exposed to soil MC contamination. In the aquatic environment of the creeks and lakes, sediment-dwelling organisms and those that prey on them are considered potential receptors if exposed to sediment MC contamination. The toxic mechanisms of MC include direct toxicity by contact and some bioaccumulation through the food chain.

2.3 HISTORICAL INFORMATION

a. Camp Croft Infantry Replacement Training Center (IRTC) was officially activated on January 10, 1941 and consisted of two general areas: a series of firing ranges and a troop housing area with attached administrative headquarters, with housing for 20,000 trainees and support personnel. Camp Croft IRTC served as one of the Army's principal IRTCs; approximately 250,000 soldiers were trained at the facility. Camp Croft was also a prisoner-of-war camp during World War II.

b. Camp Croft had at least 12 live ammunition training ranges used for small arms ammunition, anti-tank rockets, anti-aircraft artillery, 60-millimeter (mm) infantry mortars, and 81mm infantry mortars (see Exhibit 2-2). The training range impact areas comprised 16,929 acres; a 175-acre grenade court was also located at the camp. The entire installation (just over 19,000 acres) was declared surplus in November 1946 and excessed to the War Assets Administration in 1947. Over the next three years, the land was either sold or transferred by quitclaim to organizations, business interests, or private interests. One of the most significant conveyances was 7,089 acres by quitclaim deed to the South Carolina Commission of Forestry; the property is now known as Croft State Natural Area (USACE, 1993).

2.3.1 Previous Investigations

a. Since the early 1990s, many investigation and removal actions have been conducted at various locations within the former Camp Croft property (see Exhibit 2-3 through Exhibit 2-7). Documents associated with these investigations were reviewed and are summarized below. Summaries for previous investigations are provided using nomenclature that existed during the time of the investigation, as presented in those documents. The reader should note that munitions nomenclature has been revised since the early 1990s; UXO and discarded military munitions (DMM) are subsets of MEC.

b. The earliest known investigation at the former Camp Croft was an August 1984 On-site Survey conducted by the U.S. Army Corps of Engineers, Charleston District (CESAC), Environmental and Real Estate Divisions. The survey determined that that there was no Building Demolition and Debris Removal (BD/DR) responsibility incurred by the Department of Defense (DoD) at Camp Croft. Further investigation was recommended to define the extent of MEC/MC based on interviews revealing the "potential for unexploded ordnance and dangerous bombs, shells, rockets, mines, and charges either upon or below the surface" and "a great deal of unexploded ordnance" uncovered and hauled away during the grading of the country club golf course (USACE, 1993).

c. SCDHEC, Bureau of Solid and Hazard Waste Management, conducted a site visit in March 1990 to the Camp Croft landfill, a domestic waste landfill first used in 1971. No records have been found to indicate use of this landfill by DoD or the existence of any previous Army landfill on the site.

2.3.1.1 Preliminary Assessment and Time Critical Removal Actions (TCRAs)

d. A Preliminary Assessment was performed by CESAC with a Findings and Determination (FDE) dated 25 November 1991; the site was determined to be FUDS-eligible (USACE, 1993). An Archives Search Report (ASR) was prepared by the USACE, Rock Island District in 1993 that covered the following potential FUDS: 1) Training Range Impact Area A, 2) Gas Chambers/Gas Obstacle Course Area D, 3) Cantonment Area B, and 4) Grenade Court Area B.

A Time Critical Removal Action (TCRA) was performed in 1994 at OOU 6 (HFA, 1995a). A second TCRA was performed in at OOU 7, recovering 35 UXO items, as well as 89 rounds of small arms ammunition and 546 pounds of UXO-related scrap (HFA, 1995b).

2.3.1.1 Phase I Engineering Evaluation/Cost Analysis (EE/CA) and Removal Actions

a. In 1996, a Phase I Engineering Evaluation/Cost Analysis (EE/CA) was conducted by Environmental Science and Engineering Inc. Nine Ordnance Operable Units (OOUs) were investigated (OOUs 1A, 1B, 2, 3, 4, 5, 6, 7 and 8); munitions debris, including practice grenades and 2.36-inch rocket fragments were found at OOU 3, the former location of the grenade court, located in the former cantonment area (ESE, 1996a). OOU1 is a 1,020-acre wooded area in the northwest portion of MRS 3 within Croft State Natural Area consisting of OOU1A and OOU1B; a small portion of OOU1A falls outside the boundaries of the former Camp Croft, the Croft State Natural Area, and MRS 3. No UXO was discovered in OOU1A during the Phase I EE/CA; therefore No Further Action was recommended for OOU1A. OOU1B is located within the boundary of OOU1A; because 12 60mm and one 81mm mortar were discovered in the 65-acre forested area, the entire area was surface cleared. In addition, 3,000 feet of horse trails, plus a 10-foot buffer on either side, were clear to two feet below ground surface (bgs) (HFA, 1997). OOU1 is now a portion of MRS 3, Sub-Area 1.

b. OOU2 is a 325-acre site within Croft State Natural Area. During the Phase I EE/CA, one 81mm and 19 60mm mortars were discovered, along with a piece from a 4.2-inch mortar. Current recreational activities at OOU2 include hiking and horseback riding. The Phase I EE/CA recommended surface clearance for OOU2 (ESE, 1996a). In 1997, 5,400 feet of new trails were established in OOU2 under the supervision of park personnel. These new trails were cleared (a width of 30 feet) to a depth of two feet bgs. OOU2 yielded one 81mm high explosive-filled (HE) mortar and 13 60mm HE mortars. Scrap, consisting of 150 pounds of OE-related (ordnance and explosives) scrap and 94 pounds of non-OE scrap, was removed from OOU2 (HFA, 1997). OOU2 is now a portion of MRS 3, Sub-Area 1.

c. AoPI 3 was known as OOU3 during previous investigations. AoPI 3 (formerly OOU3) is a residential area generally surrounding and including the Wedgewood Subdivision and portions of The Creek Golf Course, both of which are located north of Croft State Natural Area. It was investigated in the Phase I EE/CA due reports that hand grenade parts had been found. A Mk II fragmentation grenade, multiple practice hand grenades, and grenade parts were found during the Phase I EE/CA investigation suggesting that OOU3 may have been a former grenade practice area. Clearance to depth was recommended in the Phase I EE/CA (ESE, 1996a). In 1997, a removal action took place on three acres of private property (one house bordered by other houses and a golf course) based on this recommendation. Seven Mk II HE fragmentation hand grenades, with eroded fuzes, were relocated to OOU2 for disposal. OE related scrap (197 pounds) and non OE related scrap (116 pounds) was released to a scrap dealer (HFA, 1997). As a result, a removal action was recommended for OOU3 as described in the EE/CA Action Memorandum (ESE, 1996b). Seven Mk II fragmentation hand grenades were recovered, as well as numerous practice hand grenades and grenade parts (HFA, 1997).

d. OOU6 is 340 acres of privately-owned land that is partially used as a landfill. A Time Critical Removal Action (TCRA) was performed in 1995 in a 30-acre area of OOU6 to remove surface and subsurface ordnance to a depth of 4 feet, and to perform geophysical mapping of the site. Four UXO items were found in the 30-acre area of investigation: one live 105mm artillery

projectile with an M48 series fuse, one explosive burster from a white phosphorus projectile, and two 60mm HE mortars with fuzes (HFA, 1995). Phase I EE/CA findings included nine 105mm smoke canisters, two 105mm fuzed ejections rounds, one explosive burster, two 60mm mortars, and one 81mm illumination mortar (ESE, 1996a). In 1996 and 1997, Parsons Engineering Science evaluated OOU6, recommending a subsurface clearance to four feet bgs in a small area. HFA conducted a removal action but parts of the action failed the government's quality assurance (QA) inspections (HFA, 1997). OOU6 is now a portion of MRS 3, Sub-Area 1.

e. OOU7 borders Lake Craig and is located in the busiest area of the park and includes the park office, store, horse exercise yard, corral, and campgrounds. A TCRA was performed in 1995; approximately 50 acres were surface cleared and 35 UXO items were located. Sixty 60mm and two 81mm mortars were discovered during the Phase I EE/CA investigation and a follow up TCRA was performed consisting of surface clearance. Parts of 2.36-inch rockets were discovered at OOU 7 during the TCRA. Clearance to depth (22 inches) was recommended in the Phase I EE/CA (ESE, 1996). In 1997, OOU7 was cleared to a depth of two feet. Fifty-six UXO items were unearthed, consisting of three 81mm HE mortars and 53 60mm HE mortars. All UXO were blown-in-place (BIP). A total of 2,742 pounds of scrap, consisting of 927 pounds of OE-related scrap and 1,815 pounds of non-OE scrap, was located and removed from the grids (HFA, 1997). OOU7 is now contained within MRS 3, Sub-Area 1.

f. AoPI 8, a small area in the northwest corner of Croft State Natural Area, was known as OOU8 during the Phase I EE/CA investigation. The only OE finding was 14 empty mine shipping containers found by HFA during an earlier investigation directed by the USAESCH. No UXO was discovered during the Phase I EE/CA. Since activities in the area are generally limited to surface use and no UXO was found, No Further Action was recommended in the Phase I EE/CA (ESE, 1996a).

2.3.1.2 Phase II Engineering Evaluation/Cost Analysis (EE/CA) and Removal Actions

a. In 1998, a Phase II EE/CA was performed that investigated five OOUs (9[A-H], 10[A-D], 11[A-D], 12[A-B], and an expanded area of OOU3 after the previous removal action). The Phase II EE/CA recommended remedial actions at all sites but OOU9 (QST, 1998). The Final Removal Report prepared in 2001 states that one site, OOU3, was partially cleared but that the planned project could not be finished due to insufficient funding (UXB, 2001).

b. OOU9 Sectors A-D, F, and H fall within MRS 3; OOUs 9C, 9D and a portion of 9A are within Sub-Area 1 and 9B, 9F, 9H, and a portion of 9A are within Sub-Area 2. OOU9 sectors 9E and 9G are not within MRS 3; they are now known as AoPI 9E and 9G. OOU9 covers approximately 1,036 acres, of which 306 acres (Sectors A-E) are within Croft State Natural Area. During the Phase II EE/CA, all items found in OOU9 were generally associated with small arms; no UXO was found. Activities at OOU9 sectors (A-E) are generally limited to recreational surface use (hiking and horseback riding). Since no UXO was discovered during the Phase II EE/CA investigation, No Further Action was proposed for Sectors A-D. OOU9 Sectors F and H are owned by local residents. Sectors 9F and 9H are covered with trees and underbrush of moderate density. No UXO or munitions-related scrap was found during the Phase II EE/CA investigation. No Further Action was also proposed for the private property OOU9 sectors (QST, 1998).

c. OOU10 is a 210-acre area within Croft State Natural Area. OOU10 is divided into four sectors: OOU10A and B are now associated with AoPI 10A and 10B; OOU10C and D are within

MRS 3. The Phase II EE/CA sampling found significant amounts of ordnance-related scrap associated with higher detonations although no UXO was found. Current activities at OOU10 are generally limited to recreational use such as hiking and horseback riding. Surface Clearance was proposed for OOU10 in the Phase II EE/CA (QST, 1998).

d. OOU11 consists of 87 acres mostly outside of Croft State Natural Area consisting of four sectors (A-D). Sector 11A is the only OOU11 sector that falls within MRS 3. OOU11A was previously used for training maneuvers. During the Phase II EE/CA, the top of a grenade and a 60mm practice mortar (expended) were found. No UXO was found but the ordnance-related scrap found was indicative of high order detonations and was located less than 20 inches deep. Less than 100 visitors per year are estimated to use OOU11 (except the OOU11D area); there is little use other than hiking. The Phase II EE/CA recommended Clearance for Use as a risk reduction for the entire OOU11 including Section A (QST, 1998).

e. OOU12 is comprised of 94 acres divided into two sectors, A and B; both are within MRS 3. Sector 12A includes 78 acres north of Croft State Natural Area near the intersection of Dairy Ridge Road and State Route 295. The property is owned by several residents. Sector 12B covers 16 acres and is south of the park and west of Forest Mill Road. It is also privately owned by a single resident. OOU12A is suspected of being a former impact range for high explosive ordnance. Items found at the site include M9 rifle grenades, 2.36-inch rockets, practice M6A3 rifle grenades, M11 practice rifle grenades, and Mk II fragmentation hand grenades. OOU12B may have been used for training maneuvers; a live M9 rifle grenade (UXO) was found at the site. However, no ordnance-related scrap was found at OOU12B indicating that area had only limited training use. Clearance for use was recommended for both sectors as the risk reduction alternative in the Phase II EE/CA (QST, 1998).

f. In 1999, UXB International was tasked with performing a removal action at OOU6 in the area that failed QA inspections during the removal action in 1997. UXB evaluated previous geophysical data and conducted additional geophysical investigation (mag and flag) to locate anomalies. Geophysical data verified the presence of substantially large amounts of metallic clutter and debris within the top one foot of soil. Due to the large amount of debris and density of fragmentation, the removal action was halted due to lack of funding (UXB, 2001). A removal action followed in 2001, finishing clearance of the last 4.13 acres of the site; remotely operated equipment was used to remove the top layers of soil containing high concentrations of metal fragments. A total of 24,019 digs were performed; seven live OE items were detonated (ZAPATA, 2002). OOU 6 is now a portion of MRS 3, Sub-Area 1.

2.3.1.3 Additional Actions

a. An ASR Supplement was prepared in 2004 focusing on the 12 ranges at Camp Croft and the munitions used there (USACE, 2004). In 2005 and 2006, areas at OOU3 were cleared, unearthing and disposing of 24 M15 white phosphorous (WP) grenades, one M15 fuze, eight Mk II practice grenades, and four Mk II fragmentation grenades (ZAPATA, 2006a and 2006b). Over the last two years, geophysical mapping has been conducted at OOU3 (now AoPI 3) and OOU11C (now AoPI 11C) and supported USACE efforts to obtain rights-of-entry (ROE), which included participating in numerous meetings/discussions to minimize the financial impact to The Creek Golf Club. In 2010, a MEC clearance was conducted at AoPI 11C, and in January 2011 performed a removal of priority anomalies in an expanded area of AoPI 3.

2.3.1.4 Discrepancies

a. While preparing the RI/FS Work Plan (WP), investigation and removal action documents were reviewed and compared to findings with the information provided in the ASR and the ASR supplement. Discrepancies between documented ordnance types and actual findings were identified in numerous locations, as described in the RI/FS Work Plan (ZAPATA, 2011c). The discrepancies represent a potential misunderstanding of how the former ranges may have been used or the exact extent of the range fans. Furthermore, MEC and Munitions Debris (MD) have been found in areas outside of range fans (e.g., OOU9H, OOU10B, and OOU11B). Anecdotal information provided through the Restoration Advisory Board (RAB) from local residents indicates that munitions-related items have been found outside range fans and close to the FUDS boundary; two residents have independently indicated that items may be located along Fairforest Creek at its intersection with South Carolina Highway 150. This information has been taken into account in development of the initial Conceptual Site Model (CSM) and RI approach.

2.3.1.5 Historical Maps from Fort Worth District

In October 2014, following the submittal of the Final RI Report, historical maps documenting ordnance finds, tactical and maneuver areas, and range firing areas were discovered by the USACE, Wilmington District. The USACE reviewed data presented in those historical maps and elected to incorporate those data into the project GIS. Pertinent data presented illustrated on those historical maps (e.g., MEC/MD and dud areas) are included in Exhibits 2-3 through 2-7, which have been revised.

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Site Location
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-1

KEY

Former Camp Croft Boundary

N
W E
S

0 1 2 Miles

Overview

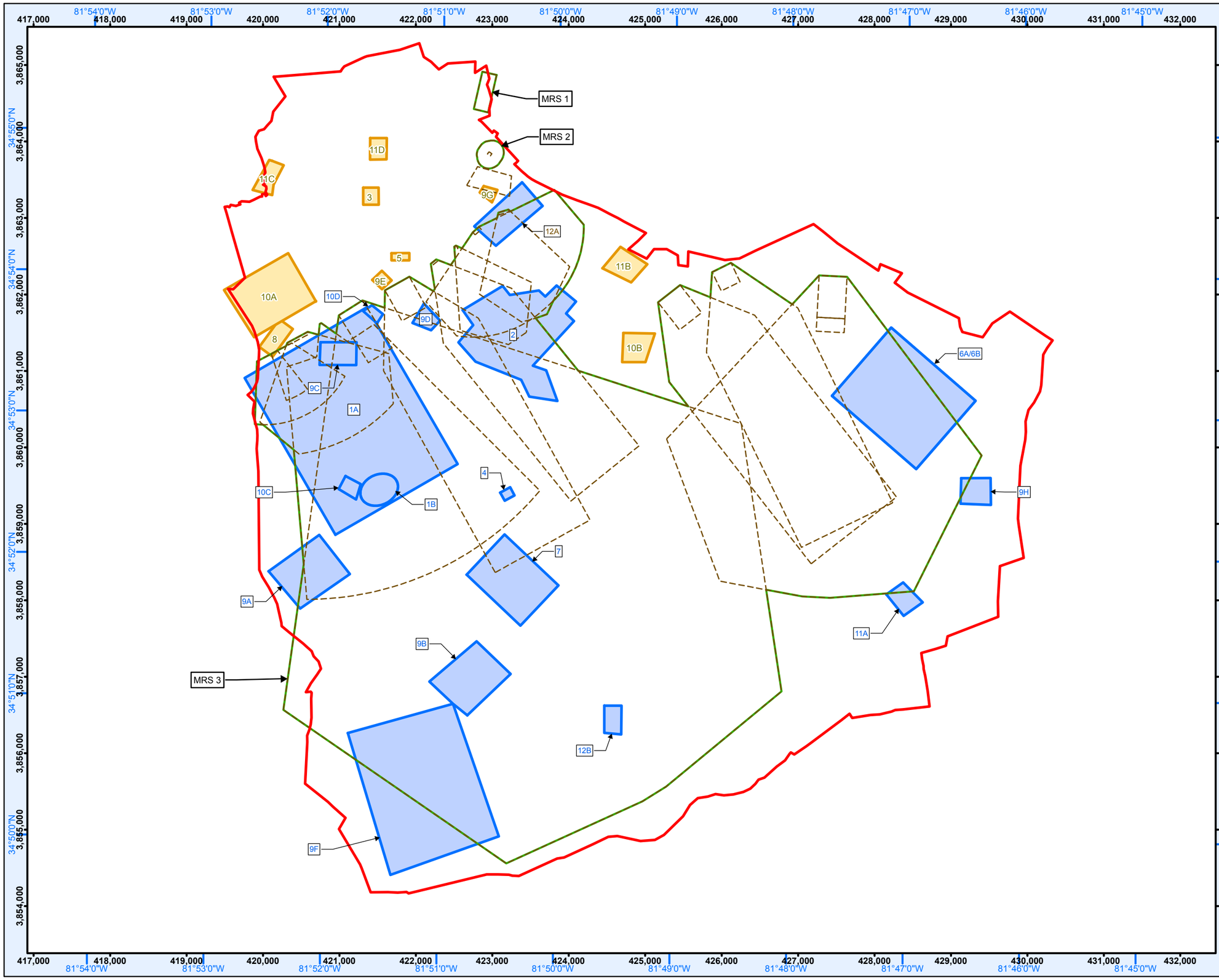
Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Note(s)
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1" = 2 miles	ATD

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Site Boundaries
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-2

KEY

- Former Camp Croft Boundary
- Historical Range
- MRS
- PWS-Defined Area of Potential Interest
- Former OOU

N
W E
S

0 2,000 4,000 Feet

Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=4,000'	ATD

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Historic Findings
Revision 2

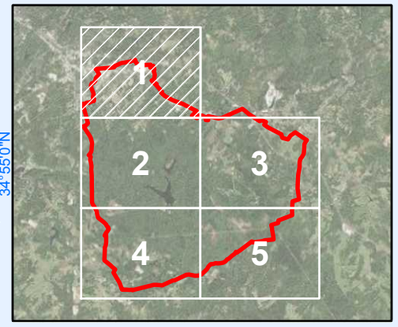
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-3

KEY

- MD
- MEC
- UXO
- Historical Points
- Historical Ranges
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- MRS
- Approximate Croft State Natural Area Boundary
- Historical Dudded Impact Area
- Former Camp Croft Boundary

N W E S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Red symbol denotes MEC/UXO item.

Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Historic Findings
Revision 2

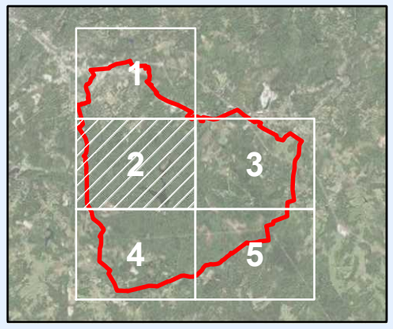
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-4

KEY

- MD
- MEC
- Small Arms Concentrations
- Historical Points
- Historical Ranges
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- MRS
- Approximate Croft State Natural Area Boundary
- Historical Dudded Impact Area
- Former Camp Croft Boundary

N, W, E, S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Red symbol denotes MEC/UXO item.

Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	ATD/EAA

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Support Center Huntsville
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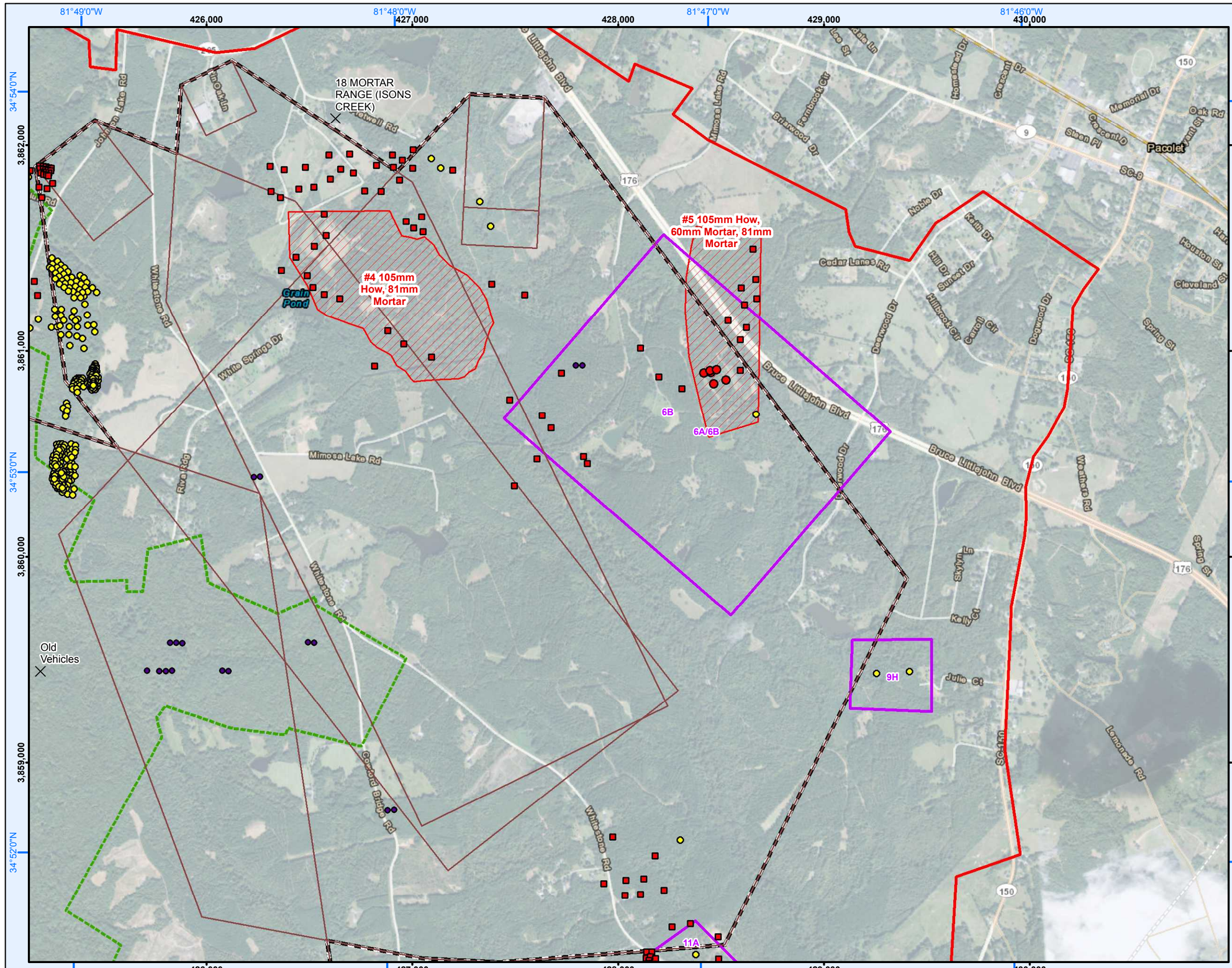
Huntsville, AL 35816



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Historic Findings
Revision 2

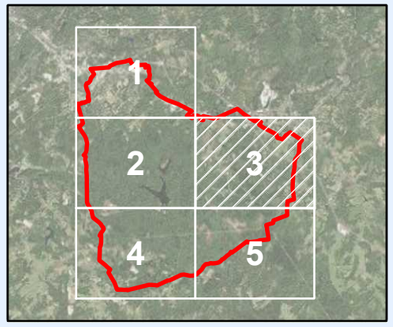
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-5

KEY

- MD
- MEC
- UXO
- Small Arms Concentrations
- Historical Points
- Historical Ranges
- Former OOU
- MRS
- Approximate Croft State Natural Area Boundary
- Historical Dudded Impact Area
- Former Camp Croft Boundary

N, W, E, S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
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Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	ATD/EAA

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Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Historic Findings
Revision 2

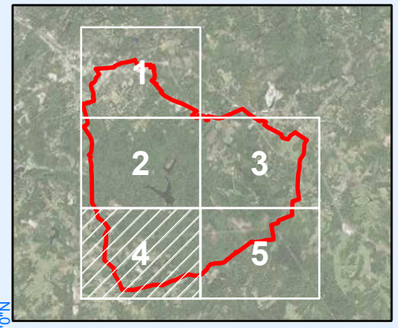
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-6

KEY

- MD
- MEC
- Historical Ranges
- Former OOU
- MRS
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

N
W E
S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Red symbol denotes MEC/UXO item.

Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	ATD/EAA

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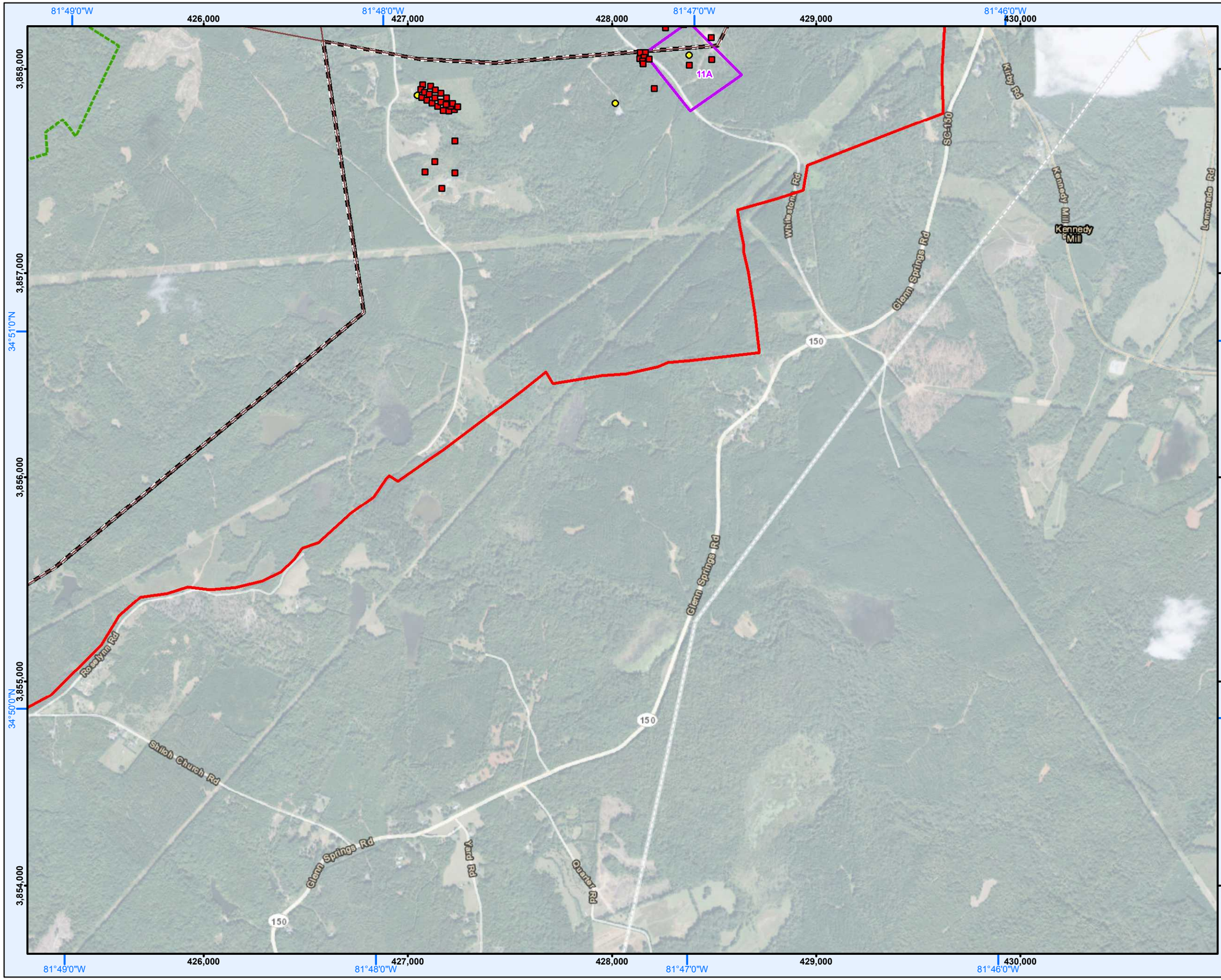


Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Historic Findings
Revision 2

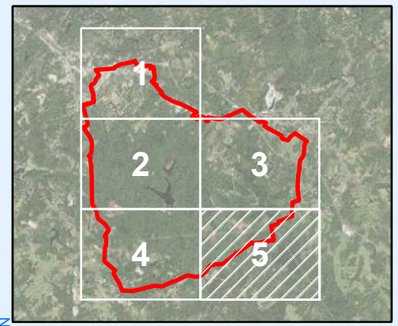
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	2-7

KEY

- MD
- MEC
- Historical Ranges
- Former OOU
- MRS
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

N
W E
S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

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3.0 PROJECT REMEDIAL RESPONSE OBJECTIVES

a. This RI is being conducted in accordance with the objectives and goals established by the project delivery team (PDT) during the technical project planning (TPP) phase as summarized in the Final TPP Memorandum (ZAPATA, 2011a) and TPP Memorandum Addendum (ZAPATA, 2011b) provided in Appendix L. The primary objective for the RI at Camp Croft is to determine the nature and extent of MEC/MC and perform and ecological and human health risk assessments (HHRA) for the purpose of developing and evaluating effective remedial alternatives.

b. The MRSs and AoPIs at Camp Croft were evaluated for current and potential land use through the TPP process to determine the best characterization process (see Exhibit 3-1). Three general approaches were used to define the nature and extent of MEC at the former Camp Croft. A combination of mag-and-dig, AIR, and digital geophysical mapping (DGM) was conducted to characterize nature, density, and extent of MEC. Based on findings from the MEC investigation, discrete soil samples were collected from areas of high and medium MEC/MD density. In some areas, field screening was performed using a handheld X-ray fluorescence (XRF) device to narrow soil sampling locations. Soil samples were submitted to the analytical laboratory for explosives and select metals analysis. Analytical results were used to characterize the nature and extent of MC contamination.

3.1 CONCEPTUAL SITE MODEL (CSM) AND PROJECT APPROACH

a. A preliminary CSM describing each MRS/AoPI, sources of MEC/MC, previous investigations, receptors, and potential source-receptor interaction was developed and presented in tabular form in the Final RI Work Plans (ZAPATA, 2011c). Conceptual Site Exposure Models (CSEMs) for MEC and MC, developed along with the preliminary CSM were also included in the Final RI Work Plans. The CSM and CSEMs (MEC and MC) have been revised to include RI field investigation results and refined potential source-receptor interactions (see Table 3-1 thorough Table 3-3).

3.1.1 MEC/MC Release Profiles

a. The former Camp Croft was used for a variety of training exercises over a large area (see Exhibit 2-2). Based on findings reported across the former camp, munitions used onsite ranged from small arms to high explosive 155mm. Despite historical range designation, findings from previous investigations and this RI indicate that historical documented site use is a poor indicator of how property may have actually been used (see Exhibits 2-3 through 2-7). Some training activities, like the 2-chlorobenzalmalononitrile (CS) Gas Chambers, were localized in nature and debris left behind would conceivably be characterized as being relatively shallow. Other activities involved live fire practices with large munitions; these activities result in larger areas of debris on the surface and potentially buried below the surface. Anecdotal evidence (partially corroborated by local landowners) suggests that vast swaths of land, south of the designated ranges along Dairy Ridge Road, were used for intermittently and for various training exercises from small arms practice to larger live fire exercises. Thus, MEC release should only be evaluated based on actual findings from field investigations.

b. Explosives and select metals are associated with munitions use. Considering the heavy and varied MEC use at the former Camp Croft, there is a reasonable potential for MC to coexist with MEC. However, explosives generally degrade when exposed to the environment over time,

which is likely the case for the former Camp Croft. Selected metals will persist in the environment over time. However, those metals are usually associated with areas of heavy small arms use (e.g., a small arms berm) rather than an impact area for projectiles or mortars. When areas indicating heavy small arms use were observed in the field, soil samples were collected.

3.1.2 Human and Ecological Risk Exposure Profiles

a. A majority of the former Camp Croft is now the Croft State Natural Area. Other parts of the former camp are composed of private residential property, commercial/industrial property, private recreational property, public space (roadways), and private agricultural property. Access to some of the privately-owned property is restricted by fencing. However, much of the land is accessible to residents, employees, and the public. In areas of high MEC and MD density, there is a high risk of direct contact exposure to human receptors.

b. Similar to human receptors, ecological receptors have access to much of the former Camp Croft. On privately-owned property, farm and domestic animals are at risk of direct contact exposure to MC. Within the State Natural Area, animals are less restricted by human boundaries (e.g., fencing, etc.) and have access to localized areas with potentially-elevated MC concentrations and thus, may also at risk of exposure MC.

3.1.3 Risk Characterization

3.1.3.1 MEC Risk Characterization

a. The risk of exposure by direct contact of human receptors to MEC exists at several areas across the former Camp Croft, and at varying levels of risk. Eight areas contain MEC and/or very high MD concentrations that are directly accessible to humans; those include (see Exhibits 5-4 and 5-6):

- MRS 3 – southeast of Dairy Ridge Road, within the area formerly known as OOU12A;
- MRS 3 – along Henningston Road, just inside Croft State Natural Area property;
- MRS 3 – an area centrally-located within the area formerly known as OOU6A/B;
- MRS 3 – two areas along Whitestone Road, one centered near the intersection with Cow Ford Bridge Road and another further south, at the southern extent of MRS 3;
- MRS 3 – along Croft State Park Road, within the area formerly known as OOU1A;
- MRS 3 – north of Croft State Park Road, within the area formerly known as OOU7; and
- AoPI 10A – an area located within the eastern half of the AoPI.

b. Numerous other areas contain smaller concentrations of MD. Individual MEC items were discovered in several areas, as well. However, these areas are different from those listed above in that the MD and MEC appears not to be associated with a training exercise but rather, a singular event or item left behind, generally with no other evidence in the immediate vicinity.

3.1.3.2 MC Risk Characterization

a. Following the MEC investigation, numerous locations were selected as locations to collect soil samples. Five soil samples (plus QC duplicates) were collected from each of 23 grids (see Exhibits 5-7 through 5-11). Analytical results indicated lead exceedances at two grid locations; MRS3-A and A4718. Field teams returned to those locations and collected additional

soil samples to determine the extent of lead contamination (see Exhibits 5-12 and 5-13). One soil sample (CC-MRS-ZSB-PB05) was lost at the lab. Lead concentrations at both locations were localized, and the boundaries of lead exceedances were determined. Location MRS3-A is along a trail, frequently used by hikers. However, considering the short duration of human exposure to lead in that area and the likelihood soil would not be ingested, lead exposure is not considered a risk. Similarly, the A4718 location is in the middle of a wooded area, off of any marked trail. It is highly unlikely that the area is visited by park patrons on any routine basis and thus, would be expected to be a low risk to human receptors.

3.2 PRELIMINARY REMEDIATION GOALS

a. Preliminary Remediation Goals (PRGs) are both site- and contaminant-specific and provide the minimum characteristics necessary to be protective of human health and the environment. The general PRGs for the Camp Croft MRSs/AoPIs are to manage MEC and MC risk through a combination of removal/remediation, administrative controls, and public education; thereby rendering the sites as safe as reasonably possible to humans and the environment and conducive to the anticipated future land use. While PRGs are initially established within the RI, they are subject to review and refinement throughout the course of the CERCLA process as more project-related information is obtained.

b. Specific PRGs for MEC and MC should be developed through discussions with the PDT and stakeholders. No specific PRGs have been established for the former Camp Croft. Example PRGs for MEC would include descriptions of methods likely to be protective of the particular exposure pathway(s) identified at the site; e.g., levels of cleanup such as surface removal, removal to depth or the implementation of land use controls (LUCs). Example PRGs for MC would include concentration values believed to be protective based upon site information. Following an evaluation of the Draft and Draft-Final RI Reports, the PDT may decide to include PRGs in the Final RI Report, in which case this section would be revised. PRGs are refined throughout the process following the Final RI Report as new information becomes available.

3.3 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED INFORMATION

a. CERCLA requires that on-site remedial actions must attain or formally waive Federal or more stringent State applicable or relevant and appropriate requirements (ARARs) of environmental laws upon completion of the remedial action. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires compliance with ARARs during remedial actions as well as at their completion. Applicable requirements mean those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. If a requirement is not applicable, it still may be relevant or appropriate. Relevant and appropriate requirements mean those cleanup standards that address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site.

b. Three types of ARARS were examined in light of site-specific circumstances to determine the actual ARARs for remedial actions carried out at the former Camp Croft sites: chemical-specific ARARs, location-specific ARARs, and action-specific ARARs. Further refinement of ARARs will be accomplished in the FS phase if necessary.

c. Chemical-specific ARARs are promulgated health-based or risk-based numerical values that establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Where more than one requirement addressing contaminant is determined to be an ARAR, the most stringent requirement should be used. Risk-based screening levels (e.g., EPA regional screening levels) are not considered chemical-specific ARARs because they are not promulgated. The baseline risk assessment at the former Camp Croft concluded that the potential for adverse risks to human health or ecological receptors from exposure to the identified COPCs is negligible. Therefore, there are no chemical-specific ARARs for remedial actions carried out at the former Camp Croft.

d. Location-specific ARARs are generally restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in locations determined to have unique or sensitive qualities. Some examples of locations with unique or sensitive qualities include flood plains, wetlands, historic places, and sensitive ecosystems or habitats. There are no location-specific ARARs that have been identified at the former Camp Croft.

e. Action-specific ARARs are usually technology- or activity-based requirements or limitations placed on actions taken with respect to remedial or removal actions. These ARARs control remedial actions involving the design or use of certain equipment, or regulate discrete actions. No action-specific ARARs have been identified for the former Camp Croft.

3.4 SUMMARY OF INSTITUTIONAL ANALYSIS

a. There are many ways to protect the public from MEC-related accidents. Institutional controls are an effective way to protect the public and other personnel, while still maintaining day-to-day operations. Institutional controls may include warning signs and community educational programs such as instructional pamphlets and meetings.

b. Institutional analyses are prepared to support the development of institutional control strategies and plans of action as a munitions response alternative. These strategies rely on existing powers and authorities of government agencies to protect the public at large from potential MEC hazards and MC risks.

c. The former Camp Croft is owned by private landowners (residential and business) and public (Camp Croft Natural Area) entities. The cooperation of the public and private entities is required for institutional control to be effective.

d. The institutional analysis identifies government agencies having jurisdiction over properties that have MEC presence. The following governmental entities were identified for potential involvement in future institutional controls: USACE, South Carolina Department of Parks, Recreation and Tourism (SCPRT), and SCDHEC.

e. The USACE represents the federal government and acts as the lead agency by providing overall program management and execution, which includes funding and technical direction, for FUDS within their respective district. They are responsible for initiating the Decision Documents, inspecting the condition of signage, reporting new discoveries of MEC to environmental regulators (SCDHEC), attending public meetings and disseminating information and instructional pamphlets.

f. The SCDHEC is the state environmental regulator for the former Camp Croft. The agency's role is to protect the public from environmental hazards at the State level. SCDHEC is

responsible for permitting, reporting, variance and application review, and participating in public meetings. The agency has the authority to enforce environmental laws.

g. As noted during the field activities, warning signs reading "No Trespassing" or "Danger Explosives" are currently in place at the gated entrances into the property. Additional warning signs may be added along the road traversing across the former Camp Croft, if acceptable.

h. The cost for each of these institutional controls can vary greatly. The cost analysis of institutional controls will be provided, in detail, in the Feasibility Study report.

i. The Preliminary Institutional Analysis (IA) is provided as Appendix C to this RI report.

3.5 DATA NEEDS AND DATA QUALITY OBJECTIVES

a. Data Quality Objectives (DQOs) are qualitative and quantitative criteria used to guide sample collection and analysis activities. Based on the TPP, input from the RAB, and the preliminary CSM, the DQOs for this RI/FS project were developed prior to conducting the investigation to ensure that the data generated during the execution of the analytical program are of appropriate quality to support the anticipated end use of the data. DQOs are intended to ensure that the adequate type, amount, and quality of data are collected to accomplish the objectives of the project. The following subsections summarize the DQOs for each MRS/AoPI, for both MEC and MC (if applicable), along with a statement verifying whether the DQOs were achieved. Additional geophysical measurement quality objectives (MQO) established for this investigation are discussed in Chapter 5.

b. The site characterization goals of the RI are to collect sufficient data to determine if MEC or MC poses a threat to human health, public safety, or the environment. Additionally, the RI will further define the areas of MEC occurrence and generate sufficient data to complete risk assessment development and analysis of remedial alternatives for preparation of the FS, and preparation of a Proposed Plan and Decision Document for each MRS/AoPI.

c. Each MRS/AoPI at the former Camp Croft had a MEC DQO developed during the RI Work Plan to meet the project objectives (see Exhibit 3-1). These are presented below:

- MRS 1 (23.8 acres): Collect data along transects spaced 36 meters (m) apart within the MRS boundary and 16.24m apart south of the MRS boundary. Grids equated to 50 feet by 50 feet within the MRS.
- MRS 2 (24.9 acres): Collect data along transects spaced 36m apart within the MRS.
- MRS 3 (12,102.4 acres): Collect data along one-meter-wide transects spaced at various intervals (i.e., 36m, 73m, or 135m on center). Grids equated to 50 feet by 50 feet within the MRS.
- AoPI 3, 8, 9E, 9G, 10A, 11B, 11C, 11D: Collect data along transects spaced 36m apart. Grids equated to 50 feet by 50 feet. AoPI 11C included approximately two acres of DGM on a baseball field.
    - AoPI 3 – 11 acres
    - AoPI 8 – 23.9 acres
    - AoPI 9E – 7.6 acres
    - AoPI 9G – 6.6 acres
    - AoPI 10A – 171.5 acres

  - AoPI 11B – 34.7 acres
  - AoPI 11C – 23.0 acres
  - AoPI 11D – 15.1 acres

- AoPI 5 (5.5 acres): Collect data along transects spaced 73m apart. Grids equated to 50 feet by 50 feet.
- AoPI 10B (33.6 acres): Collect data along transects spaced 135m meters apart. Grids equated to 50 feet by 50 feet.
- Lake Craig (148.1 acres) and Lake Johnson (37.5 acres) (185.6 acres): Transects were spaced approximately 135m apart and grids equated to 50 feet by 50 feet along the shorelines.
- Soil samples were collected at selected locations of high and medium density MD. Those locations were evaluated by the PDT before samples were collected. Sample grids were established at MRS 3, AoPI 9G, and AoPI 10A. Five discrete soil samples were collected from each grid (0 to 2 inches bgs) and analyzed for explosives and select metals (antimony, copper, lead, and zinc).

d. The investigative methodology for each MRS/AoPI was developed to ensure, with a 90% confidence level, that all MEC-contaminated areas are identified and that boundaries of MEC-contaminated areas are delineated to an accuracy of +/- half of the transect spacing for each MRS/AoPI.

e. The RI field investigation teams received signed rights-of-entry to much of the former Camp Croft. DQOs were achieved in those areas where access was granted, namely MRS 1, portions of MRS 3,AoPI 8, AoPI 9E, AoPI 10A, AoPI 10B, and AoPI 11C. The portions of MRS 3 associated with the lakes included only the shorelines of the lakes; no investigation was performed within the bodies of water. For areas that denied rights-of-entry, the required investigation coverage area was not accessible and DQOs were not achieved; those area include MRS 2, portions of MRS 3, AoPI 3, AoPI 5, AoPI 9G, AoPI 11B, and AoPI 11D.

TABLE 3-1 MUNITIONS AND EXPLOSIVES OF CONCERN AND MUNITIONS CONSTITUENTS REVISED CONCEPTUAL SITE MODEL

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
MRS 1 GAS CHAMBER	23.8	Training using CS smoke pots/grenades[iii]. Assume disposal of canisters in pits or tossed away from the gas chamber (gas chamber #1) in the same general area. Disposal trenches may have been used near the gas chamber structure. **NOTE:** Three other gas chambers are identified in historical photographic analysis. Gas chamber # 2 and gas chamber #3 are in the vicinity of the 10th and 3rd holes of the golf course, respectively, adjacent to AoPI 3 (previously referred to as OOU3). Gas chamber # 4 is due east of AoPI 11C (previously referred to as OOU 11C) near the ball fields. These locations are not associated with this MRS.	CS smoke pots/grenades. No documented finds since site closure. No MEC or MD was discovered during the RI field investigation. No burial pits were discovered. The remnant of a concrete pad, potentially the floor of the gas chamber, was discovered. Per the ASR Supplement, it is unlikely that CS is present after 50 years. In addition, this is not a compound routinely analyzed by certified laboratories, and is currently not included in the ADR software database. There was no need to sample for metals – smoke canisters are not expected to be comprised of metals of concern for risk analysis. Thus, no MC samples were collected.	No known site-specific investigations have been completed prior to the RI investigation.	Private/commercial facility owns the majority of the property; half of the property is forested. Private railway and right-of-way at southern extent of the site. Public roadway and right-of-way at southern extent of the site. The property owner has cleared trees from the northern portion of the property and uses the cleared area to manage porcelain waste. Receptors: public, landowners, employees.	Private property access is restricted by fencing. Additional future land clearance activities are possible. Access to the private railway and right-of-way and public roadway and right-of-way are not restricted.	Upon review of the historical photographic analysis, gas chamber #1 appeared to be located south of the southern boundary of MRS 1, as defined in the PWS. As such, the field investigation focused south of the delineated MRS 1. ***MEC investigation*** – 0.37 acres were investigated by AIR methods along transects. Within the defined MRS boundary, a surface reconnaissance was performed along transects spaced 36m apart based on the Mk II grenade to identify areas of potential munitions contamination. To the south of the defined boundary, a surface reconnaissance was performed along transects spaced 16.24m apart. Digital geophysical mapping (DGM) using an EM61 was performed in five 50 ft x 50 ft grids (0.29 acres), located around a concrete pad suspected to be associated with the former structure, to attempt to locate disposal pits and/or a consolidated disposal area. ***MC sampling*** – None.
MRS 2 GRENADE COURT	24.9	Live and practice grenade training.	Live and practice grenades. No documented finds since site closures. No MEC or MD was discovered during the RI field investigation. However, only a small portion of the site was accessible to the investigation team. No MEC/MD was found; thus, no MC samples were collected.	No known site-specific investigations have been completed prior to the RI investigation.	Private residential property. Public roadway and right-of-way at northern extent of the site. The property owners have cleared trees from a majority of the site and used the cleared areas for residential structures. Receptors: landowners, residents, and public.	Private property access is not restricted. Access to the public roadway and right-of-way is not restricted. The majority of the site was not investigated because rights-of-entry were not granted by the property owners. The potential source and receptor interaction remains unclear.	***MEC investigation*** – 0.09 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. The acreage investigated represents a small portion of the planned investigation acreage of this site; rights-of-entry were not granted by the property owners. Site access was limited, and findings from transect investigations indicated no MEC/MD. Thus, no grids were placed in this site. ***MC sampling*** – None.
MRS 3 OPERATIONAL RANGE COMPLEX	12,102.4[iv]	Artillery training and combat range using live and practice munitions. Documented and undocumented firing points. 12 ranges, as documented in the Supplemental ASR.	60mm mortars, 81mm mortars, 1,000” AT, rifle grenades. Items found since site closure include: 37mm, 57mm, 60mm, 81mm, 105mm, 2.36” rockets, grenades, rifle grenades, 155mm with burster tube. Specifically:	EE/CA (1996 and 1998). MEC surface removals at OOU1B, OOU2, and OOU7 in 1997. MEC removal at OOU6A/6B in 2001. Less than 1% of the MRS	Croft State Natural Area, private residential, commercial, and religious property. Public roadways and rights-of-way throughout the site.	MRS 3 is composed of many different types of property. Some private property access is restricted, and some is not.	Due to the nature of the previous clearances, the minimal amount of acreage that was cleared of MEC, and the difficulty in accurately relocating the exact grids/acreage that was cleared more than 10 years ago, those areas were included in the RI investigation. MRS 3 was divided into sub-areas based on past land

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
			1A - 37mm and 57mm inert projectiles. 1B – 60mm and 81mm mortar parts. 2 – 60mm and 81mm mortar parts, 4.2" mortar parts. 6A/6B – M43 81mm mortars, M49 60mm mortar, M84 105mm HC smoke round. 7 – 60mm mortars, 81mm mortars, 2.36" rocket parts. 9F – 37mm APT with tracer (expended), grenade ring. 10C – Mk II practice grenade scrap. 10D – Grenade frag, part of a white phosphorus grenade. 11A – Grenade top, 60mm mortar (expended). 12A – Grenade spoon, M9 HEAT rifle grenades practice rifle grenades, 2.36" rocket motors, frag, and scrap, Mk II hand grenades and scrap. 12B – M9 rifle grenade. --- Some parcels of land were not accessible to the RI field investigation teams. 34 MEC items, 1 discarded military munitions (DMM) and thousands pounds of MD were found throughout MRS 3 during the RI field investigation; those items are generally characterized as grenades, landmines, mortars, projectiles, rockets, and undifferentiated MD. Numerous soil samples were collected from grids established	has undergone MEC clearance, most of which was surface or shallow depth clearance as part of Time Critical Removal Actions.	Portions of the site have been reworked including the small landfill on the western side of the site, the construction and debris landfill on the eastern side of the site, and numerous residential, industrial, religious, and Croft State Natural Area structures scattered across the site. --- Receptors: Recreational users (e.g., hikers, bikers, camping, horseback riding), residents, landowners, and public.	Access to public roadways and rights-of-way is not restricted. Some timber harvesting is conducted on private property. Portions of the site were not investigated because rights-of-entry were not granted by the property owners. The potential source and receptor interaction remains unclear.	use. *Sub-area 1* is inclusive of the range complex most likely to have Mk II grenades, 37mm, and 60mm mortars or larger munitions, based on documented MEC finds. *Sub-area 2* represents all remaining portions where only sporadic and small quantities of munitions have been found. ***MEC investigation, Sub-area 1*** – 35.06 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along variously-spaced transects were intrusively investigated. ***MEC investigation, Sub-area 2*** – 49.77 acres were investigated by AIR methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 135m apart were recorded for estimated anomaly distribution calculations. 132 grids (50'x50' equivalent; 7.58 acres) were placed in areas of high and medium estimated anomaly distribution. In areas initially investigated using the mag-and-dig method, grids were further investigated using a digital geophysical mapping (DGM) method. MEC-like anomalies were intrusively investigated. In areas initially investigated using the AIR method, all anomalies encountered in a grid were intrusively investigated using MineLab detectors. ***MC sampling –*** 100 primary and nine duplicate discrete soil samples were collected at 20 grids across the MRS. At 19 grids, five samples were collected from each grid. At grid MRS3-10450, three samples were collected along a berm. At grids MRS3-A and MRS3-B, only one sample was collected. Samples were submitted to an analytical laboratory for explosives and select metals (i.e., Pb, Sb, Zn, Cu) analyses. Ten additional soil samples were collected at two locations, MRS3-A (five samples) and A4718 (five samples), that exhibited Pb concentrations that exceeded project action limits (see Exhibits 5-12 and 5-13). Those samples were submitted to an analytical laboratory for Pb analysis. One soil sample (CC-MRS-ZSB-PB05) was lost at the lab. Seven composite (e.g. wheel method) soil samples were collected at seven post-BIP locations (from 0 to 2" bgs) and analyzed for explosives and select metals (Cu, Pb, Sb, and Zn).

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
			throughout the site. Lead exceedances were reported at two locations, MRS3-A and A4718; exceedances appear to be localized.				
RANGE COMPLEX LAKE CRAIG AND LAKE JOHNSON	185.6[v]	Situated within MRS 3.	60mm and 81mm mortars. No documented finds since site closure. No MEC or MD was discovered during the RI field investigation. However, only shoreline of the site was investigated, as established by the PDT during investigation plan development. No MEC/MD was found thus, no MC samples were collected.	None	Croft State Natural Area. Receptors: Recreational users (e.g., boaters, fishers).	Croft State Natural Area property access is not restricted.	Mag-and-dig investigation of transects conducted in areas west of the lakes was performed up to the water boundary, then turned and followed the shoreline until the point at which the transect turned and lead away from the lake. A similar shoreline pathway was followed during surface reconnaissance east of the lakes. A total of 0.59 acres of shoreline was investigated. Findings from transect investigations indicated no MEC/MD were found along the shoreline. Thus, no grids were placed along the shoreline. ***MC sampling –*** None.
AOPI 3	11[vi]	Cantonment area.	Grenades. Items found since site closure include: grenades, 2.36" rocket fragmentation. No MEC or MD was discovered during the RI field investigation. However, only a small portion of the site was accessible to the investigation team. No MEC/MD was found thus, no MC samples were collected.	EE/CA (1996), multiple removal reports. Subsurface clearance to depth in approximately 40 acres in the Wedgewood development that encompasses the majority of AoPI 3. DGM and clearance in a portion of the golf course buffer. General location of gas chamber #3 was geophysically mapped while investigating OOU3.	Private residential and recreational (i.e., golf course). Public roadways and rights-of-way throughout the site. The property owners have reworked soil and/or cleared trees from a majority of the site to create the golf course. Receptors: Residents, golfers, golf course maintenance personnel, and public.	Private property access is not restricted. Access to the public roadways and rights-of-way are not restricted. The majority of the site was not investigated because rights-of-entry were not granted by the property owners. The potential source and receptor interaction remains unclear.	Prior to the RI, the PDT concluded the extent of MEC has not been defined. MEC has been encountered beyond the currently delineated boundary of AoPI 3 as documented during the MEC removal at OOU3. RI field investigation occurred beyond this boundary to the west, north and east to the road depicted in the historical photo analysis. Areas that have undergone previous MEC removals were excluded from the acres investigated under this RI based upon coordinates provided in removal documents. ***MEC investigation*** – Access to the golf course was not allowed by the property owner. The investigation team investigated 0.09 acres by mag-and-dig methods along transects on residential property. Using Minelab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. The acreage investigated represents a small portion of the planned investigation acreage of this site. Site access was limited, and findings from transect investigations indicated no MEC/MD. Thus, no grids were placed in this site. ***MC sampling*** – None.

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
AoPI 5	5.5	North of the Range 7 firing point; southwest of grenade court.	Grenades. Items found since site closure include: rifle grenade. No MEC or MD was discovered during the RI field investigation. However, only a small portion of the site was accessible to the investigation team. No MEC/MD was found; thus, no MC samples were collected.	EE/CA (1996)	Private residential. Public roadway and right-of-way throughout the site. Receptors: Residents and public.	Private property access is not restricted. Access to the public roadway and right-of-way is not restricted. The majority of the site was not investigated because rights-of-entry were not granted by the property owners. The potential source and receptor interaction remains unclear.	***MEC investigation*** – Access to several parcels was not allowed by the property owners. The investigation team investigated 0.06 acres by mag-and-dig methods along transects. Using Minelab detectors, all anomalies encountered along transects spaced 73m apart were intrusively investigated. The acreage investigated represents a small portion of the planned investigation acreage of this site. Site access was limited, and findings from transect investigations indicated no MEC/MD. Thus, no grids were placed in this site. ***MC sampling*** - None.
AoPI 8	23.9	North of the Range 11 firing point.	Small arms ammunition. No MEC or MD was discovered during the RI field investigation. No MEC/MD was found; thus, no MC samples were collected.	EE/CA (1996)	Croft State Natural Area and private residential. Public roadway, electrical distribution corridor and rights-of-way through the site. Receptors: Recreational (e.g., hikers, bikers, campers, horseback riders), residential and public.	Private property access is not restricted. Access to the public roadway, electrical distribution corridor, and rights-of-way are not restricted.	***MEC investigation*** – 0.50 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. Findings from transect investigations indicated no MEC/MD. However, because this area is between two areas with considerable MD. ***MC sampling*** - None.
AoPI 9E	7.6	Northwest of the Range 7 firing point.	Small arms ammunition, which has also been found since site closure. No MEC or MD was discovered during the RI field investigation. No MEC/MD was found thus, no MC samples were collected.	EE/CA (1998)	Croft State Natural Area. Receptors: recreational users (hikers, bikers, campers, horseback riders).	Access to the property is not restricted.	***MEC investigation*** – 0.21 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. Findings from transect investigations indicated no MEC/MD. Thus, no grids were placed in this site. ***MC sampling*** - None.

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
AoPI 9G	6.6	North of the Range 3 firing point.	Small arms ammunition, which has also been found since site closure. Anecdotal evidence of grenades has been provided by the public. --- Only a small portion of the original AoPI 9G area was accessible to the RI field investigation team. Property east of AoPI 9G, recommended for investigation during the RI Work Plan development, was accessible. Five MEC items and hundreds of pounds of MD were discovered during the RI field investigations; those items are generally categorized as rockets and grenades. Three MEC items were detonated in-place and thus, three post-blow-in-place (BIP) soil samples were collected. In addition, soil samples were collected at three grid locations. These samples were analyzed for explosives and select metals; no exceedances were reported.	EE/CA (1998)	Private residential property. Public roadway and right-of-way through the site. Portions of private land have been cleared of timber and surface soil has been reworked during those activities. --- Receptors: Residents and public.	Private property access is not restricted. Access to the public roadway and right-of-way is not restricted. Portions of the site were not investigated because rights-of-entry were not granted by the property owners. The potential source and receptor interactions in those areas remain unclear. Property east of AoPI 9G contained many MEC and MD items. At this time, there is considerable risk of exposure to MEC for receptors on this site. Following the planned TCRA, the risk of exposure will need to be revised.	Based on anecdotal information provided by the public and the Spartanburg County Sheriff's Office and in agreement with the PDT, AoPI 9G was expanded to the east, to the MRS 3 boundary. ***MEC investigation*** – 0.64 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. Three grids (50'x50' equivalent; 0.17 acres) were placed in areas of high and medium density. All anomalies encountered were intrusively investigated. Numerous MEC and MD items were encountered along the transects and in the grids. An Interim Removal Action was conducted in May 2013. ***MC sampling*** - Fifteen primary and three duplicate discrete soil samples were collected at three grids across the AoPI (five samples from each grid). Samples were submitted to an analytical laboratory for explosives and select metals (i.e., Pb, Sb, Zn, Cu) analyses. Five composite (e.g. wheel method) soil samples were collected at five post-BIP locations (from 0 to 2" bgs) and analyzed for explosives and select metals (Cu, Pb, Sb, and Zn).

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
AoPI 10A	171.5	North of AoPI 8 and Ranges 10 and 11 firing points.	Grenades and mortars. Items found since site closure include: rifle grenade parts, landmine parts, practice grenade, 2.36" rocket, small arms ammunition. No MEC was discovered during the RI field investigation. Various MD was discovered during the RI field investigation; those items are generally categorized as rockets, grenades, landmines, mortars, projectiles, and undifferentiated MD. Soil samples were collected at one grid location. These samples were analyzed for explosives and select metals; no exceedances were reported.	EE/CA (1998)	Croft State Natural Area and private residential property. Public roadway and right-of-way through the site. Receptors: Recreational users (e.g., hikers, bikers, campers, horseback riders), residents, and public.	Croft State Natural Area and private property access is not restricted. Access to the public roadway and right-of-way is not restricted.	***MEC investigation*** – 4.45 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. Eight grids (50'x50' equivalent; 0.46 acres) were placed in areas of high and medium density. All anomalies encountered were intrusively investigated. ***MC sampling*** - Five primary and one duplicate discrete soil samples were collected at one grid at the AoPI. Samples were submitted to an analytical laboratory for explosives and select metals (i.e., Pb, Sb, Zn, Cu) analyses.
AoPI 10B	33.6	Southwest of Range 2 firing point.	Undetermined. Items found since site closure include: small arms ammunition, 60mm mortar. No MEC was discovered during the RI field investigation. Hundreds of pounds of MD were discovered during the RI field investigation; those items are generally categorized as grenades, mortars, and undifferentiated MD. Minimal and sporadic MD was found; thus, no MC samples were collected.	EE/CA (1998)	Croft State Natural Area Receptors: Recreational users (e.g., hikers, bikers, campers, horseback riders).	Croft State Natural Area access is not restricted.	***MEC investigation*** – 0.27 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 135m apart were intrusively investigated. Three grids (50'x50' equivalent; 0.17 acres) were placed in areas of high and medium density. All anomalies encountered were intrusively investigated. ***MC sampling*** - None.

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
AoPI 11B	34.7	Northwest of Range 2 firing point.	Undetermined. Items found since site closure include: small arms ammunition, grenade part. No MEC was discovered during the RI field investigation. One MD item, categorized as a grenade, was discovered. However, only a portion of the site was accessible to the investigation team. Minimal MD was found; thus, no MC samples were collected.	EE/CA (1998)	Private residential property. Receptors: Residents.	Private residential property access is not restricted. Portions of the site were not investigated because rights-of-entry were not granted by the property owners. The potential source and receptor interactions in those areas remain unclear.	***MEC investigation*** – 0.61 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. Findings from transect investigations indicated minimal MD. However, because this area is near areas with considerable MD, one 50 ft by 50 ft grid (0.06 acres) was placed in an area of medium estimated anomaly distribution. All anomalies encountered were intrusively investigated. ***MC sampling*** - None.
AoPI 11C	23.0	Undetermined.	Undetermined. Items found since site closure include: grenades, grenade fuzes, anti-tank mines. Hundreds of pounds of MD were discovered during the RI field investigation; items are generally categorized as grenades. Minimal and sporadic MD was found; thus, no MC samples were collected.	EE/CA (1998) Clearance to depth of 11 acres (2010).	Private residential and recreational property (i.e., baseball field). A portion of the site has been cleared and graded for a baseball field. Receptors: Residents and recreational users (e.g., baseball players and supporters).	Private residential property access is not restricted. Private recreational property access is restricted by fencing.	The area that underwent a previous MEC removal was excluded from the acres investigated under this RI. The PDT concurred to investigate the AoPI boundary area to the east, based on analysis of historical photo interpretations and previous site investigations and removals. ***MEC investigation*** – 0.13 acres were investigated by mag-and-dig methods along transects. Using MineLab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. Two acres were investigated by digital geophysical mapping (DGM) methods. MEC-like anomalies were intrusively investigated. Findings from transect investigations indicated minimal MD. However, because this area is near areas with considerable MD, one 50 ft by 50 ft grid (0.06 acres) was placed in an area of medium estimated anomaly distribution. All anomalies encountered were intrusively investigated. ***MC sampling*** - None.

MRS or AoPI[i]	Area (Acres)	Suspect Past DoD Activities[ii]	Potential MEC/MD/MC MEC/MD/MC Found During RI	Previous Investigation/ Clearance Actions	Post-DoD/Current Land Use Potential Receptors	Potential Source and Receptor Interaction	RI Field Investigations
AoPI 11D	15.1	Cantonment area.	Undetermined. Items found since site closure include: grenade, mortars (reported to sheriff). No MEC was discovered during the RI field investigation. One MD item, categorized as a mortar, was discovered. However, only a small portion of the site was accessible to the investigation team. Minimal MD was found; thus, no MC samples were collected.	EE/CA (1998)	Private property / recreational (i.e., golf course). The property owner has reworked soil and/or cleared trees from a portion of the site to create the golf course. Receptors: Golfers and golf course maintenance personnel.	Private property access is not restricted. Portions of the site were not investigated because right-of-entry was not granted by the property owner. The potential source and receptor interactions in those areas remain unclear.	Location of AoPI appears to be offset, based on evaluation of the historic photo analysis. AoPI was shifted northwest. ***MEC investigation*** – Access to the golf course was not allowed by the property owner. The investigation team investigated 0.21 acres by mag-and-dig methods along transects. Using Minelab detectors, all anomalies encountered along transects spaced 36m apart were intrusively investigated. The acreage investigated represents a small portion of the planned investigation acreage of this site. Site access was limited, and findings from transect investigations indicated no MEC. Thus, no grids were placed in this site. ***MC sampling*** – None.

Notes:

[i] Munitions Response Site (MRS) or Area of Potential Interest (AoPI)
[ii] ASR, ASR Supplement, and GIS-based Historical Photographic Analysis
[iii] CS smoke grenades, also known as "tear gas", are typically composed of 2-chlorobenzalmalononitrile.
[iv] Acreage does not include Lake Johnson or Lake Craig.
[v] Lake Johnson footprint is approximately 37.5 acres. Croft State Natural Area personnel were contacted on 12/3/10 and SC DNR on 12/6/10 concerning lake water levels. Officials indicated that Lake Johnson has been drained but is currently being naturally filled and has approximately 7 acres of water. Lake Craig is 148.1 acres.
[vi] AoPI 3 is defined as 11 acres. OOU3 (Wedgewood) has previously been defined as 46 acres.

TABLE 3-2 GENERALIZED MUNITIONS AND EXPLOSIVES OF CONCERN CONCEPTUAL SITE EXPOSURE MODEL

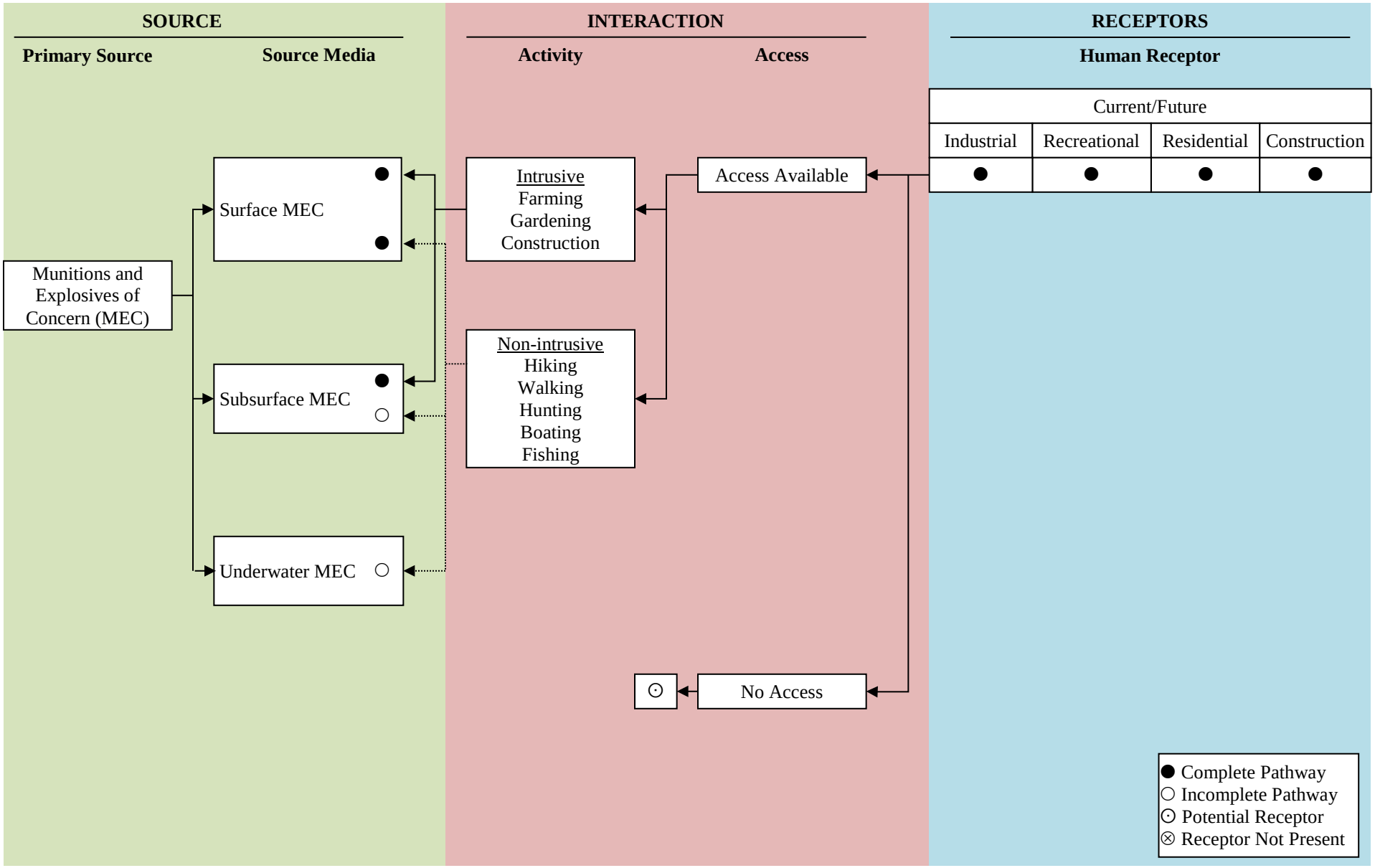
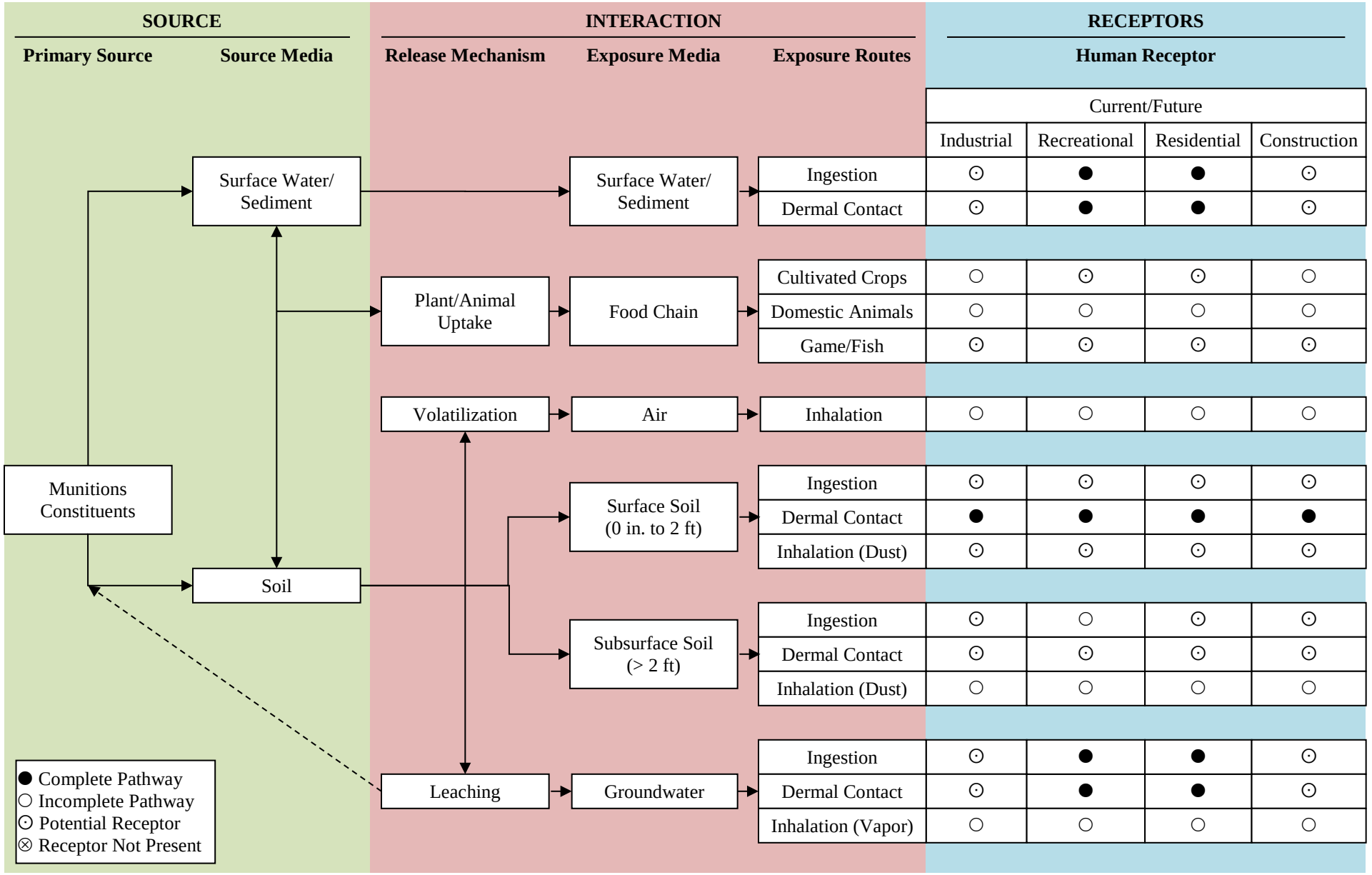
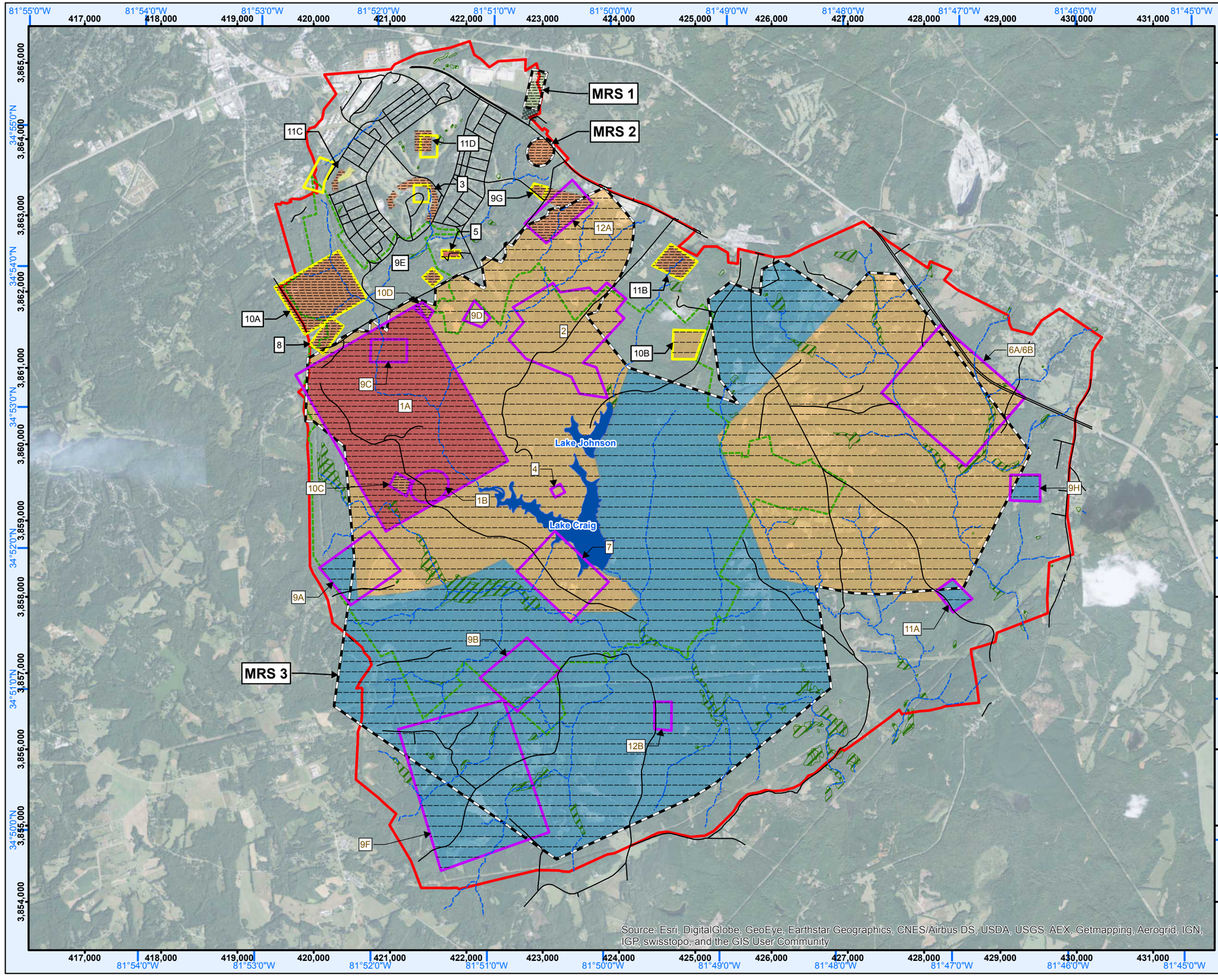


TABLE 3-3 GENERALIZED MUNITIONS CONSTITUENTS CONCEPTUAL SITE EXPOSURE MODEL



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Proposed Investigation Approach
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	3-1



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

KEY

- Transects
- Streams
- Streets
- PWS-Defined Area of Potential Interest
- Former OOU
- MRS
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Wetland
- Lake
- AIR (135m Transect Spacing)
- AIR (16.24m Transect Spacing)
- AIR (36m Transect Spacing)
- DGM (100%)
- Mag & Dig (135m Transect Spacing)
- Mag & Dig (36m Transect Spacing)
- Mag & Dig (73m Transect Spacing)

N
W E
S

0 2,000 4,000 Feet

Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Transect Spacing indicates the computed spacing between transect centers for one meter-wide transect pathways, as calculated by VSP.
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=4,000'	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

4.0 CHARACTERIZATION OF MEC AND MC

4.1 MEC CHARACTERIZATION

a. The PDT conducted a comprehensive review of existing site-specific data, including the 1984 On-site Survey, the 1993 ASR, the two TCRA Reports, multiple EE/CAs, the Removal Action Reports, the 2004 ASR Supplement, and other available historical documents and records, noting the type of ordnance used. It was determined that a combination of transects and grids positioned across the MRSs would be sufficient to characterize the nature and extent of MEC. Fieldwork was conducted in accordance with the Final Work Plans dated September 2011 (ZAPATA, 2011c).

b. Based on historic data, it was suspected that MEC contamination could exist in three MRSs and 11 other sites of varying sizes located within the FUDS boundary but outside of the three MRSs. The three MRSs include the Gas Chamber (MRS 1), the Grenade Court (MRS 2), and the Land Range Complex (MRS 3). Of the 11 other sites, 10 are "Areas of Potential Interest" (AoPI), and one appears to be associated with MRS 3, that being the Lake Craig and Lake Johnson Range Complex. The MRSs and AoPIs were established based on historical range locations at Camp Croft (see Exhibit 2-2). The AoPIs correspond to areas previously referred to as OOUs; those areas include AoPIs 3, 5, 8, 9E, 9G, 10A, 10B, 11B, 11C, and 11D. Eighteen previously defined OOUs exist within or partially within MRS 3; those include OOUs 1A, 1B, 2, 4, 6A, 6B, 7, 9A, 9B, 9C, 9D, 9F, 9H, 10C, 10D, 11A, 12A, and 12B.

4.1.1 MEC Intrusive Investigation

a. UXO Technicians who met the standards of DDESB TP-18 excavated and positively identified anomalies in mag-and-dig areas and counted subsurface anomalies in AIR areas. The field teams maintained a detailed record of the items excavated including quantities of MD items and non-munitions related debris items; proper identifying nomenclature; and condition, location, and disposition. Digital photographs of representative items were taken for reporting purposes. As MEC items were discovered, disposal operations were conducted same day with support of the local law enforcement bomb squad.

b. Necessary personnel and equipment were furnished to make final disposition of all recovered Material Potentially Presenting an Explosive Hazard (MPPEH). All recovered MPPEH and MD was inspected, consolidated, and disposed of in accordance with Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2. Upon inspection, it was determined that none of the MPPEH and MD collected (following detonation of MEC items) contained explosives hazards or other dangerous fillers or engine fluids, illuminating dials, or other visible liquid Hazardous, Toxic, and Radioactive Waste (HTRW) materials. The inspected materials were packaged and sealed into four 55-gallon drums. The SUXOS and UXO QCS completed DD Form 1348-1A for the four containers, with an estimated weight of 3,400 lbs. The Bill of Lading was estimated by the transportation company to be 4,500 lbs; the associated manifest was matched to that Bill of Lading. The containers were transferred to an approved scrap dealer; the four containers were weighed upon arrival and totaled 2,904 lbs. Per EM 1110-1-4009, Bonetti Explosives, LLC provided a written statement certifying that all Material Documented As Safe (MDAS) were not sold, traded or otherwise given to another party until the contents were smelted and were only identifiable by their basic content. On November 14, 2012 the material was dispositioned into civilian recycling (Appendix A).

4.1.2 Analog Test Strip and DGM Instrument Verification Strip Construction

a. The probable munitions range from 37mm to 105mm projectiles, hand grenades, and landmines. Actual detection depths can vary based on numerous factors including site-specific conditions and type of sensor. As such, detection depths were established utilizing an instrument test strip (for analog sensors) and an Instrument Verification Strip (IVS; for digital sensors) seeded with inert items indicative of probable munitions and positioned at various depths.

b. The MineLab Explorer SE PRO Series metal detector was primarily used for the analog RI field work. The instrument settings were determined based upon the response results from the analog test strip. The MineLab was selected as the most effective sensor based on information and prior experience obtained during field investigations in similar geological settings (i.e., extensive amount of mineralized soil content from the natural background bedrock).

c. The analog test strip was constructed at the beginning of the project fieldwork using one Small Industry Standard Object (ISO), one 37mm projectile, one 60mm mortar, one 81mm mortar, one Mk II hand grenade, and one 105mm projectile. Each seed item was placed in the horizontal orientation at a depth between four and seven inches bgs. Seed items were photographed, and their locations were recorded with the GPS.

d. During analog sensor operation, the quality control check for Repeatability/Functionality of Analog Equipment required detection of targets in the test strip. A summary of the test strip construction is provided in Table 4-1.

e. Once areas were selected for DGM, a digital IVS was established. The IVS Report details construction and test results and is presented in Appendix E, herein. Thirteen items were buried at various depths, ranging from the ground surface to 34 inches bgs. Based on the results of the IVS, anomaly selection criteria was set at 3 millivolts on Channel 2, for all data sets.

4.1.3 Brush Clearing

a. Limited clearing of brush understory was performed along transects and in grids to allow access for mag-and-dig, AIR, and DGM data collection. Manual clearing included the use of machetes and brush cutters; no heavy equipment was utilized. To minimize impacts on the environment, brush cutting was limited to vegetation less than four inches in diameter and no closer than six inches above the ground surface. All brush removal operations were performed by UXO Technicians as transects and grids were investigated.

4.1.4 Mag-and-Dig Transects

a. Transects of varying spacing were placed across every MRS and AoPI in the investigation area traversing the area in an east-west orientation (see Exhibit 4-1 through Exhibit 4-5).

b. The detonation fragmentation distance of the smallest item of interest in each area (e.g., 37 mm, HE, Mk II hand grenade) was used as the design basis for the transect spacing. This spacing ensured adequate coverage to identify suspect areas of interest (i.e., target areas, crater fields, heavy fragmentation areas, firing points, etc., and other forensic evidence of HE usage) as determined from historical documents and past site investigations. Coverage area (i.e., acres) was calculated by multiplying the transect length by a one-meter instrument swath width derived from one pass of the analog geophysical instrument.

c. Transects were divided into individual 100-ft segments (as site conditions dictated) with each segment being as straight as possible. A wooden stake (hub) was securely embedded in the ground at the beginning and end of each segment. The stakes were labeled with a unique hub number. The hub position was surveyed using a Trimble® GeoXH™ Global Positioning System (GPS) with a pole-mounted external antenna (when satellite coverage was available). Objects such as large trees, boulders, buildings, water bodies, steep terrain, etc. were skirted, and the transect line was picked up on the other side of the obstruction. Approximately 147.25 miles of mag-and-dig transects were covered during this investigation.

d. Transects located in safely-accessible areas (i.e., slopes less than 30 degrees) were intrusively investigated by two, four-man teams using MineLab Explorer SE PRO Series metal detectors. The teams completed mag-and-dig of all anomalies along approximate 100-foot segments. Quantities of MD and non-munitions related debris (type and description) were recorded per 100-ft transect segment in field log books and digitally in a Trimble® GeoXH™ GPS hand-held device. Forensic evidence of potential historical military activity was noted. Data collection results are discussed in Section 5.0 of this report.

4.1.5 Analog Instrument-Assisted Surface Reconnaissance (AIR)

a. Just as in the mag-and-dig areas, transects in the designated AIR areas were also divided into individual 100-ft segments (as site conditions dictated) with each segment being as straight as possible. A wooden stake (hub) was securely embedded in the ground at the beginning and end of each segment. The stakes were labeled with a unique hub number. The hub position was surveyed using a Trimble® GeoXH™ GPS with a pole-mounted external antenna (when satellite coverage was available). Objects such as large trees, boulders, buildings, water bodies, steep terrain, etc. were skirted, and the transect line was picked up on the other side of the obstruction. Approximately 96.5 miles of transect was investigated using the AIR method.

b. Transects located in safely-accessible areas (i.e., slopes less than 30 degrees) were visually inspected by one, two-man team using MineLab Explorer SE PRO Series metal detectors. One team member was responsible for sweeping the one-meter wide path between each one hundred ft. section of transect, and the other team member logged the number of contacts encountered into the Trimble GPS at each hub. The team completed AIR of all anomalies along approximate 100-foot segments. Quantities of subsurface contacts as well as any surface MD or non-munitions related debris (type and description) were recorded per 100-ft transect segment in field log books and digitally in a Trimble® GeoXH™ GPS hand-held device. Forensic evidence of potential historical military activity was noted. Data collection results are discussed in Section 5.0 of this report.

4.1.6 Data Interpolation Methodology

a. Data collected along transects represent a narrow but statistically-significant view of actual site conditions, as explained in the Work Plans (ZAPATA, 2011). To facilitate the review and comprehension of these data (and thus, site conditions) and to assist with subsequent grid placement, the distribution of findings between the transect data points was estimated using an interpolation method. Exhibits illustrating the estimated MD or anomaly distribution for mag-and-dig or AIR areas, respectively, were developed. The outlined methodology described below was developed in coordination with the USAESCH in December 2005 and executed within the project GIS. Exhibits illustrating these methods are presented in Section 5, herein.

4.1.6.1 Inverse Distance Weighted (IDW) Formula

a. Uninvestigated area concentration values were inferred using an IDW algorithm, where the known concentration values from the investigation were used to estimate the unknown values in areas that were not investigated. The IDW interpolation algorithm assigns values to unknown areas based on surrounding known values and their relative proximity, where spatially closer points are given more influence.

b. The IDW algorithm employed allows two user-identified parameters to be used: neighborhood size and power. The neighborhood size variable is used to apply a search radius around an unknown to select known value to use in estimating unknown values. This radius can be in the form of a search distance, the minimum number of known values to use, or both. The power variable is used to assign the amount of influence the known values of surrounding points have on estimating an unknown value.

c. In order to ensure unknown values were inferred properly, the neighborhood size was calculated by multiplying the distance between transects by two, which allows unknown values to be based on known values from adjacently investigated areas. The default power variable value of two was determined to be most appropriate where less influence is given to more distant values. Given the neighborhood approach and USAESCH guidance, the values used for the power and neighborhood variables were chosen to be two and 125 meters, respectively.

4.1.6.2 Anomaly Distribution Data Processing

a. In order to implement the IDW algorithm to determine per-acre values of uninvestigated areas, the enumerated counts needed to be converted to per-acre values. The conversion process used is described below.

b. Since count data from the investigation were collected along a segmented line with a dimensional width and tallied up as a point at the end of each measured segment, a per-acre value can be derived from the number of features counted and the length and width of the segment investigated. The following formula was used to assign per-acre equivalent values to the midpoints of individual line segments.

$$\frac{43{,}560 ft^2 \times (Anomaly\ Count)}{(Segment\ Width) \times (Segment\ Length)}$$

4.1.7 Mag-and-Dig Grids

a. After reviewing the data collected during the AIR transect coverage, 44 individual 2,500 square foot grids were positioned principally in areas of medium and high estimated anomaly distribution to better define the nature of MEC contamination. Grids varied in shape (dependent on purpose of grid or local topography), but were 50 ft by 50 ft, 10 ft by 250 ft, or 25 ft by 100 ft (see Exhibit 4-1 through Exhibit 4-5).

b. All grids were established using an existing transect hub as a corner. The elongated grids were typically positioned in a north-south configuration to define boundaries of MEC contamination between transects.

c. It was necessary to perform limited brush cutting within some of the grid areas to allow access for mag-and-dig data collection. Grids were intrusively investigated by two, four-man teams using MineLab Explorer SE PRO Series metal. Quantities and total weight of MD and non-munitions related debris (type and description) were recorded for each grid in field log books. Data collection results are discussed in Section 5.0 of this report.

4.1.8 Digital Geophysical Mapping (DGM) Grids

a. After reviewing the data collected during the mag-and-dig transect coverage, 110 individual 2,500 square foot grids were positioned principally in areas of medium and high estimated anomaly distribution to better define the nature and extent of MEC contamination. Grids varied in shape (dependent on purpose of grid or local topography), but were 50 ft by 50 ft, 10 ft by 250 ft, or 25 ft by 100 ft.

b. All grids were established using an existing transect hub as a corner. The elongated grids were typically positioned in a north-south configuration to define boundaries of MEC contamination between transects.

c. It was necessary to perform limited brush cutting within some of the grid areas to allow access for DGM equipment to pass over for data collection. Grids were investigated by one, three-man team using the EM-61 system. The team consisted of one UXO Technician to provide escort and two geophysical technicians. Data were evaluated, and targets were selected and approved by the PDT based on criteria in the Final Work Plans. Once target selection was finalized, the UXO teams revisited each grid to mark selected targets with PVC flags using multiple measuring tapes and a local coordinate system. Once targets were investigated, quantities and total weight of MD and non-munitions related debris (e.g., type and description) were recorded for each target in field log books. Results were filed into geophysical databases to improve accuracy in future target selection and analysis. Data collection results are discussed in Section 5.0 of this report.

4.2 QUALITY CONTROL AUDIT PROCEDURES

4.2.1 Quality Control Matrix

a. Table 4-2 provides a summary of the Quality Control (QC) approach as a Quality Control Matrix. The key elements of the performance metrics include alignment with stated project objectives, quality of product, timely delivery, cost containment, customer satisfaction, and meeting the USAESCH Data Item Description (DID) requirements.

4.2.2 QC Audits

a. Daily QC reports were reviewed by the Project Manger to ensure field procedures were being conducted in accordance with project specifications and systems were functioning as planned. The audits included a review of procedures, logs, records, etc. Management audits helps determine discrepancies in information collected or if conditions and practices create the potential for QC problems, so that corrections can be implemented before problems occur.

b. Listed below are QC processes and procedures associated with personnel, data collection/analysis, instruments/sensors and other equipment, data deliverables, and for measuring the effectiveness of MEC investigations. The QC processes provided for:

- Testing and calibrating equipment used to perform work.

  - Each geophysical component was noted according to make, model, and serial number in the field logbooks.
  - Functional instrument tests for the system were digitally recorded and available for review by Quality Assurance (QA) personnel.
  - All instruments and equipment that required calibration were checked prior to the start of each workday.
  - Batteries were replaced as needed, and the instruments were checked against a known source.
  - Instrument-specific functional testing procedures were performed in accordance with specific DIDs (MR-005-05.01).
- QC procedures were implemented to ensure data acquisition (analog instrumentation operation), data processing (post processing of GPS data), and interpretation methods (anomaly concentration calculations and analysis) were monitored at a sufficient level to meet the overall program objectives. Random audits of procedures were performed by the Project Manager (PM).
- Monitoring/measuring the effectiveness of work performed.
  - The UXOQCS was responsible for ensuring that personnel accomplished all QC checks and that the appropriate log entries were made. The UXO Quality Control Specialist (UXOQCS) performed random, unscheduled checks to ensure that personnel accomplished all work specified in the Work Plan and submitted a report of their findings to the Senior UXO Supervisor (SUXOS).
  - Project deliverables, such as the RI/FS documents, were be prepared by the PM and reviewed by the Professional-in-Charge prior to submittal to USAESCH.
  - Daily QC Journals, completed by the Team Leader(s), were submitted to the PM and/or SUXOS and included descriptions of the areas checked and the results of the QC checks. Records of these inspections are included in Appendix H.
- Inspecting the maintenance and accuracy of site records.
- Determining compliance with site safety, environmental, and operational plans.
- Ensuring the accuracy, timeliness, and completeness of data deliverables.

c. Field documentation is provided in Appendix H.

4.3 CORRECTIVE/PREVENTATIVE ACTION PROCEDURES

a. Guidelines were established to assure conditions adverse to quality such as malfunctions, deficiencies, deviations and errors were promptly investigated, documented, evaluated, and corrected. If a significant condition adverse to quality was noted, the cause of the condition would be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned would be documented and reported to the Project Manager, if necessary. All project personnel were aware of the continuing responsibility to identify problem areas promptly, solicit approved corrective actions, and report any condition adverse to quality. In general terms, corrective/preventive actions would be initiated at a minimum:

- When predetermined acceptance standards are not attained,
- When procedures or data compiled are determined to be faulty,
- When equipment or instrumentation is found faulty,
- When quality assurance requirements were violated,
- As a result of system and performance audits, and/or

- As a result of management assessment.

b. One Corrective Action Request (CAR) was issued by the USAESCH on 05 April 2012. During a field demonstration of mag-and-dig transect investigation procedures to RAB and USAESCH representatives, the SUXOS provided an explanation of the work process in "layman's terms" for the benefit of the RAB members present. That explanation included a description of how multiple handheld sensors can be used for anomaly detection, particularly in areas saturated with small arms. A USAESCH representative issued a CAR noting, "The Work Plan was not followed." A response was provided on 05 April 2012. CAR documentation is provided in Appendix J.

4.4 MC CHARACTERIZATION

a. Characterization of MC contamination at the former Camp Croft included discrete surface soil sampling from within MRS 3 and just outside the MRS 3 boundary based on the MEC investigation results. As described in the RI/FS Work Plan (ZAPATA, 2011c), surface soil is defined as less than two inches below ground surface (bgs).

b. As described above, grids of approximately 2,500 square feet were established across the project site to investigate MEC. Grid locations established following transect investigation are illustrated on Exhibit 4-1 through Exhibit 4-5. In grids where a significant level of MD was found, surface soil samples (from ground surface to two inches bgs) were collected from four quadrants (northeast, northwest, southwest, and southeast) and the center point. One-hundred-twenty discrete surface soil samples, plus 12 duplicates, were collected from the former Camp Croft for laboratory analysis. Samples were analyzed for explosives (plus nitroglycerin and PETN) using EPA method 8330A and antimony, copper, lead, and zinc using EPA method 6020A. All primary samples were shipped to Accutest Laboratories Southeast, Inc. for analysis.

4.4.1 Identification of MC Areas

a. Grids of approximately 2,500 square feet were established across the former Camp Croft to investigate MEC as described above. Soil samples were collected from grids with high anomaly densities detected during the MEC investigation. Surface soil samples were collected from the four grid quadrants (northeast, northwest, southwest, and southeast) and the center point of the grid (i.e., five samples per grid). One-hundred-twenty discrete surface soil samples, plus 12 duplicates, were collected during the initial round of soil sampling conducted 28-31 August 2012. Samples were analyzed for explosives using EPA method 8330A and antimony, copper, lead, and zinc using EPA method 6020A. Four samples were re-collected on 9 October 2012 because of laboratory hold-time exceedances (the samples were misplaced in the laboratory cooler) and analyzed for explosives; the original results for metals are valid.

b. Because soil samples collected in August 2012 showed lead levels above PALs, x-ray fluorescence (XRF) was used in January 2013 to analyze soil samples in the field for lead and determine how far lead contamination extended outside grids MRS3-A and A4718. XRF samples were collected at 20-foot intervals in all directions away from the original sample locations. Ten surface soil samples were collected on 22 January 2013 from these grids and sent to Accutest to verify XRF results and provide additional metals data. One soil sample (CC-MRS-ZSB-PB05) was lost at the lab. Samples were analyzed for antimony, copper, and lead. A single discrete surface soil sample was collected from grid A4718 on 27 February 2013 based on a detection of lead above the RSL from January 2013; that sample was analyzed for lead.

c. In addition to the discrete surface soil samples described above, post-blow-in-place (BIP) composite surface soil samples were collected immediately following detonation of MEC items to determine if any MC contamination remained after the detonation. Twelve detonations took place during RI field activities; as a result, 12 post-BIP surface soil samples were collected. The U.S. Army Cold Regions Research and Engineering Laboratory's (CRREL's) 7-Sample Wheel Approach was used to collected composite post-BIP soil samples. Samples were analyzed for explosives and select metals (antimony, copper, lead, and zinc).

d. Discrete surface soil samples were also collected from areas determined to represent background locations. Background locations are geographically close to the former Camp Croft MRSs and AoPIs and have similar lithologic characteristics, but have not been impacted by historical munitions use. Ten background surface soil samples were collected and analyzed for explosives, antimony, copper, lead, and zinc.

4.4.2 Remedial Investigation MC Work Elements

a. Soil samples were collected in accordance with the Final Camp Croft RI/FS Work Plan (ZAPATA, 2011c), with the exception that the USAESCH elected to not have QA samples collected. Appendix E of the Work Plan contains the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) which contains the sampling strategy, Quality Assurance/Quality Control (QA/QC) procedures, analytical requirements, Standard Operating Procedures (SOPs), and a list of required project documents and records.

4.4.2.1 Quality Control

a. QC samples were analyzed to assess the quality of sampling methods and of the analytical data. These samples include QC duplicates, QC equipment rinsate blanks, trip blanks, and matrix spike/matrix spike duplicates. Split and duplicate samples were collected as a single sample, homogenized, divided into equal parts, and placed in separate containers. Duplicate samples were collected at the rate of 10% of field samples and sent to the primary laboratory (Accutest). The identity of the QC duplicate was not provided to Accutest but was recorded on the Daily Quality Control Report (DQCR) and in field log books. The purpose of the QC duplicate is to provide site-specific, field-originated checks of the quality of the data generated by the laboratory.

4.4.2.2 Analytical Data Validation

a. Analytical data results were provided to an independent firm as Stage 2 electronic data deliverables (SEDD) for data validation (Appendix B). Analytical data were validated using automated data review software as described in the Final Camp Croft RI/FS Work Plan (ZAPATA, 2011c).

4.5 VARIANCES FROM PLANNING DOCUMENTS

4.5.1 Field Change Requests

a. During the course of the RI field investigation, several variances or clarifications from planning documents were issued and accepted by the PDT. Those updates, referred to as Field Change Requests (FCRs), are listed below and provided in Appendix J.

- FCR 01 – Fill Mag-and-Dig Holes
- FCR 02 – Pre-BIP Samples Waived

- FCR 03 – High Anomaly Density Procedure Update
- FCR 04 – Post-BIP Samples Waived if MD
- FCR 05 – Lot Definition Revised
- FCR 06 – Grid Investigation Suspension Allowance
- FCR 07 – Transect Allowance: AIR vs. Mag-Dig
- FCR 08 – Procedures for Digging High Density Grids
- FCR 09 – MC Sample Locations and Procedure Revised
- FCR 10 – Project Action Limits Update

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TABLE 4-1 TEST STRIP CONSTRUCTION SUMMARY

Inert Seed Munitions	Diameter (mm)	Orientation	Buried Depth (inches bgs)
Small ISO	25.4	Horizontal	5
37mm Projectile	37	Horizontal	7
105mm Projectile	105	Horizontal	4
81mm Mortar	81	Horizontal	6
Mk II Hand Grenade	58.7	Horizontal	7
60mm Mortar	60	Horizontal	7

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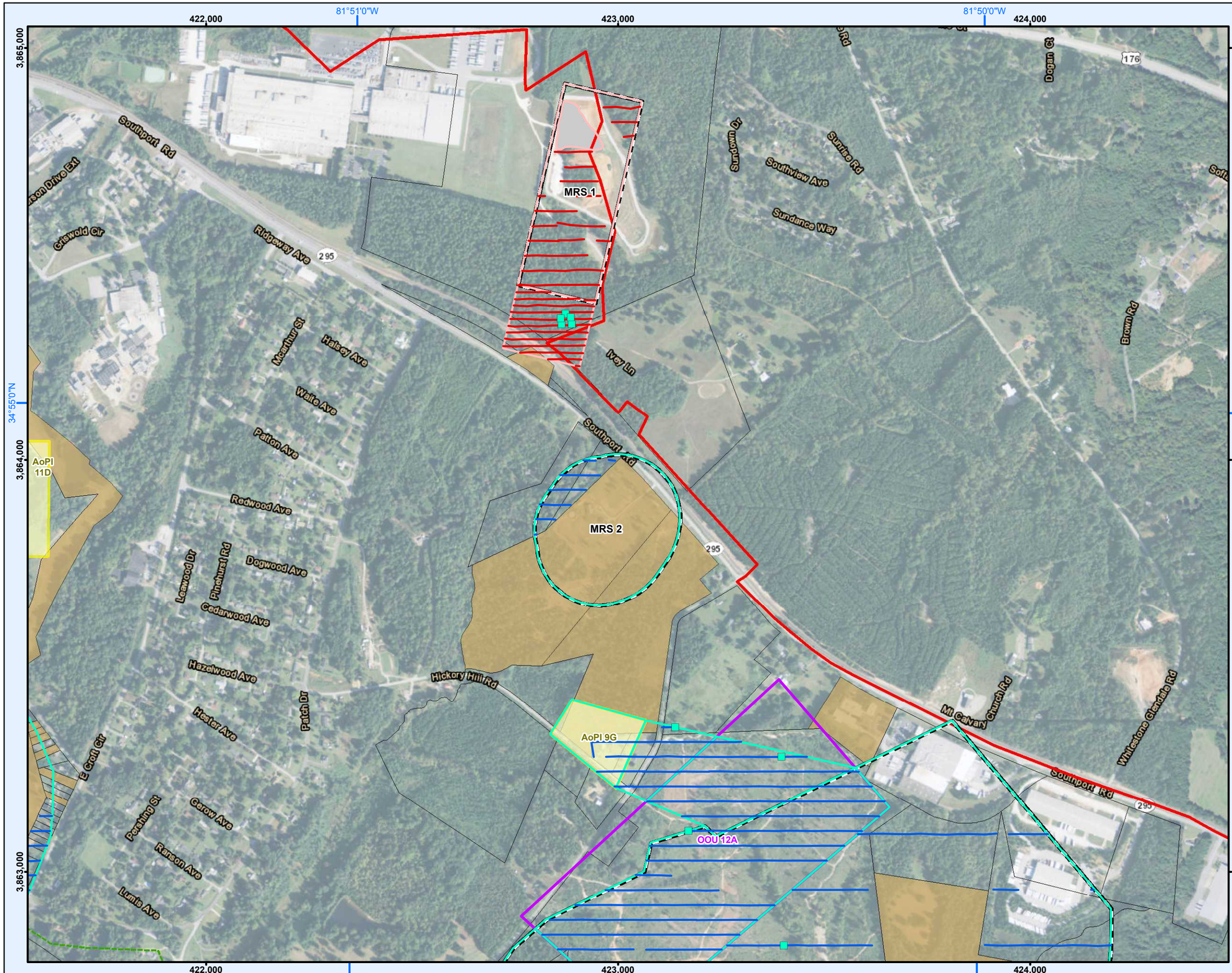
TABLE 4-2 QC MATRIX

This matrix is a summary of the QC Approach used during this RI. Safety is key to project execution. All work processes are performed and monitored in agreement with established Corporate Quality Management System. Key elements of the Performance Metrics include Alignment with Stated Project Objectives, Quality of Product, Timely Delivery, Cost Containment, Customer Satisfaction, and Meeting USACE Requirements (DIDs).

Project Phases	Performance Metrics	QC Process	Pass/Fail Criteria
Written Deliverables (Work Plans and Studies)	• Technically accurate documents with minimal grammatical or editorial errors. • Documents are submitted on time and in accordance with applicable guidance/DIDs	• Assignment of Project Delivery Team with applicable skills and experience to accomplish PWS objectives and participate in routine Team Project meetings. • Peer Review and Senior Management review of deliverables prior to submittal. • Schedule monitored by the PM.	• In-house peer-review comments addressed. • Document passes internal back-check. • No errors encountered during Senior Review.
Surveying (Establish Transects and Grids)	• Accurate placement of grid corners and transect way points. • Work product meets the requirements of Table 3-2.	• Use of licensed PLS to install any additional required general survey control points. • Daily instrument check for accuracy within tolerances of project requirements, utilizing established temporary control points.	• Transect way points (hubs) and grid corners will be positioned with screening level accuracy (10m) as specified in the PWS and Table 3-2.
Instrument Test Strip	• Selection of sensor to identify anomalies that meet scope criteria in size and depth. • Work Plan meets the requirements of DID MR-005-05.01 for analog geophysics.	• The test strip randomly reconfigured weekly by adding and/or moving seed items. • All instruments for use tested and settings recorded.	• Seed items are identified.
Mag-and-Dig Investigation	• All anomalies are investigated. • No finding of ferrous MD or RRD equal to or greater than 37mm in diameter or width within grids or along transect paths on the surface or subsurface after investigation. • Work effort follows requirements of applicable DIDs. These may include Technical Management, Explosives Management, Explosives Siting, Environmental Protection, IDW, Safety Submissions, and other applicable guidance documents. • Items investigated explain instrument response.	• Intrusive data are accurate. • Per Table 3-2, field QC is performed on 100% for the first 2 days of intrusive activity on 10% thereafter for Dynamic Repeatability to assure that anomaly counts are within 20% of the digs along transect. • Blind seed items will be placed in grids to assure Coverage, Detection and Recovery. • The number of holes requiring QC checks will be based on the number of anomalies investigated during the prior 10hr work cycle (i.e., a "Lot"). Table 3-2 will be reviewed to determine the number of holes required for re-checking.	• Intrusive data reflect accurate item depth and orientation. Item is accurately identified with sufficient description using accepted formal nomenclature that would allow determination of specific characteristics such as filler and net explosive weight, if possible (MEC or intact MD). • Anomaly counts are within 20% of dug anomalies along transects, if not then redo that day's transects. • All Coverage, Detection and Recovery seeds are recovered, if not then redo that day's grids. • All of the anomalies inspected have been resolved, if redo that day's grids/transects • Successful Government inspection.



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Areas of Investigation - MRS 1, MRS 2, AOPI 9G
Revision 2

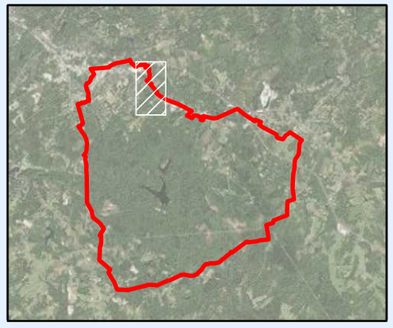
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	4-1

KEY

- Grid Location
- Mag & Dig Transect
- AIR Transect
- AIR
- Mag & Dig
- Former OOU
- PWS-Defined Area of Potential Interest
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel
- Inaccessible Area

N W E S

0 375 750 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 750 '	ATD/EAA

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Engineering and
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4820 University Square
Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Areas of Investigation - AOPI 3, 11C, 11D
Revision 2

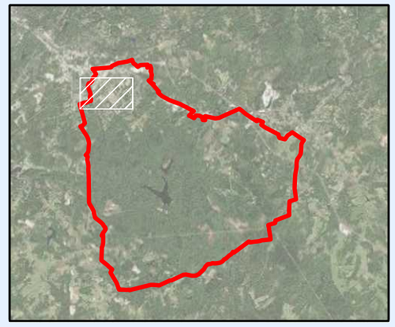
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	4-2

KEY

- Grid Location
- Mag & Dig Transect
- DGM (100%)
- Mag & Dig
- PWS-Defined Area of Potential Interest
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

N W E S

0 375 750 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
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Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 750 '	ATD/EAA

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Support Center Huntsville
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Huntsville, AL 35816

422,000

AoPI 5

AoPI 9E

Hilltop Rd

Beech Tree Ct

34°54'0"N

422,000

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Areas of Investigation - AOPI 5, 9E
Revision 2

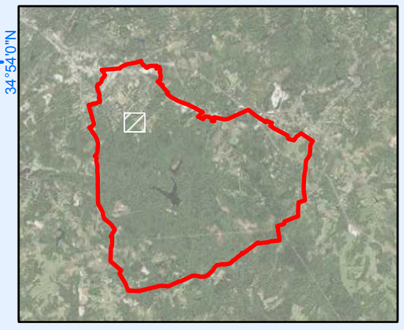
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	4-3

KEY

- Mag & Dig Transect
- Mag & Dig
- PWS-Defined Area of Potential Interest
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

N
W E
S

0 100 200 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

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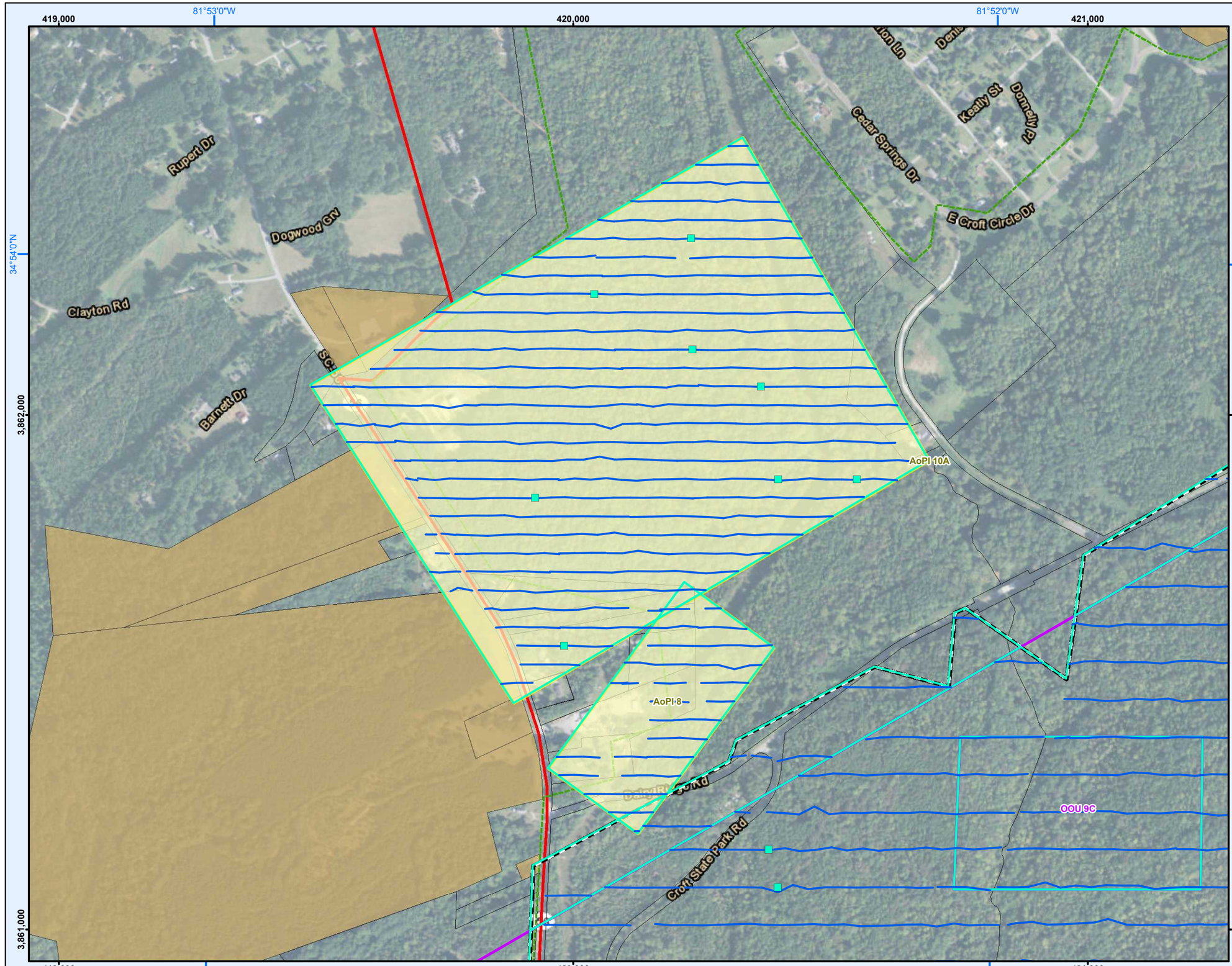


Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Areas of Investigation - AOPI 8, 10A
Revision 2

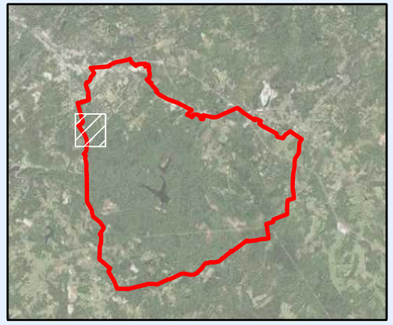
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	4-4

KEY

- Grid Location
- Mag & Dig Transect
- Mag & Dig
- Former OOU
- PWS-Defined Area of Potential Interest
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

N W E S

0 300 600 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 600 '	ATD/EAA

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Support Center Huntsville
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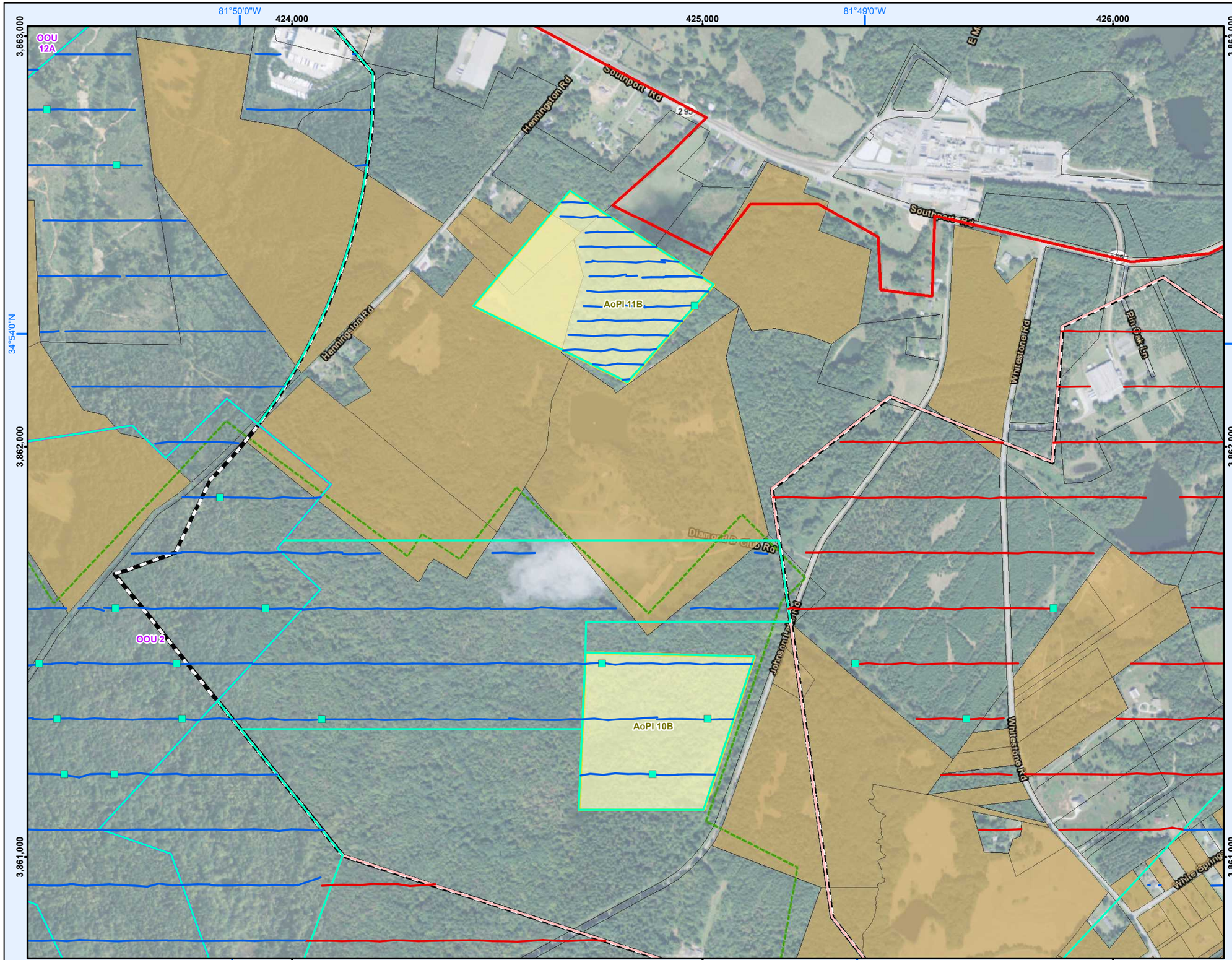
Huntsville, AL 35816



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Areas of Investigation - AOPI 10B, 11B
Revision 2

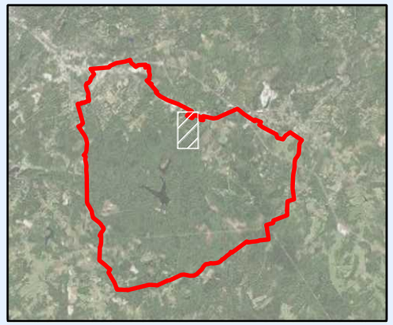
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	4-5

KEY

- Grid Location
- Mag & Dig Transect
- AIR Transect
- AIR
- Mag & Dig
- Former OOU
- PWS-Defined Area of Potential Interest
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

N W E S

0 375 750 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
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Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 750 '	ATD/EAA

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Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
Areas of Investigation - MRS 3
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	4-6

KEY

- MRS Boundary
- Grid Location
- Mag & Dig Transect
- AIR Transect
- AIR
- DGM (100%)
- Mag & Dig
- PWS-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel
- Inaccessible Area

N W E S 0 500 1,000 Feet

Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Note(s)
Engineering scale may only be accurate on a map size of 34 x 44.

Checked By	Engineering Scale	Drawn By
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5.0 REVISED CONCEPTUAL SITE MODEL AND REMEDIAL INVESTIGATION RESULTS

a. The former Camp Croft is a vast area, composed various sizes of individual properties, used for a variety of purposes. Property designations include public open space, private residential and commercial/industrial property, agricultural property, utility rights-of-way, large water bodies, and state-owned park. Access to property within the footprint of the former camp is generally not restricted. Based on the large size of the former camp and the varied use of the property within that footprint, multiple investigation approaches were used to determine the nature and extent of MEC and MC at the site. Those investigation methods, described in previous sections, include mag-and-dig, AIR, DGM, and soil sampling. In the following section, the nature and extent of MEC and MC for many of the sites included within this investigation is characterized. However, property access was denied by some property owners and thus, the RI investigation was limited in those areas. The nature and extent of MEC and MC cannot be directly determined on property that was not investigated; however, in some instances, observations made near property boundaries can be inferred on a limited basis across those boundaries.

5.1 MUNITIONS AND EXPLOSIVES OF CONCERN

a. The findings from the RI field investigation, along with associated historical findings are presented below for each of the areas included in the investigation (see Exhibit 5-1 through Exhibit 5-6). The MEC items and MD identified throughout this investigation can be classified into one of five categories (i.e., grenade, landmine, mortar, projectile, or rocket). The MD items found that could not be classified into one of these categories is simply referred to as "Undifferentiated MD"; these fragments were recognized as fragments from a type of munitions, but they were too small or too deteriorated to make a positive identification. A list of items discovered during the RI field investigation, associated with the appropriate category, is provided below:

- Grenade – MK I hand grenade (practice), Mk II hand grenade, M15 hand grenade (smoke), and M19 rifle grenade (illumination);
- Landmine – M1 anti-tank;
- Mortar – 60mm (training, illumination, HE) , 81mm (training, HE);
- Projectile – 37mm, 57mm, 105mm HE, 105mm Illumination; and
- Rocket – 2.36" Bazooka.

5.1.1 MRS 1 – Gas Chamber

a. MRS 1 is a partially wooded and gently sloping area that is located mostly on private property (see Exhibit 5-1). The area is defined as 23.8 acres; however, a review of historical photographs suggest the actual gas chamber may have been located beyond the southern boundary of the MRS. Thus, the area of investigation was extended to the south. A portion of the area has been cleared of trees and is used of disposal of porcelain waste materials from the industrial facility located immediately northwest of the site.

b. The RI field investigation team traversed 0.37 acres of transects using the AIR method. Following the transect work, five 50 ft by 50 ft grids were installed near the remnants of a concrete pad, believed to be the remaining pieces of the floor of the gas chamber. Survey teams

performed DGM within the grids. Very few anomalies and no MEC or MD was discovered in the area.

c. There has been no historical investigation conducted at this site with which to compare these findings.

5.1.2 MRS 2 – Grenade Court

a. MRS 2 is composed of partially wooded private residential parcels (See Exhibit 5-1). The PWS defines the 24.9-acre area as a former grenade court. No munitions items have been reported at this site since site closure.

b. The RI field investigation team traversed 0.09 acres of transects using mag-and-dig methods along the northern extent of MRS 2. This represents a small fraction of the planned activities as, rights-of-entry were denied by the property owners. No MEC or MD was discovered in the area investigated. The potential source and receptor interaction remains unclear.

c. There has been no historical investigation conducted at this site with which to compare these findings.

5.1.3 MRS 3 – Range Complex

a. The majority of MRS 3 consists of the Croft State Natural Area that is mostly medium density wooded land with rolling hills. Privately-owned parcels also exist in MRS 3, primarily along the eastern and southern extent of the MRS. The Supplemental ASR describes twelve ranges that were used for artillery and combat training using both practice and live munitions. There are documented and undocumented firing points within the MRS. Numerous investigations and removal actions have been conducted within various portions of the MRS. Those activities have reported finding a wide variety of MEC and MD including, rockets, projectiles (37mm to 155mm), mortars, grenades, and landmines.

b. The RI field investigation team conducted several types of investigations throughout the park; those include mag-and-dig transects, AIR transects, mag-and-dig grid, and DGM grids. The type of investigative method employed was dependent upon the preliminary site evidence and decisions reached within the TPP. Over the entire MRS, 84.83 acres were investigated by mag-and-dig or AIR transects. In general, transects were investigated along designed transect lines. Following the transect investigations, 132 grids (50 ft by 50 ft equivalent) or 7.58 acres of grids were installed and investigated across the MRS. Portions of the MRS were not accessible, as rights-of-entry were not provided by various landowners. A total of 39 MEC and 5,311 MD items were found within MRS 3 during the RI field operations.

c. Over the entire MRS, small arms, low quantities of MD and one MEC item were discovered in areas apparently disconnected from former ranges. These findings indicate that southern parts of the former Camp Croft were used sporadically for various training exercises, but none apparently heavily used. However, eight areas are identified within the former Camp Croft boundary as containing MEC and/or very high MD concentrations that are directly accessible to humans; seven of those areas are in MRS 3. In these areas, thousands of pounds of MD were removed during the RI investigation. Those seven areas are list below, shown on Exhibit 5-6, and described in greater detail in the following sections.

- Area Alpha – southeast of AoPI 9G and Dairy Ridge Road, within the area formerly known as OOU12A;
- Area Bravo – along Henningston Road, just inside Croft State Natural Area property and east of AoPI 10B;
- Area Charlie – an area west of and adjacent to Highway 176, centrally-located within the area formerly known as OOU6A/B;
- Areas Delta/Echo – two areas along Whitestone Road, one centered near the intersection with Cow Ford Bridge Road (Delta) and another further south, at the southern extent of MRS 3 (Echo);
- Area Foxtrot – along Croft State Park Road, within the area formerly known as OOU1A; and
- Area Golf – north of Croft State Park Road, within the area formerly known as OOU7.

d. Numerous MEC and MD items were discovered southeast of Dairy Ridge Road, within an area formerly known as OOU12A (Area Alpha). Many of those items were on or very near the surface. Three MEC items were detonated in place. The RI field teams communicated the number of MEC items to the USACE, indicating that MEC was present and easily accessible. The USACE determined the risk was great enough to warrant a TCRA, which was conducted between May and July 2013. Approximately 50 acres were intrusively investigated using hand-held magnetometers to a depth of six inches bgs; 100% of the area was inspected. During the TCRA, the following items were discovered and removed from within the TCRA boundary:

- 173 MEC items were discovered and destroyed. Those items included 2.36-inch fuzes, rockets, and warheads, M9 and M9A1 rifle grenades, and Mk II grenades.
- Approximately 1,200 MD items were deemed to be intact versions of the items listed above, but were not MEC; those items were detonated along with the MEC items.
- Approximately 9,900 pounds of MD were removed from the site and properly disposed.
- Four small pits, varying in size from approximately 550 ft^2 to 6,115 ft^2, with large quantities of metallic debris were identified.

e. The findings observed during the TCRA are presented in the Interim Removal Action Report dated July 2013 (Appendix P). There are two inaccessible parcels adjacent to this area. It is unclear if MEC and MD are present on those properties.

f. Henningston Road is a residential road that extends to the southwest toward Croft State Natural Area from Southport Road, along the northeastern portion of MRS. Along both sides of Henningston Road, just inside Croft State Natural Area property, numerous MEC and MD items were encountered (Area Bravo). The original investigation design only captured a small part of this area. When field teams discovered and reported the high concentrations of MD, the USACE expanded the area of investigation to the east and connected it with AoPI 10B. Many of those items were at or near the surface. Eight of those MEC items were detonated in place. There are two inaccessible parcels adjacent to this area. It is unclear if MEC and MD are present on those properties.

g. The documented use of former Combat Range 15 (see Exhibit 2-2; the teardrop-shaped hexagon located at the eastern extent of training ranges) was small arms. However, numerous

MEC and MD have been encountered in that area by the landowners and through previous investigations and removal actions. Much of the northern end of that area was inaccessible to field investigation teams. However, teams were able to access the central portion of that former range and were able to confirm previous findings. A high concentration of MD was encountered along numerous transects and grids (Area Charlie). Of note, in the area former known as OOU6, anomaly counts were so high along the mag-and-dig transects that the PDT allowed the teams to briefly convert those transects to AIR transects. While no MEC were encountered, it should be noted that the highest MD concentrations exist in the area formerly known as OOU6.

h. Within the same former Combat Range, there appear to be elevated MD concentrations along both sides Whitestone Road around the intersection with Cow Ford Bridge Road (Area Delta) and at the southern extent of the former Combat Range (Area Echo), where one MEC item was found. All of these areas are privately-owned residential parcels.

i. Croft State Park Road extends in a winding manner to the southeast through the State Natural Area from Dairy Ridge Road. Numerous MD and two MEC items were discovered along both sides of that road. These areas are generally separated into two areas; the larger area is within the former OOU1A (Area Foxtrot) and the smaller area is located within the former OOU7 (Area Golf).

j. The RI investigation findings corroborate much of the previous investigation and removal findings. This is especially true in those seven areas described above. The vast coverage of the transect investigation in MRS serves to provide important information regarding the potential extent of MEC and MD within the former Camp Croft.

5.1.4 AoPI 3 – Cantonment Area (Suspected Grenade Court)

a. For this RI investigation, AoPI 3 is an 11-acre area located on a private golf course and private residential properties (see Exhibit 5-2). The area adjacent to (and south of) AoPI 3 has undergone previous MEC investigations and removal actions. Numerous MEC and MD items indicative of grenade court usage have been removed from those areas. Those areas previously cleared were excluded from this investigation; however, the findings were used to refine our understanding of the site usage and to develop the proposed RI investigation area.

b. The RI field investigation team traversed 0.09 acres of transects using mag-and-dig methods within residential property along the eastern extent of AoPI 3. This represents a small fraction of the planned activities as, rights-of-entry were denied by numerous property owners. No MEC or MD was discovered in the area investigated. The potential source and receptor interaction remains unclear.

c. Previous investigation and removal actions noted the following items were removed from areas adjacent to AoPI 3: Mk II HE fragmentation grenades, practice hand grenades, grenade parts, various MD (197 pounds) and cultural debris (CD) (116 pounds) (see Exhibit 2-3).

5.1.5 AoPI 5 – Cantonment Area

a. AoPI 5 is composed of partially wooded private residential parcels. The PWS notes the 5.5-acre area is in the former cantonment area, north of the former Range 7 firing point and southwest of a grenade court (see Exhibit 5-3). Since site closure, only a rifle grenade has been reported in this area.

b. The RI field investigation team traversed 0.06 acres of transects using mag-and-dig methods within residential property along the northern extent of AoPI 5. This represents a small fraction of the planned activities as, rights-of-entry were denied by numerous property owners. No MEC or MD was discovered in the area investigated. The potential source and receptor interaction remains unclear.

c. This area was included in the 1996 EE/CA; no items of note were reported in that document.

5.1.6 AoPI 8 – Cantonment Area

a. AoPI 8 is composed primarily of wooded State-owned and private residential property (see Exhibit 5-4). The PWS notes the 23.9-acre area is located just north of the former Range 11 firing point. Small arms have been reportedly found at the site.

b. The RI field investigation team traversed 0.5 acres of transects using mag-and-dig methods. This area is in between two areas with considerable MD. All anomalies encountered were intrusively investigated. No MEC or MD was discovered in the area investigated.

c. This area was included in the 1996 EE/CA; no items of note were reported in that document, which is similar to findings during this RI investigation.

5.1.7 AoPI 9E – Cantonment Area

a. AoPI 9E is composed primarily of wooded State-owned property (see Exhibit 5-3). The PWS notes the 7.6-acre area is located just north of the former Range 7 firing point. Small arms have been reportedly found at the site.

b. The RI field investigation team traversed 0.21 acres of transects using mag-and-dig methods. No MEC or MD was discovered in the area investigated.

c. This area was included in the 1998 EE/CA; no items of note were reported in that document, which is similar to findings during this RI investigation.

5.1.8 AoPI 9G – Cantonment Area

a. AoPI 9G is an 6.6-acre area composed of private residential property in the PWS (see Exhibit 5-1). Based on anecdotal information provided by the public and the Spartanburg County Sheriff's Office and in agreement with the PDT, AoPI 9G was expanded to the east during the investigation design phase, to the MRS 3 boundary. This site is located north of the former Range 3 firing point. Since site closure, small arms and grenades have been reportedly found.

b. The RI field investigation team traversed 0.64 acres of transects using mag-and-dig methods along the southern extent of AoPI 9G and within the expanded area to the east. Based on findings during the transect investigation, three 50 ft by 50 ft grids were established and all anomalies were intrusively investigated. Various MD and MEC were discovered during the RI field investigations; those items are generally categorized as rockets and grenades, and include 2.36-inch fuzes, rockets, and warheads, M9 and M9A1 rifle grenades, and Mk II grenades. Numerous MD items (and hundreds of pounds of metal) were removed from the site and properly disposed. Three MEC items were detonated in place. Based on the substantial MEC and MD findings during the RI investigation, the expansion area to the east of AoPI 9G and a

portion of MRS 3 recommended for an IRA, which was conducted between May and July 2013, as described above in Section 5.1.3.0.4.

c. The northern portion of AoPI 9G was not accessible to the RI field investigation team, as rights-of-entry were not permitted. Thus, the potential source and receptor interaction in that area remains unclear.

d. This area was included in the 1998 EE/CA; no items of note were reported in that document. Anecdotal information has indicated the area just south of Dairy Ridge Road likely contained MEC and MD. The RI field investigations have corroborated that information.

5.1.9 AoPI 10A – Cantonment Area

a. AoPI 10A is a 171.5-acrea area composed of wooded State-owned and private residential property, located north of the former Range 10 and Range 11 firing points (see Exhibit 5-4). Numerous munitions items have been reported at this site since site closure; those include grenades, mortars, landmines, rockets, and small arms. This area is one of the eight areas containing MEC and/or very high MD concentrations that are directly accessible to humans, as mentioned in Section 5.1.3.0.3.

b. The RI field investigation team traversed 4.45 acres of transects using mag-and-dig methods. Based on MD findings during the transect investigation, eight 50 ft by 50 ft grids were established and all anomalies were intrusively investigated. No MEC was discovered during the RI field investigation. A total of 33 various MD were discovered during the RI field investigation; those items are generally categorized as rockets, grenades, landmines, mortars, projectiles, and undifferentiated MD. Specific examples of items found include parts of Mk II hand grenades, 2.36-inch rockets, and M1 landmines. The majority of the findings appear to be in the eastern half and southwestern corner of the AoPI.

c. This area was included in the 1998 EE/CA investigation. Findings reported in this RI investigation corroborate previous findings at this site.

5.1.10 AoPI 10B – Adjacent to Range Complex

a. AoPI 10B is a 33.6-acre area composed of partially-wooded State-owned property (see Exhibit 5-5). The site is located southwest of the former Range 2 firing point. Since site closure, small arms and 60mm mortars have been reported at this site.

b. The RI field investigation team traversed 0.27 acres of transects using mag-and-dig methods. Based on MD findings during the transect investigation, three 50 ft by 50 ft grids were established and all anomalies were intrusively investigated. No MEC was discovered during the RI field investigation. Various MD were discovered during the RI field investigation; those items are generally categorized as grenades, mortars, and undifferentiated MD. Specific examples of items found include pieces of Mk II hand grenades and 60mm/81mm HE mortars.

c. During the RI field investigation, the PDT recognized that MD found at AoPI 10B was similar to MEC and MD found several thousand feet immediately to the west in MRS 3 (Area Bravo). Suspecting that those items may exist in between the two areas (an area not originally planned for investigation), the PDT decided to extend transect lines in MRS 3 to the east, connecting those transects to transects in AoPI 10B. Findings for that expanded area are discussed above, with MRS 3. A total of 25 MD items were discovered in AoPI 10B.

d. This area was included in the 1998 EE/CA investigation. Findings reported in this RI investigation corroborate previous findings at this site.

5.1.11 AoPI 11B – Adjacent to Range Complex

a. AoPI 11B is composed of partially wooded private residential parcels (see Exhibit 5-5). The PWS notes the 34.7-acre area is located northwest of the former Range 2 firing point. Since site closure, only a small arms and grenade parts have been reported in this area.

b. The RI field investigation team traversed 0.61 acres of transects using mag-and-dig methods within residential property along the southern extent of AoPI 11B. This represents a portion of the planned activities as, rights-of-entry were denied by numerous property owners. Based on minimal MD findings during the transect investigation, one 50 ft by 50 ft grid was established and all anomalies were intrusively investigated. No MEC was discovered during the RI field investigation. One MD item, categorized as a grenade, was discovered. The potential source and receptor interaction remains unclear.

c. This area was included in the 1998 EE/CA; no items of note were reported in that document.

5.1.12 AoPI 11C – Cantonment Area

a. AoPI 11C is a 23-acre area composed of private residential and recreational property (see Exhibit 5-2). Areas adjacent to this AoPI that have undergone previous MEC removals were excluded from the acres investigated under this RI. The PWS-defined boundary may be improperly located. Based on findings during previous removal actions in OOU11C, the area of potential interest is to the east of both the PWS-defined boundary and the former removal action boundary. The site corresponds to the approximate location of gas chamber #4, based on historical photographic analysis. Munitions items discovered during previous investigations and removal actions include grenades and anti-tank mines.

b. The RI field investigation team traversed 0.13 acres of transects across the residential property using mag-and-dig methods. Based on minimal MD findings during the transect investigation, one 50 ft by 50 ft grid was established and all anomalies were intrusively investigated. The RI field investigation team collected digital geophysical data of 100% of the baseball fields located east of the residential property. No MEC was discovered during the RI field investigation. Three MD items from Mk II hand grenades were discovered near the baseball fields.

c. This area was included in the 1998 EE/CA investigation. Adjacent areas have been cleared during removal actions in 2010. Findings reported in this RI investigation corroborate previous findings at this site.

5.1.13 AoPI 11D – Cantonment Area

a. For this RI investigation, AoPI 11D is a 15.1-acre area located on a private golf course and an empty private property (see Exhibit 5-2). Since site closure, one grenade as well as several mortars have been reported to the local Sheriff.

b. The RI field investigation team traversed 0.21 acres of transects using mag-and-dig methods within residential property along the western and eastern extents of AoPI 11D. This represents a small fraction of the planned activities as, rights-of-entry were denied by property

owners. Six MD items, mortar fragmentation, were discovered in the southeastern corner of the area investigated. The potential source and receptor interaction remains unclear.

c. This area was included in the 1998 EE/CA; no items of note were reported in that document. However, the item discovered during this RI field investigation corroborates previous reports of mortar findings.

5.2 MUNITIONS CONSTITUENTS

a. Discrete surface soil samples, defined as 0-2 inches bgs, were collected from grids defined during the MEC investigation and determined to have a high density of anomalies. In addition, post-BIP composite surface soil samples were collected using CRREL's 7-point wheel method. Background samples were collected to determine chemical concentrations in soil from background locations (i.e., locations unaffected by historical munitions use). Sample locations, by hub # for grids, are shown on Exhibit 5-7 through Exhibit 5-13. For the former Camp Croft sites, constituent concentrations from chemical analyses will be compared to Resident Soil levels from EPA RSLs (EPA, November 2012). Sample results are reported in Tables 5-1 through 5-6.

b. Three of the 120 discrete surface soil samples collected during the initial sampling event, from 28-31 August 2012, exhibited detections of lead above the RSL of 400 mg/kg. The highest lead concentration was 1,080 mg/kg in sample CC-MRS3-ZSB-29 collected from grid MRS3-A as shown on Exhibit 5-11. Samples CC-MRS3-ZSB-101 and -102 (and its duplicate) had lead detections of 430 and 675 mg/kg. Both samples were collected from grid A4718 shown on Exhibit 5-12. Metals were detected in all soil samples collected, but none exceeded PALs. A single explosive was detected in one surface soil sample; PETN was detected in soil sample CC-MRS3-ZSB-18 collected from grid 12A-187 (Exhibit 5-6) at 1,240 µg/kg, below the RSL of 120,000 µg/kg. Samples results are reported in Tables 5-1 and 5-2.

c. Because lead was detected above its RSL in grids MRS3-A and A4718 in samples collected during August 2012, the areas surrounding these grids were investigated further for metals contamination. Ten additional surface soil samples were collected on 22 January 2013 guided by x-ray fluorescence (XRF) field testing for lead. One soil sample (CC-MRS-ZSB-PB05) was lost at the lab. Soil samples were analyzed for antimony, copper, and lead by Accutest Laboratory. XRF results were compared with laboratory results for lead and are shown on Exhibits 5-11 and 5-12. Analytical results from January 2013 again exhibited lead concentrations above the PAL. As shown in Table 5-2, surface soil samples CC-MRS3-ZSB-PB01 and -PB08 had lead levels of 461 and 2,320 mg/kg, respectively. CC-MRS3-ZSB-PB01 was collected from grid MRS3-A; CC-MRS3-ZSB-PB08 was collected approximately 80 feet south of grid A4718.

d. The area south of grid A4718 was again investigated on 27 February 2013. Additional XRF field testing was performed to guide sample collection. One surface soil sample was collected approximately 140 feet south of grid #A4718 and analyzed for lead. Lead was detected in surface soil sample CC-MRS3-ZSB-PB10 at a concentration of 337 of mg/kg, below the RSL of 400 mg/kg. Exhibit 5-12 presents all XRF results compared with laboratory results for lead for grid A4718.

e. Ten post-BIP soil samples were collected during this project. There was a detection of RDX in the BIP sample CC-12A-POSTZSB-2 at 117 µg/kg, below the RSL of 5,600 µg/kg.

There were no detections of metals above PALs in post-BIP samples. Post-BIP locations are shown on Exhibit 5-6 through Exhibit 5-10 and results are reported in Tables 5-3 and 5-4.

f. Ten background samples were collected and analyzed for explosives and metals. Analyses of background samples revealed no detections of explosives. Antimony, copper, lead, and zinc detections are significantly below PALs, indicating that background soil concentrations at the former Camp Croft do not take precedence as soil screening levels. Background soil sample results are reported in Tables 5-5 and 5-6. Background sample locations are shown on Exhibit 5-6 through Exhibit 5-10.

5.2.1 Summary of MC Contamination

a. Lead was the only MC detected above its RSL in surface soil samples collected from the former Camp Croft. These samples were collected from grids MRS3-A and A4718 located in MRS 3, as shown on Exhibit 5-6. As shown by subsequent samples and XRF field testing performed on samples collected from areas outside the grids, lead contamination appears to be localized and limited to these grids and the areas immediately surrounding them.

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Table 5-1: Soil Analytical Results for Explosives

Grid ID	Sample Name	Date	USEPA Method 8330A															
			1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
			99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PAL*		**2,200,00**	**6,100**	**19,000**	**1,600**	**61,000**	**150,000**	**150,000**	**3,800,000**	**6,100**	**4,800**	**6,100**	**2,900**	**120,000**	**30,000**	**5,600**	**240,000**
12A-196	CC-MRS3-ZSB-1	8/28/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	83 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-2	8/28/2012	70 U	70 U	70 U	85 U	76 U	70 U	70 U	70 U	70 U	81 U	440 U	70 U	440 U	88 U	70 U	70 U
	CC-MRS3-ZSB-3	8/28/2012	76 U	76 U	76 U	92 U	82 U	76 U	76 U	76 U	76 U	88 U	470 U	76 U	470 U	96 U	76 U	76 U
	CC-MRS3-DUP-1		77 U	77 U	77 U	94 U	84 U	77 U	77 U	77 U	77 U	90 U	480 U	77 U	480 U	98 U	77 U	77 U
	CC-MRS3-ZSB-4	8/28/2012	75 U	75 U	75 U	92 U	82 U	75 U	75 U	75 U	75 U	88 U	470 U	75 U	470 U	95 U	75 U	75 U
	CC-MRS3-ZSB-5	8/28/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	87 U	470 U	74 U	470 U	94 U	74 U	74 U
12A-205	CC-MRS3-ZSB-6	8/28/2012	71 U	71 U	71 U	86 U	77 U	71 U	71 U	71 U	71 U	83 U	440 U	71 U	440 U	90 U	71 U	71 U
	CC-MRS3-ZSB-7	8/28/2012	65 U	65 U	65 U	79 U	71 U	65 U	65 U	65 U	65 U	76 U	410 U	65 U	410 U	82 U	65 U	65 U
	CC-MRS3-DUP-2		61 U	61 U	61 U	74 U	66 U	61 U	61 U	61 U	61 U	71 U	380 U	61 U	380 U	77 U	61 U	61 U
	CC-MRS3-ZSB-8	8/28/2012	63 U	63 U	63 U	76 U	69 U	63 U	63 U	63 U	63 U	73 U	390 U	63 U	390 U	80 U	63 U	63 U
	CC-MRS3-ZSB-9	8/28/2012	58 U	58 U	58 U	71 U	63 U	58 U	58 U	58 U	58 U	68 U	360 U	58 U	360 U	73 U	58 U	58 U
	CC-MRS3-ZSB-10	8/28/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	94 U	74 U	74 U
MRS3-11369	CC-MRS3-ZSB-11	8/29/2012	78 U	78 U	78 U	94 U	84 U	78 U	78 U	78 U	78 U	90 U	490 U	78 U	490 U	98 U	78 U	78 U
	CC-MRS3-ZSB-12	8/29/2012	61 U	61 U	61 U	74 U	67 U	61 U	61 U	61 U	61 U	71 U	380 U	61 U	380 U	77 U	61 U	61 U
	CC-MRS3-DUP-3		74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	94 U	74 U	74 U
	CC-MRS3-ZSB-13	8/29/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	87 U	470 U	74 U	470 U	94 U	74 U	74 U
	CC-MRS3-ZSB-14	8/29/2012	63 U	63 U	63 U	76 U	68 U	63 U	63 U	63 U	63 U	73 U	390 U	63 U	390 U	79 U	63 U	63 U
	CC-MRS3-ZSB-15	8/29/2012	76 U	76 U	76 U	92 U	83 U	76 U	76 U	76 U	76 U	89 U	480 U	76 U	480 U	96 U	76 U	76 U
12A-187	CC-MRS3-ZSB-16	8/29/2012	80 U	80 U	80 U	97 U	87 U	80 U	80 U	80 U	80 U	93 U	500 U	80 U	500 U	100 U	80 U	80 U
	CC-MRS3-ZSB-17	8/29/2012	73 U	73 U	73 U	88 U	79 U	73 U	73 U	73 U	73 U	85 U	450 U	73 U	450 U	92 U	73 U	73 U
	CC-MRS3-ZSB-18	8/29/2012	61 U	61 U	61 U	74 U	66 U	61 U	61 U	61 U	61 U	71 U	380 U	61 U	**1,240**	77 U	61 U	61 U
	CC-MRS3-ZSB-19	8/29/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	74 U	400 U	64 U	400 U	81 U	64 U	64 U
	CC-MRS3-ZSB-20	8/29/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
MRS3-8944	CC-MRS3-ZSB-21	8/29/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
	CC-MRS3-ZSB-22	8/29/2012	75 U	75 U	75 U	92 U	82 U	75 U	75 U	75 U	75 U	88 U	470 U	75 U	470 U	95 U	75 U	75 U
	CC-MRS3-ZSB-23	8/29/2012	77 U	77 U	77 U	93 U	83 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
	CC-MRS3-ZSB-24	8/29/2012	69 U	69 U	69 U	83 U	75 U	69 U	69 U	69 U	69 U	80 U	430 U	69 U	430 U	87 U	69 U	69 U
	CC-MRS3-ZSB-25	8/29/2012	62 U	62 U	62 U	75 U	67 U	62 U	62 U	62 U	62 U	72 U	390 U	62 U	390 U	78 U	62 U	62 U

Table 5-1: Soil Analytical Results for Explosives

Grid ID	Sample Name	Date	USEPA Method 8330A														
			1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
			99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PAL*		780,000	6,100	19,000	1,600	61,000	150,000	150,000	3,800,000	6,100	4,800	6,100	2,900	120,000	30,000	5,600	150,000
MRS3-10450	CC-MRS3-ZSB-26	8/29/2012	78 U	78 U	78 U	95 U	85 U	78 U	78 U	78 U	78 U	91 U	490 U	78 U	490 U	99 U	78 U	78 U
	CC-MRS3-ZSB-27	8/29/2012	73 U	73 U	73 U	89 U	79 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	92 U	73 U	73 U
	CC-MRS3-ZSB-28	8/30/2012	65 U	65 U	65 U	79 U	71 U	65 U	65 U	65 U	65 U	76 U	410 U	65 U	410 U	82 U	65 U	65 U
#	CC-MRS3-ZSB-29	8/30/2012	75 U	75 U	75 U	91 U	82 U	75 U	75 U	75 U	75 U	87 U	470 U	75 U	470 U	95 U	75 U	75 U
#	CC-MRS3-ZSB-30	8/30/2012	58 U	58 U	58 U	70 U	63 U	58 U	58 U	58 U	58 U	67 U	360 U	58 U	360 U	73 U	58 U	58 U
MRS3-10085	CC-MRS3-ZSB-31	8/30/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	75 U	400 U	64 U	400 U	81 U	64 U	64 U
	CC-MRS3-ZSB-32	8/30/2012	60 U	60 U	60 U	73 U	65 U	60 U	60 U	60 U	60 U	70 U	370 U	60 U	370 U	76 U	60 U	60 U
	CC-MRS3-ZSB-33	8/30/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	94 U	74 U	74 U
	CC-MRS3-ZSB-34	8/30/2012	73 U	73 U	73 U	88 U	79 U	73 U	73 U	73 U	73 U	85 U	450 U	73 U	450 U	92 U	73 U	73 U
	CC-MRS3-ZSB-35	8/30/2012	73 U	73 U	73 U	89 U	79 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	92 U	73 U	73 U
	CC-MRS3-DUP-7		67 U	67 U	67 U	81 U	72 U	67 U	67 U	67 U	67 U	77 U	420 U	67 U	420 U	84 U	67 U	67 U
MRS3-9345	CC-MRS3-ZSB-36	8/30/2012	59 U	59 U	59 U	72 U	64 U	59 U	59 U	59 U	59 U	69 U	370 U	59 U	370 U	75 U	59 U	59 U
	CC-MRS3-ZSB-37	8/30/2012	71 U	71 U	71 U	87 U	78 U	71 U	71 U	71 U	71 U	83 U	450 U	71 U	450 U	90 U	71 U	71 U
	CC-MRS3-ZSB-38	8/30/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	83 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-39	8/30/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
	CC-MRS3-ZSB-40	8/30/2012	60 U	60 U	60 U	73 U	65 U	60 U	60 U	60 U	60 U	70 U	370 U	60 U	370 U	76 U	60 U	60 U
MRS3-9120	CC-MRS3-ZSB-41	8/30/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
	CC-MRS3-ZSB-42	8/30/2012	70 U	70 U	70 U	85 U	76 U	70 U	70 U	70 U	70 U	82 U	440 U	70 U	440 U	89 U	70 U	70 U
	CC-MRS3-ZSB-43	8/30/2012	63 U	63 U	63 U	77 U	69 U	63 U	63 U	63 U	63 U	74 U	400 U	63 U	400 U	80 U	63 U	63 U
	CC-MRS3-ZSB-44	8/30/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
	CC-MRS3-ZSB-45	8/30/2012	65 U	65 U	65 U	79 U	71 U	65 U	65 U	65 U	65 U	76 U	410 U	65 U	410 U	82 U	65 U	65 U
MRS3-8662	CC-MRS3-ZSB-46	8/30/2012	66 U	66 U	66 U	80 U	72 U	66 U	66 U	66 U	66 U	77 U	410 U	66 U	410 U	83 U	66 U	66 U
	CC-MRS3-DUP-8		72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	83 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-47	8/30/2012	77 U	77 U	77 U	93 U	83 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
	CC-MRS3-ZSB-48	8/30/2012	73 U	73 U	73 U	89 U	80 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	93 U	73 U	73 U
	CC-MRS3-ZSB-49	8/30/2012	66 U	66 U	66 U	80 U	72 U	66 U	66 U	66 U	66 U	77 U	410 U	66 U	410 U	83 U	66 U	66 U
	CC-MRS3-ZSB-50	8/30/2012	77 U	77 U	77 U	94 U	84 U	77 U	77 U	77 U	77 U	90 U	480 U	77 U	480 U	98 U	77 U	77 U

Table 5-1: Soil Analytical Results for Explosives

Grid ID	Sample Name	Date	USEPA Method 8330A														
			1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
			99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PAL*		**780,000**	**6,100**	**19,000**	**1,600**	**61,000**	**150,000**	**150,000**	**3,800,000**	**6,100**	**4,800**	**6,100**	**2,900**	**120,000**	**30,000**	**5,600**	**150,000**
MRS3-10762	CC-MRS3-ZSB-51	8/30/2012	73 U	73 U	73 U	89 U	79 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	92 U	73 U	73 U
	CC-MRS3-DUP-9		73 U	73 U	73 U	89 U	79 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	92 U	73 U	73 U
	CC-MRS3-ZSB-52	8/30/2012	75 U	75 U	75 U	91 U	81 U	75 U	75 U	75 U	75 U	87 U	470 U	75 U	470 U	94 U	75 U	75 U
	CC-MRS3-ZSB-53	8/30/2012	68 U	68 U	68 U	82 U	74 U	68 U	68 U	68 U	68 U	79 U	420 U	68 U	420 U	86 U	68 U	68 U
	CC-MRS3-ZSB-54	8/30/2012	77 U	77 U	77 U	93 U	83 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
	CC-MRS3-ZSB-55	8/30/2012	77 U	77 U	77 U	93 U	84 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
MRS3-10304	CC-MRS3-ZSB-56	8/30/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	83 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-57	8/30/2012	68 U	68 U	68 U	82 U	74 U	68 U	68 U	68 U	68 U	79 U	420 U	68 U	420 U	86 U	68 U	68 U
	CC-MRS3-DUP-10		76 U	76 U	76 U	92 U	83 U	76 U	76 U	76 U	76 U	89 U	480 U	76 U	480 U	96 U	76 U	76 U
	CC-MRS3-ZSB-58	8/30/2012	74 U	74 U	74 U	89 U	80 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	93 U	74 U	74 U
	CC-MRS3-ZSB-59	8/30/2012	70 U	70 U	70 U	85 U	76 U	70 U	70 U	70 U	70 U	81 U	440 U	70 U	440 U	88 U	70 U	70 U
	CC-MRS3-ZSB-60	8/30/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	84 U	450 U	72 U	450 U	91 U	72 U	72 U
MRS3-10292	CC-MRS3-ZSB-61	8/30/2012	72 U	72 U	72 U	88 U	79 U	72 U	72 U	72 U	72 U	84 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-62	8/30/2012	70 U	70 U	70 U	85 U	76 U	70 U	70 U	70 U	70 U	82 U	440 U	70 U	440 U	89 U	70 U	70 U
	CC-MRS3-ZSB-63	8/30/2012	62 U	62 U	62 U	75 U	67 U	62 U	62 U	62 U	62 U	72 U	390 U	62 U	390 U	78 U	62 U	62 U
	CC-MRS3-ZSB-64	8/30/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	75 U	400 U	64 U	400 U	81 U	64 U	64 U
	CC-MRS3-ZSB-65	8/30/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	75 U	400 U	64 U	400 U	81 U	64 U	64 U
MRS3-10216	CC-MRS3-ZSB-66	8/30/2012	79 U	79 U	79 U	96 U	86 U	79 U	79 U	79 U	79 U	92 U	490 U	79 U	490 U	100 U	79 U	79 U
	CC-MRS3-ZSB-67	8/30/2012	58 U	58 U	58 U	70 U	63 U	58 U	58 U	58 U	58 U	67 U	360 U	58 U	360 U	73 U	58 U	58 U
	CC-MRS3-ZSB-68	8/30/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	74 U	400 U	64 U	400 U	81 U	64 U	64 U
	CC-MRS3-ZSB-69	8/30/2012	61 U	61 U	61 U	73 U	66 U	61 U	61 U	61 U	61 U	70 U	380 U	61 U	380 U	77 U	61 U	61 U
	CC-MRS3-ZSB-70	8/30/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	83 U	450 U	72 U	450 U	91 U	72 U	72 U
MRS3-9928	CC-MRS3-ZSB-71	8/30/2012	69 U	69 U	69 U	84 U	75 U	69 U	69 U	69 U	69 U	80 U	430 U	69 U	430 U	87 U	69 U	69 U
	CC-MRS3-ZSB-72	8/30/2012	75 U	75 U	75 U	91 U	82 U	75 U	75 U	75 U	75 U	87 U	470 U	75 U	470 U	95 U	75 U	75 U
	CC-MRS3-ZSB-73	8/30/2012	76 U	76 U	76 U	92 U	83 U	76 U	76 U	76 U	76 U	89 U	480 U	76 U	480 U	96 U	76 U	76 U
	CC-MRS3-ZSB-74	10/9/2012	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	460 U	73 U	460 U	73 U	73 U	73 U
	CC-MRS3-ZSB-75	10/9/2012	61 U	61 U	61 U	61 U	61 U	61 U	61 U	61 U	61 U	61 U	380 U	61 U	380 U	61 U	61 U	61 U

Table 5-1: Soil Analytical Results for Explosives

Grid ID	Sample Name	Date	USEPA Method 8330A														
			1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
			99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PAL*		**780,000**	**6,100**	**19,000**	**1,600**	**61,000**	**150,000**	**150,000**	**3,800,000**	**6,100**	**4,800**	**6,100**	**2,900**	**120,000**	**30,000**	**5,600**	**150,000**
MRS3-9848	CC-MRS3-ZSB-76	10/9/2012	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	450 U	73 U	450 U	73 U	73 U	73 U
	CC-MRS3-ZSB-77	10/9/2012	72 U	72 U	72 U	72 U	72 U	72 U	72 U	72 U	72 U	72 U	450 U	72 U	450 U	72 U	72 U	72 U
	CC-MRS3-DUP-11		75 U	75 U	75 U	75 U	75 U	75 U	75 U	75 U	75 U	75 U	470 U	75 U	470 U	75 U	75 U	75 U
	CC-MRS3-ZSB-78	8/30/2012	69 U	69 U	69 U	84 U	75 U	69 U	69 U	69 U	69 U	81 U	430 U	69 U	430 U	87 U	69 U	69 U
	CC-MRS3-ZSB-79	8/30/2012	60 U	60 U	60 U	73 U	66 U	60 U	60 U	60 U	60 U	70 U	380 U	60 U	380 U	76 U	60 U	60 U
	CC-MRS3-ZSB-80	8/30/2012	65 U	65 U	65 U	78 U	70 U	65 U	65 U	65 U	65 U	75 U	400 U	65 U	400 U	81 U	65 U	65 U
10A-110	CC-MRS3-ZSB-81	8/31/2012	60 U	60 U	60 U	72 U	65 U	60 U	60 U	60 U	60 U	69 U	370 U	60 U	370 U	75 U	60 U	60 U
	CC-MRS3-ZSB-82	8/31/2012	70 U	70 U	70 U	84 U	76 U	70 U	70 U	70 U	70 U	81 U	430 U	70 U	430 U	88 U	70 U	70 U
	CC-MRS3-DUP-12		69 U	69 U	69 U	83 U	75 U	69 U	69 U	69 U	69 U	80 U	430 U	69 U	430 U	87 U	69 U	69 U
	CC-MRS3-ZSB-83	8/31/2012	78 U	78 U	78 U	95 U	85 U	78 U	78 U	200 U	78 U	91 U	490 U	78 U	490 U	99 U	78 U	78 U
	CC-MRS3-ZSB-84	8/31/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	74 U	400 U	64 U	400 U	81 U	64 U	64 U
	CC-MRS3-ZSB-85	8/31/2012	68 U	68 U	68 U	82 U	73 U	68 U	68 U	68 U	68 U	78 U	420 U	68 U	420 U	85 U	68 U	68 U
1A-949	CC-MRS3-ZSB-86	8/31/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	87 U	470 U	74 U	470 U	94 U	74 U	74 U
	CC-MRS3-DUP-13		74 U	74 U	74 U	89 U	80 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	93 U	74 U	74 U
	CC-MRS3-ZSB-87	8/31/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	84 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-88	8/31/2012	73 U	73 U	73 U	89 U	79 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	92 U	73 U	73 U
	CC-MRS3-ZSB-89	8/31/2012	73 U	73 U	73 U	89 U	80 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	93 U	73 U	73 U
	CC-MRS3-ZSB-90	8/31/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	75 U	400 U	64 U	400 U	81 U	64 U	64 U
1A-653	CC-MRS3-ZSB-91	8/31/2012	72 U	72 U	72 U	87 U	78 U	72 U	72 U	72 U	72 U	83 U	450 U	72 U	450 U	91 U	72 U	72 U
	CC-MRS3-ZSB-92	8/31/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	87 U	470 U	74 U	470 U	94 U	74 U	74 U
	CC-MRS3-ZSB-93	8/31/2012	70 U	70 U	70 U	85 U	76 U	70 U	70 U	70 U	70 U	82 U	440 U	70 U	440 U	89 U	70 U	70 U
	CC-MRS3-ZSB-94	8/31/2012	74 U	74 U	74 U	89 U	80 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	93 U	74 U	74 U
	CC-MRS3-ZSB-95	8/31/2012	66 U	66 U	66 U	80 U	72 U	66 U	66 U	66 U	66 U	77 U	410 U	66 U	410 U	83 U	66 U	66 U
1A-572	CC-MRS3-ZSB-96	8/31/2012	71 U	71 U	71 U	86 U	77 U	71 U	71 U	71 U	71 U	83 U	440 U	71 U	440 U	90 U	71 U	71 U
	CC-MRS3-ZSB-97	8/31/2012	71 U	71 U	71 U	87 U	78 U	71 U	71 U	71 U	71 U	83 U	450 U	71 U	450 U	90 U	71 U	71 U
	CC-MRS3-ZSB-98	8/31/2012	71 U	71 U	71 U	86 U	77 U	71 U	71 U	71 U	71 U	82 U	440 U	71 U	440 U	89 U	71 U	71 U
	CC-MRS3-ZSB-99	8/31/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	87 U	470 U	74 U	470 U	94 U	74 U	74 U
	CC-MRS3-ZSB-100	8/31/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	74 U	400 U	64 U	400 U	81 U	64 U	64 U

Table 5-1: Soil Analytical Results for Explosives

Grid ID	Sample Name	Date	USEPA Method 8330A														
			1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
			99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
	PAL*		**780,000**	**6,100**	**19,000**	**1,600**	**61,000**	**150,000**	**150,000**	**3,800,000**	**6,100**	**4,800**	**6,100**	**2,900**	**120,000**	**30,000**	**5,600**	**150,000**
A4718	CC-MRS3-ZSB-101	8/31/2012	77 U	77 U	77 U	93 U	84 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
	CC-MRS3-ZSB-102	8/31/2012	76 U	76 U	76 U	92 U	82 U	76 U	76 U	76 U	76 U	88 U	470 U	76 U	470 U	96 U	76 U	76 U
	CC-MRS3-DUP-14		65 U	65 U	65 U	79 U	71 U	65 U	65 U	65 U	65 U	76 U	410 U	65 U	410 U	82 U	65 U	65 U
	CC-MRS3-ZSB-103	8/31/2012	73 U	73 U	73 U	88 U	79 U	73 U	73 U	73 U	73 U	85 U	450 U	73 U	450 U	92 U	73 U	73 U
	CC-MRS3-ZSB-104	8/31/2012	68 U	68 U	68 U	82 U	74 U	68 U	68 U	68 U	68 U	79 U	420 U	68 U	420 U	86 U	68 U	68 U
	CC-MRS3-ZSB-105	8/31/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
1A-212	CC-MRS3-ZSB-106	8/31/2012	62 U	62 U	62 U	75 U	67 U	62 U	62 U	62 U	62 U	72 U	380 U	62 U	380 U	78 U	62 U	62 U
	CC-MRS3-ZSB-107	8/31/2012	65 U	65 U	65 U	78 U	70 U	65 U	65 U	65 U	65 U	75 U	400 U	65 U	400 U	81 U	65 U	65 U
	CC-MRS3-ZSB-108	8/31/2012	64 U	64 U	64 U	78 U	70 U	64 U	64 U	64 U	64 U	75 U	400 U	64 U	400 U	81 U	64 U	64 U
	CC-MRS3-ZSB-109	8/31/2012	65 U	65 U	65 U	79 U	71 U	65 U	65 U	65 U	65 U	76 U	410 U	65 U	410 U	82 U	65 U	65 U
	CC-MRS3-ZSB-110	8/31/2012	69 U	69 U	69 U	84 U	75 U	69 U	69 U	69 U	69 U	80 U	430 U	69 U	430 U	87 U	69 U	69 U
	CC-MRS3-DUP-15		60 U	60 U	60 U	73 U	65 U	60 U	60 U	60 U	60 U	70 U	380 U	60 U	380 U	76 U	60 U	60 U
1A-249	CC-MRS3-ZSB-111	8/31/2012	63 U	63 U	63 U	76 U	68 U	63 U	63 U	63 U	63 U	73 U	390 U	63 U	390 U	79 U	63 U	63 U
	CC-MRS3-ZSB-112	8/31/2012	68 U	68 U	68 U	82 U	73 U	68 U	68 U	68 U	68 U	78 U	420 U	68 U	420 U	85 U	68 U	68 U
	CC-MRS3-ZSB-113	8/31/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U
	CC-MRS3-ZSB-114	8/31/2012	77 U	77 U	77 U	93 U	83 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
	CC-MRS3-ZSB-115	8/31/2012	68 U	68 U	68 U	82 U	74 U	68 U	68 U	68 U	68 U	79 U	420 U	68 U	420 U	86 U	68 U	68 U
1A-368	CC-MRS3-ZSB-116	8/31/2012	77 U	77 U	77 U	93 U	83 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
	CC-MRS3-ZSB-117	8/31/2012	67 U	67 U	67 U	81 U	73 U	67 U	67 U	67 U	67 U	78 U	420 U	67 U	420 U	85 U	67 U	67 U
	CC-MRS3-ZSB-118	8/31/2012	73 U	73 U	73 U	89 U	79 U	73 U	73 U	73 U	73 U	85 U	460 U	73 U	460 U	92 U	73 U	73 U
	CC-MRS3-ZSB-119	8/31/2012	74 U	74 U	74 U	90 U	81 U	74 U	74 U	74 U	74 U	86 U	460 U	74 U	460 U	94 U	74 U	74 U
	CC-MRS3-ZSB-120	8/31/2012	62 U	62 U	62 U	75 U	67 U	62 U	62 U	62 U	62 U	72 U	390 U	62 U	390 U	78 U	62 U	62 U

CC-MRS3-ZSB-29 was collect at MRS3-B and CC-MRS3-ZSB-30 was collected at MRS3-A; both were single discrete samples rather than typical grid samples (i.e., five discrete samples per grid).
*PALs (Project Action Levels) are based on EPA Regional Screening Levels (RSLs), Residential Soil Screening Levels (SSLs), November 2012.
U – The analyte was not detected above the level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
Bolded values denote levels greater than Method Detection Limits (MDLs).
µg/kg = microgram per kilogram

Table 5-2: Soil Analytical Results for Metals

Grid ID	Sample Name	Date	USEPA Method 6020A			
			Antimony	Copper	Lead	Zinc
			7440-36-0	7440-50-8	7439-92-1	7440-66-6
			mg/kg	mg/kg	mg/kg	mg/kg
	PAL*		31	3,100	400	23,000
12A-196	CC-MRS3-ZSB-1	8/28/2012	**0.082 J**	**5.4**	**15.4**	**11.6**
	CC-MRS3-ZSB-2	8/28/2012	**0.077 J**	**4.5**	**11.2**	**10.4**
	CC-MRS3-ZSB-3	8/28/2012	**0.058 J**	**5**	**13.3**	**12**
	CC-MRS3-DUP-1		**0.068 J**	**5.8**	**13.9**	**13.4**
	CC-MRS3-ZSB-4	8/28/2012	**0.071 J**	**4**	**12.5**	**10.5**
	CC-MRS3-ZSB-5	8/28/2012	**0.07 J**	**4.1**	**10.1**	**9.4**
12A-205	CC-MRS3-ZSB-6	8/28/2012	**0.24 J**	**34.3**	**27.1**	**72.2**
	CC-MRS3-ZSB-7	8/28/2012	**0.33**	**128**	**92**	**164**
	CC-MRS3-DUP-2		**0.45**	**129**	**93.9**	**179**
	CC-MRS3-ZSB-8	8/28/2012	**0.75**	**86.9**	**63**	**117**
	CC-MRS3-ZSB-9	8/28/2012	**0.66**	**29.1**	**26.6**	**118**
	CC-MRS3-ZSB-10	8/28/2012	**0.16 J**	**40.6**	**33.5**	**86.5**
MRS3-11369	CC-MRS3-ZSB-11	8/29/2012	**0.12 J**	**3.9**	**20.1**	**23.5**
	CC-MRS3-ZSB-12	8/29/2012	**0.097 J**	**1.9**	**11.6**	**11.1**
	CC-MRS3-DUP-3		**0.091 J**	**2.1**	**14.6**	**11.5**
	CC-MRS3-ZSB-13	8/29/2012	**0.099 J**	**6.8**	**12.8**	**17.1**
	CC-MRS3-ZSB-14	8/29/2012	**0.069 J**	**2.7**	**12.8**	**12**
	CC-MRS3-ZSB-15	8/29/2012	**0.074 J**	**2.9**	**11.7**	**13.3**
12A-187	CC-MRS3-ZSB-16	8/29/2012	**0.11**	**13.2**	**8.2**	**17.9**
	CC-MRS3-ZSB-17	8/29/2012	**0.062 J**	**61.6**	**7**	**14.9**
	CC-MRS3-ZSB-18	8/29/2012	**0.13 J**	**87.3**	**14.7**	**27.2**
	CC-MRS3-ZSB-19	8/29/2012	**0.059 J**	**32.2**	**7.6**	**17.6**
	CC-MRS3-ZSB-20	8/29/2012	**0.18 J**	**3.4**	**2.3**	**13.4**
MRS3-8944	CC-MRS3-ZSB-21	8/29/2012	**0.11 J**	**3.5**	**14.1**	**15.3**
	CC-MRS3-ZSB-22	8/29/2012	**0.13 J**	**7.6**	**15.1**	**29.5**
	CC-MRS3-ZSB-23	8/29/2012	**0.098 J**	**13.4**	**24**	**38.4**
	CC-MRS3-ZSB-24	8/29/2012	**0.07 J**	**5.2**	**13.9**	**18.1**
	CC-MRS3-ZSB-25	8/29/2012	**0.069 J**	**7.9**	**15**	**26.9**
MRS3-10450	CC-MRS3-ZSB-26	8/29/2012	**0.72**	**28.3**	**76.1**	**30.4**
	CC-MRS3-ZSB-27	8/29/2012	**1.2**	**30.2**	**119**	**36.1**
	CC-MRS3-ZSB-28	8/30/2012	**0.4**	**10.4**	**46.8**	**23.9**

Table 5-2: Soil Analytical Results for Metals						
Grid ID	**Sample Name**	**Date**	**USEPA Method 6020A**			
			Antimony	**Copper**	**Lead**	**Zinc**
			7440-36-0	**7440-50-8**	**7439-92-1**	**7440-66-6**
			mg/kg	**mg/kg**	**mg/kg**	**mg/kg**
	PAL*		**31**	**3,100**	**400**	**23,000**
#	CC-MRS3-ZSB-29	8/30/2012	**3**	**255**	**1,080**	**53.8**
#	CC-MRS3-ZSB-30	8/30/2012	**0.98**	**100**	**244**	**47**
MRS3-10085	CC-MRS3-ZSB-31	8/30/2012	0.019 U	**3**	**8.7**	**22.4**
	CC-MRS3-ZSB-32	8/30/2012	**0.089 J**	**5.9**	**14.9**	**42.5**
	CC-MRS3-ZSB-33	8/30/2012	**0.059 J**	**3.5**	**11.7**	**23.5**
	CC-MRS3-ZSB-34	8/30/2012	**0.19 J**	**80**	**48.7**	**46.4**
	CC-MRS3-ZSB-35	8/30/2012	**0.12 J**	**4**	**21.7**	**26.3**
	CC-MRS3-DUP-7		**0.12 J**	**4.5**	**11**	**35.5**
MRS3-9345	CC-MRS3-ZSB-36	8/30/2012	**0.086 J**	**7.8**	**24.3**	**41.1**
	CC-MRS3-ZSB-37	8/30/2012	**0.14 J**	**10.6**	**36.6**	**43.9**
	CC-MRS3-ZSB-38	8/30/2012	**0.086 J**	**8.2**	**20.7**	**42.4**
	CC-MRS3-ZSB-39	8/30/2012	**0.12 J**	**8.8**	**26.9**	**50.9**
	CC-MRS3-ZSB-40	8/30/2012	**0.07 J**	**20.8**	**21.7**	**25.2**
MRS3-9120	CC-MRS3-ZSB-41	8/30/2012	**0.077 J**	**8.5**	**20.4**	**57.9**
	CC-MRS3-ZSB-42	8/30/2012	**0.27 J**	**23.6**	**30.8**	**33.6**
	CC-MRS3-ZSB-43	8/30/2012	**0.22 J**	**35.4**	**48.2**	**54.8**
	CC-MRS3-ZSB-44	8/30/2012	**0.18 J**	**21.6**	**13.5**	**41.2**
	CC-MRS3-ZSB-45	8/30/2012	**0.18 J**	**31.7**	**31.8**	**70.6**
MRS3-8662	CC-MRS3-ZSB-46	8/30/2012	**0.084 J**	**9.3**	**15.3**	**29.5**
	CC-MRS3-DUP-8		**0.05 J**	**6.5**	**12.6**	**24.8**
	CC-MRS3-ZSB-47	8/30/2012	**0.051 J**	**8.7**	**16.2**	**26.5**
	CC-MRS3-ZSB-48	8/30/2012	**0.038 J**	**11.1**	**12.4**	**30.6**
	CC-MRS3-ZSB-49	8/30/2012	**0.068 J**	**15.6**	**24.9**	**39.4**
	CC-MRS3-ZSB-50	8/30/2012	**0.063 J**	**11.5**	**15.8**	**33.1**
MRS3-10762	CC-MRS3-ZSB-51	8/30/2012	**0.19 J**	**18.5**	**27.4**	**25.7**
	CC-MRS3-DUP-9		**0.33**	**22.9**	**32.5**	**26.2**
	CC-MRS3-ZSB-52	8/30/2012	**0.17 J**	**18.8**	**23.4**	**47.2**
	CC-MRS3-ZSB-53	8/30/2012	**0.094 J**	**10.5**	**27.1**	**51.6**
	CC-MRS3-ZSB-54	8/30/2012	**0.07 J**	**7.7**	**13**	**10.6**
	CC-MRS3-ZSB-55	8/30/2012	**0.18 J**	**18.2**	**27.6**	**20.9**

Table 5-2: Soil Analytical Results for Metals						
Grid ID	**Sample Name**	**Date**	**USEPA Method 6020A**			
			Antimony	**Copper**	**Lead**	**Zinc**
			7440-36-0	**7440-50-8**	**7439-92-1**	**7440-66-6**
			mg/kg	**mg/kg**	**mg/kg**	**mg/kg**
	PAL*		**31**	**3,100**	**400**	**23,000**
MRS3-10304	CC-MRS3-ZSB-56	8/30/2012	**0.19 J**	**49**	**13.5**	**69.3**
	CC-MRS3-ZSB-57	8/30/2012	**0.15 J**	**28.5**	**14.2**	**35.7**
	CC-MRS3-DUP-10		**0.12 J**	**24.7**	**12.7**	**42.6**
	CC-MRS3-ZSB-58	8/30/2012	**0.051 J**	**5.2**	**11.2**	**42.4**
	CC-MRS3-ZSB-59	8/30/2012	**0.19 J**	**34.7**	**20.8**	**55.4**
	CC-MRS3-ZSB-60	8/30/2012	**0.13 J**	**21.6**	**20.7**	**44.9**
MRS3-10292	CC-MRS3-ZSB-61	8/30/2012	**0.084 J**	**15.7**	**17.2**	**31.1**
	CC-MRS3-ZSB-62	8/30/2012	**0.089 J**	**11.1**	**11.2**	**22.9**
	CC-MRS3-ZSB-63	8/30/2012	**0.2 J**	**30.7**	**13.6**	**1680**
	CC-MRS3-ZSB-64	8/30/2012	**0.059 J**	**15.6**	**11.9**	**19.9**
	CC-MRS3-ZSB-65	8/30/2012	**0.093 J**	**15.6**	**16.2**	**24.5**
MRS3-10216	CC-MRS3-ZSB-66	8/30/2012	**0.15 J**	**22.8**	**14**	**35.4**
	CC-MRS3-ZSB-67	8/30/2012	**0.12 J**	**22.5**	**14.6**	**39.1**
	CC-MRS3-ZSB-68	8/30/2012	**0.24 J**	**10.1**	**14.5**	**14.3**
	CC-MRS3-ZSB-69	8/30/2012	**0.27 J**	**28.7**	**18.3**	**37.6**
	CC-MRS3-ZSB-70	8/30/2012	**0.14 J**	**11.3**	**16.3**	**21**
MRS3-9928	CC-MRS3-ZSB-71	8/30/2012	**0.094 J**	**22.2**	**46.2**	**14.2**
	CC-MRS3-ZSB-72	8/30/2012	**0.068 J**	**4.1**	**10.7**	**10.7**
	CC-MRS3-ZSB-73	8/30/2012	**0.06 J**	**5**	**8.3**	**15.5**
	CC-MRS3-ZSB-74	8/30/2012	**0.12 J**	**6**	**23.5**	**14**
	CC-MRS3-ZSB-75	8/30/2012	**0.15 J**	**14.8**	**15.7**	**21.4**
MRS3-9848	CC-MRS3-ZSB-76	8/30/2012	**0.12 J**	**8.9**	**38.6**	**9.5**
	CC-MRS3-ZSB-77	8/30/2012	**0.13 J**	**6.1**	**15.6**	**14.6**
	CC-MRS3-ZSB-78	8/30/2012	0.018 U	**3**	**8.4**	**7.9**
	CC-MRS3-DUP-11		**0.11 J**	**4.3**	**16.3**	**10.7**
	CC-MRS3-ZSB-79	8/30/2012	0.018 U	**3.4**	**14.5**	**9**
	CC-MRS3-ZSB-80	8/30/2012	**0.12 J**	**5.3**	**32.9**	**13.9**

Table 5-2: Soil Analytical Results for Metals						
Grid ID	Sample Name	Date	USEPA Method 6020A			
			Antimony	Copper	Lead	Zinc
			7440-36-0	7440-50-8	7439-92-1	7440-66-6
			mg/kg	mg/kg	mg/kg	mg/kg
	PAL*		31	3,100	400	23,000
10A-110	CC-MRS3-ZSB-81	8/31/2012	**0.051 J**	**4.7**	**7.3**	**31**
	CC-MRS3-ZSB-82	8/31/2012	**0.13 J**	**32.6**	**21.3**	**26.6**
	CC-MRS3-DUP-12		**0.14 J**	**30.8**	**22.9**	**23.4**
	CC-MRS3-ZSB-83	8/31/2012	**0.058 J**	**9.7**	**10.3**	**13.5**
	CC-MRS3-ZSB-84	8/31/2012	**0.13 J**	**18.9**	**20.8**	**38.6**
	CC-MRS3-ZSB-85	8/31/2012	**0.057 J**	**6.9**	**12.2**	**10.5**
1A-949	CC-MRS3-ZSB-86	8/31/2012	**0.16 J**	**18.8**	**23.1**	**31.2**
	CC-MRS3-DUP-13		**0.11 J**	**14.9**	**11.7**	**22.3**
	CC-MRS3-ZSB-87	8/31/2012	**0.1 J**	**41.1**	**26**	**45.9**
	CC-MRS3-ZSB-88	8/31/2012	**0.14 J**	**43.6**	**34.1**	**61.9**
	CC-MRS3-ZSB-89	8/31/2012	**0.067 J**	**9.9**	**6.3**	**27.3**
	CC-MRS3-ZSB-90	8/31/2012	**0.11 J**	**37.3**	**21.1**	**54.3**
1A-653	CC-MRS3-ZSB-91	8/31/2012	**0.066 J**	**9.5**	**30.5**	**14.8**
	CC-MRS3-ZSB-92	8/31/2012	**0.057 J**	**13.3**	**16.6**	**22.3**
	CC-MRS3-ZSB-93	8/31/2012	**0.15 J**	**22.9**	**22.9**	**24.4**
	CC-MRS3-ZSB-94	8/31/2012	**0.31**	**8.2**	**14.3**	**19.7**
	CC-MRS3-ZSB-95	8/31/2012	**0.031 J**	**10.7**	**8.1**	**20**
1A-572	CC-MRS3-ZSB-96	8/31/2012	**0.14 J**	**23.9**	**13.4**	**30.3**
	CC-MRS3-ZSB-97	8/31/2012	**0.28 J**	**14.8**	**12**	**21.1**
	CC-MRS3-ZSB-98	8/31/2012	**0.058 J**	**16.3**	**12.3**	**23.2**
	CC-MRS3-ZSB-99	8/31/2012	**0.028 J**	**5.5**	**4.3**	**32.1**
	CC-MRS3-ZSB-100	8/31/2012	**0.067 J**	**8**	**8.9**	**13.4**
A4718	CC-MRS3-ZSB-101	8/31/2012	**0.94**	**43.3**	**430**	**68.5**
	CC-MRS3-ZSB-102	8/31/2012	**1.1**	**48.7**	**675**	**92**
	CC-MRS3-DUP-14		**1.1**	**47.3**	**504**	**87.2**
	CC-MRS3-ZSB-103	8/31/2012	**1.1**	**44.5**	**327**	**65.1**
	CC-MRS3-ZSB-104	8/31/2012	**1**	**45.6**	**382**	**98.2**
	CC-MRS3-ZSB-105	8/31/2012	**1**	**37.9**	**296**	**63**

Table 5-2: Soil Analytical Results for Metals

Grid ID	Sample Name	Date	USEPA Method 6020A			
			Antimony	Copper	Lead	Zinc
			7440-36-0	7440-50-8	7439-92-1	7440-66-6
			mg/kg	mg/kg	mg/kg	mg/kg
	PAL*		31	3,100	400	23,000
1A-212	CC-MRS3-ZSB-106	8/31/2012	**0.079 J**	**7.2**	**44.1**	**24.5**
	CC-MRS3-ZSB-107	8/31/2012	**0.21 J**	**8.8**	**70.1**	**30.8**
	CC-MRS3-ZSB-108	8/31/2012	**0.8**	**46.2**	**276**	**62.6**
	CC-MRS3-ZSB-109	8/31/2012	**0.52**	**18.2**	**129**	**28**
	CC-MRS3-ZSB-110	8/31/2012	**0.058 J**	**8.6**	**9.6**	**18.1**
	CC-MRS3-DUP-15		**0.075**	**10.9**	**14.9**	**23.9**
1A-249	CC-MRS3-ZSB-111	8/31/2012	**0.21 J**	**23.9**	**13**	**24.6**
	CC-MRS3-ZSB-112	8/31/2012	**0.06 J**	**34.6**	**10.6**	**32.2**
	CC-MRS3-ZSB-113	8/31/2012	**0.17 J**	**137**	**32**	**62**
	CC-MRS3-ZSB-114	8/31/2012	**0.081 J**	**35.6**	**17.1**	**32.5**
	CC-MRS3-ZSB-115	8/31/2012	**0.14 J**	**18.4**	**10.8**	**26.9**
1A-368	CC-MRS3-ZSB-116	8/31/2012	**0.33**	**19.8**	**10.3**	**32.9**
	CC-MRS3-ZSB-117	8/31/2012	**0.14 J**	**26.6**	**12.6**	**64.3**
	CC-MRS3-ZSB-118	8/31/2012	**0.077 J**	**12.2**	**15.4**	**35.2**
	CC-MRS3-ZSB-119	8/31/2012	**0.083 J**	**28.8**	**14.8**	**74.5**
	CC-MRS3-ZSB-120	8/31/2012	**0.036 J**	**18.4**	**7.9**	**44.5**
MRS3-A/B	CC-MRS-ZSB-PB01	1/22/2013	**1.2**	**306**	**461**	**NA**
	CC-MRS-ZSB-PB02	1/22/2013	**0.63**	**39.6**	**95.3**	**NA**
	CC-MRS-ZSB-PB03	1/22/2013	**0.65**	**21.5**	**294**	**NA**
	CC-MRS-ZSB-PB04	1/22/2013	**1.6**	**129**	**395**	**NA**
	CC-MRS-ZSB-PB05	1/22/2013	**Sample lost at lab**			
A4718	CC-MRS-ZSB-PB06	1/22/2013	**0.5**	**50.6**	**154**	**NA**
	CC-MRS-ZSB-PB07	1/22/2013	**0.67**	**21.4**	**183**	**NA**
	CC-MRS-ZSB-PB08	1/22/2013	**5.4**	**165**	**2,320**	**NA**
	CC-MRS-ZSB-PB09	1/22/2013	**1.0**	**94.7**	**317**	**NA**
	CC-MRS-ZSB-PB10	2/27/2013	**NA**	**NA**	**337**	**NA**

CC-MRS3-ZSB-29 was collect at MRS3-B and CC-MRS3-ZSB-30 was collected at MRS3-A; both were single discrete samples rather than typical grid samples (i.e., five discrete samples per grid).

*PALs (Project Action Levels) are based on EPA Regional Screening Levels (RSLs), Residential Soil Screening Levels (SSLs), November 2012.

U – The analyte was not detected above the level of the reported sample quantitation limit.

J – The result is an estimated quantity. The associated numerical value is an approximate concentration.

Bolded values denote levels greater than Method Detection Limits (MDLs).

Shaded and **bolded** values denote levels greater than PALs.

mg/kg = milligram per kilogram

NA – Not Analyzed

Table 5-3: Soil Analytical Results for Explosives Post-BIP

Sample ID	Date	US EPA Method 8330A														
		1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
		99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PAL*		**780,000**	**6,100**	**19,000**	**1,600**	**61,000**	**150,000**	**150,000**	**3,800,000**	**6,100**	**4,800**	**6,100**	**2,900**	**120,000**	**30,000**	**5,600**	**150,000**
CC-12A-POSTZSB-1	4/9/2012	77 U	77 U	77 U	93 U	84 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	190 U	77 U
CC-12A-POSTZSB-2	4/10/2012	77 U	77 U	77 U	93 U	84 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	**117**	77 U
CC-12A-POSTZSB-3	4/17/2012	65 U	65 U	65 U	78 U	70 U	65 U	65 U	65 U	65 U	75 U	400 U	65 U	400 U	81 U	65 U	65 U
CC-12A-POSTZSB-4	4/17/2012	60 U	60 U	60 U	73 U	65 U	60 U	60 U	60 U	60 U	70 U	380 U	60 U	380 U	76 U	60 U	60 U
CC-12A-POSTZSB-5	4/17/2012	63 U	63 U	63 U	77 U	69 U	63 U	63 U	63 U	63 U	74 U	400 U	63 U	400 U	80 U	63 U	63 U
CC-MRS3-POSTZSB-1	3/29/2012	78 U	78 U	78 U	95 U	85 U	78 U	78 U	78 U	78 U	91 U	490 U	78 U	490 U	99 U	78 U	78 U
CC-MRS3-POSTZSB-2	3/29/2012	78 U	78 U	78 U	94 U	84 U	78 U	78 U	78 U	78 U	90 U	490 U	78 U	490 U	98 U	78 U	78 U
CC-MRS3-POSTZSB-3	3/29/2012	77 U	77 U	77 U	93 U	83 U	77 U	77 U	77 U	77 U	89 U	480 U	77 U	480 U	97 U	77 U	77 U
CC-MRS3-POSTZSB-7	8/10/2012	67 U	67 U	67 U	82 U	73 U	67 U	67 U	67 U	67 U	78 U	420 U	67 U	420 U	85 U	67 U	67 U
CC-MRS3-POSTZSB-8	8/10/2012	63 U	63 U	63 U	77 U	69 U	63 U	63 U	63 U	63 U	74 U	400 U	63 U	400 U	80 U	63 U	63 U
CC-MRS3-POSTZSB-9	8/10/2012	65 U	65 U	65 U	79 U	71 U	65 U	65 U	65 U	65 U	76 U	410 U	65 U	410 U	82 U	65 U	65 U
CC-MRS3-POSTZSB-10	8/10/2012	68 U	68 U	68 U	83 U	74 U	68 U	68 U	68 U	68 U	79 U	430 U	68 U	430 U	86 U	68 U	68 U

*PALs (Project Action Levels) are based on EPA Regional Screening Levels (RSLs), Residential Soil Screening Levels (SSLs), November 2012.
U – The analyte was not detected above the level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
Bolded values denote levels greater than Method Detection Limits (MDLs).
µg/kg = microgram per kilogram

Table 5-4: Soil Analytical Results for Metals Post-BIP

Sample ID	Date	USEPA Method 6020A			
		Antimony	Copper	Lead	Zinc
		7440-36-0	7440-50-8	7439-92-1	7440-66-6
		mg/kg	mg/kg	mg/kg	mg/kg
PAL*		31	3,100	400	23,000
CC-12A-POSTZSB-1	4/9/2012	**0.25 J**	**735**	**174**	**30.5**
CC-12A-POSTZSB-2	4/10/2012	**0.15 J**	**38.5**	**28**	**20.1**
CC-12A-POSTZSB-3	4/17/2012	**0.21 J**	**70.1**	**126**	**97.6**
CC-12A-POSTZSB-4	4/17/2012	**0.1 J**	**84.4**	**25.4**	**14.4**
CC-12A-POSTZSB-5	4/17/2012	**0.097 J**	**53.9**	**26.5**	**20.5**
CC-MRS3-POSTZSB-1	3/29/2012	**0.32**	**20.8**	**15.9**	**27.9**
CC-MRS3-POSTZSB-2	3/29/2012	**0.31 J**	**58.2**	**25.9**	**26.5**
CC-MRS3-POSTZSB-3	3/29/2012	**0.28 J**	**349**	**99**	**25.8**
CC-MRS3-POSTZSB-7	8/10/2012	**0.2 J**	**486**	**198**	**21.6**
CC-MRS3-POSTZSB-8	8/10/2012	**0.065**	**110**	**22.9**	**14.5**
CC-MRS3-POSTZSB-9	8/10/2012	**0.075 J**	**15.3**	**14.3**	**22.4**
CC-MRS3-POSTZSB-10	8/10/2012	**0.18 J**	**787**	**163**	**20**

*PALs (Project Action Levels) are based on EPA Regional Screening Levels, Residential Soil Screening Levels (SSLs), November 2012.

U – The analyte was not detected above the level of the reported sample quantitation limit.

J – The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Bolded values denote levels greater than Method Detection Limits (MDLs).

mg/kg = milligram per kilogram

Table 5-5: Soil Analytical Results for Explosives Background Samples

Sample ID	Date	USEPA Method 8330A														
		1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-amino-4,6-Dinitrotoluene	4-amino-2,6-Dinitrotoluene	HMX	m-Nitrotoluene	Nitrobenzene	Nitroglycerine	o-Nitrotoluene	PETN	p-Nitrotoluene	RDX	Tetryl
		99-35-4	99-65-0	118-96-7	121-14-2	606-20-2	35572-78-2	19406-51-0	2691-41-0	99-08-1	98-95-3	55-63-0	88-72-2	78-11-5	99-99-0	121-82-4	479-45-8
		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PAL*		**780,000**	**6,100**	**19,000**	**1,600**	**61,000**	**150,000**	**150,000**	**3,800,000**	**6,100**	**4,800**	**6,100**	**2,900**	**120,000**	**30,000**	**5,600**	**150,000**
CC-BKGD-ZSB-1	10/9/2012	66 U	66 U	66 U	66 U	66 U	66 U	66 U	66 U	66 U	66 U	410 U	66 U	410 U	66 U	66 U	66 U
CC-BKGD-ZSB-2	10/9/2012	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	70 U	440 U	70 U	440 U	70 U	70 U	70 U
CC-BKGD-ZSB-3	10/9/2012	72 U	72 U	72 U	72 U	72 U	72 U	72 U	72 U	72 U	72 U	450 U	72 U	450 U	72 U	72 U	72 U
CC-BKGD-ZSB-4	10/9/2012	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	430 U	69 U	430 U	69 U	69 U	69 U
CC-BKGD-ZSB-5	10/9/2012	62 U	62 U	62 U	62 U	62 U	62 U	62 U	62 U	62 U	62 U	390 U	62 U	390 U	62 U	62 U	62 U
CC-BKGD-DUP-ZSB-1		65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	400 U	65 U	400 U	65 U	65 U	65 U
CC-BKGD-ZSB-6	10/9/2012	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	410 U	65 U	410 U	65 U	65 U	65 U
CC-BKGD-ZSB-7	10/9/2012	67 U	67 U	67 U	67 U	67 U	67 U	67 U	67 U	67 U	67 U	420 U	67 U	420 U	67 U	67 U	67 U
CC-BKGD-ZSB-8	10/9/2012	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U	440 U	71 U	440 U	71 U	71 U	71 U
CC-BKGD-ZSB-9	10/9/2012	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	65 U	410 U	65 U	410 U	65 U	65 U	65 U
CC-BKGD-ZSB-10	10/9/2012	63 U	63 U	63 U	63 U	63 U	63 U	63 U	63 U	63 U	63 U	400 U	63 U	400 U	63 U	63 U	63 U

*PALs (Project Action Levels) are based on EPA Regional Screening Levels (RSLs), Residential Soil Screening Levels (SSLs), November 2012.
U – The analyte was not detected above the level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
µg/kg = microgram per kilogram

Table 5-6: Soil Analytical Results for Metals Background Samples

Sample ID	Date	USEPA Method 6020A			
		Antimony	Copper	Lead	Zinc
		7440-36-0	7440-50-8	7439-92-1	7440-66-6
		mg/kg	mg/kg	mg/kg	mg/kg
PAL*		**31**	**3,100**	**400**	**23,000**
CC-BKGD-ZSB-1	10/9/2012	**0.036 J**	**11.5**	**7.9**	**12**
CC-BKGD-ZSB-2	10/9/2012	**0.028 J**	**9.5**	**16.6**	**30.7**
CC-BKGD-ZSB-3	10/9/2012	**0.038 J**	**6.6**	**21.5**	**24.8**
CC-BKGD-ZSB-4	10/9/2012	**0.25 J**	**17.5**	**56.8**	**123**
CC-BKGD-ZSB-5	10/9/2012	**0.083**	**16.1**	**26.5**	**40.5**
CC-BKGD-DUP-ZSB-1		**0.085 J**	**16**	**25.6**	**42.6**
CC-BKGD-ZSB-6	10/9/2012	**0.57**	**27.8**	**43.4**	**127**
CC-BKGD-ZSB-7	10/9/2012	**0.064**	**11.5**	**40**	**56.9**
CC-BKGD-ZSB-8	10/9/2012	**0.098 J**	**17.3**	**125**	**92.2**
CC-BKGD-ZSB-9	10/9/2012	0.023 U	**22.5**	**21.2**	**105**
CC-BKGD-ZSB-10	10/9/2012	**0.4**	**25.7**	**27**	**159**

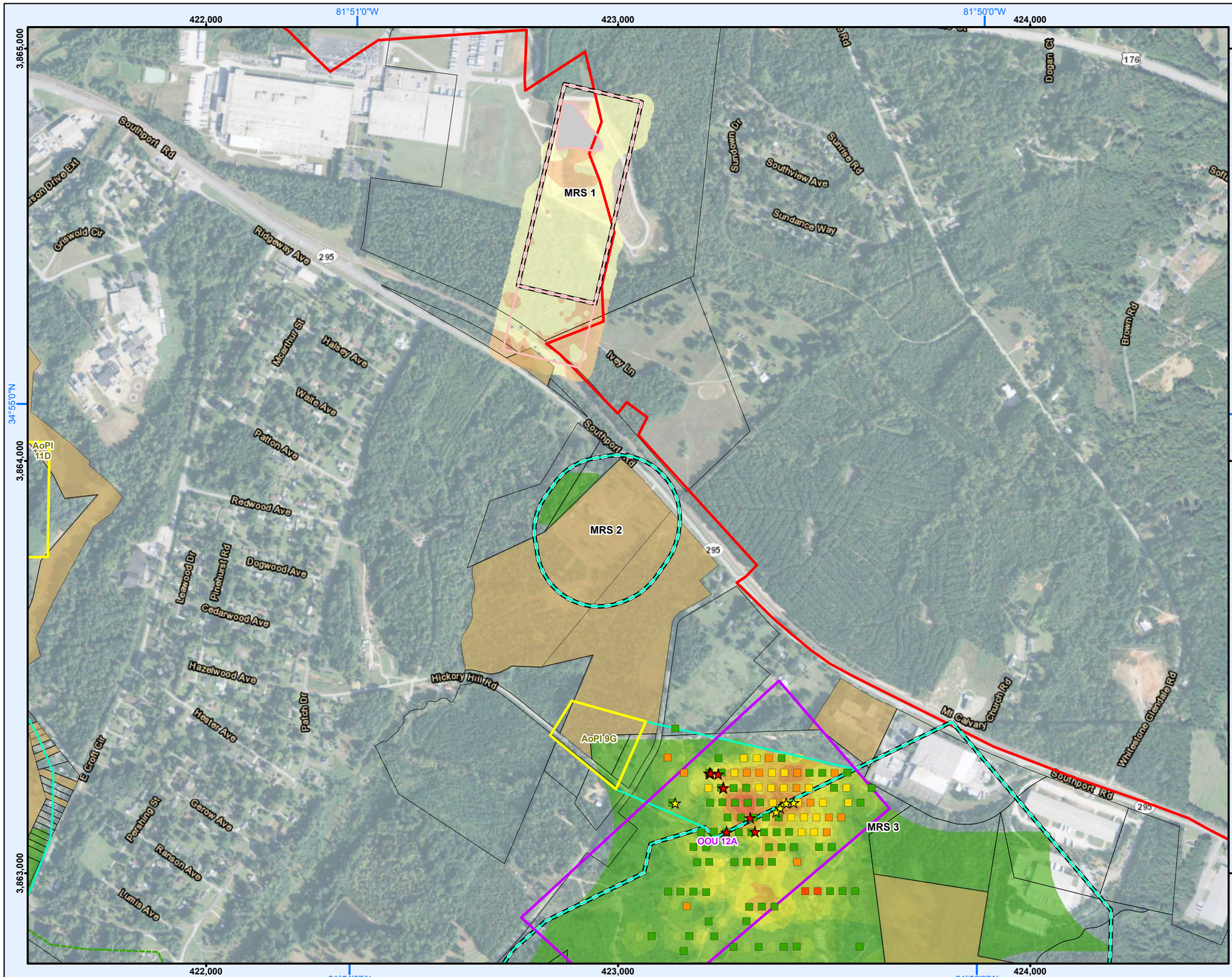
*PALs (Project Action Levels) are based on EPA Regional Screening Levels (RSLs), Residential Soil Screening Levels (SSLs), November 2012.

U – The analyte was not detected above the level of the reported sample quantitation limit.

J – The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

Bolded values denote levels greater than Method Detection Limits (MDLs).

mg/kg = milligram per kilogram



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MEC & MD Findings - MRS 1, MRS 2, AOPI 9G
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-1

KEY

- UXO, 2.36 in Rocket
- UXO, Grenade
- Grenade MD
- Grenade / Rocket MD
- Rocket MD
- Rocket / Mortar MD
- Former OOU
- PWS-Defined Area of Potential Interest
- AIR
- Mag & Dig
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel
- Inaccessible Area

AIR Interpolation
Anom / Acre

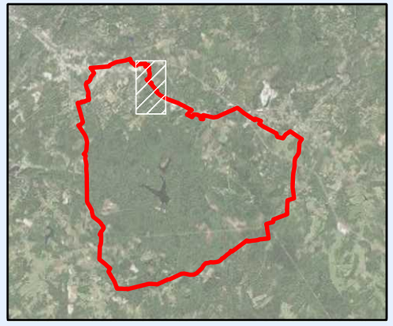
- 0
- 0.1 - 10
- 10.1 - 50
- 50.1 - 100
- 100.1 - 500
- 500.1 - 1,000
- 1,000.1 - 10,000
- 10,000.1 - 20,000
- 20,000.1 - 31,322.9

Mag & Dig Interpolation
MD / Acre

- 0
- 0.1 - 100
- 100.1 - 200
- 200.1 - 500
- 500.1 - 1,000
- 1,000.1 - 2,000
- 2,000.1 - 5,000
- 5,000.1 - 10,000
- 10,000.1 - 23,812.9

N W E S

0 375 750 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 750 '	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MEC & MD Findings - AOPI 3, 11C, 11D
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-2

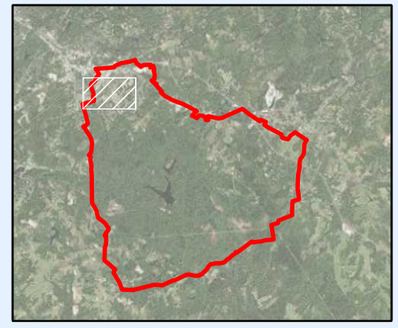
KEY

- Grenade MD
- Mortar MD
- PWS-Defined Area of Potential Interest
- DGM (100%)
- Mag & Dig
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

AIR Interpolation Anom / Acre	Mag & Dig Interpolation MD / Acre
0	0
0.1 - 10	0.1 - 100
10.1 - 50	100.1 - 200
50.1 - 100	200.1 - 500
100.1 - 500	500.1 - 1,000
500.1 - 1,000	1,000.1 - 2,000
1,000.1 - 10,000	2,000.1 - 5,000
10,000.1 - 20,000	5,000.1 - 10,000
20,000.1 - 31,322.9	10,000.1 - 23,812.9

N W E S

0 375 750 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 750 '	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

422,000

34°54'0"N

AoPI 5

AoPI 9E

MRS 3

Hilltop Rd

Beech Tree Ct

150

149

100

300

50

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MEC & MD Findings - AOPI 5, 9E
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-3

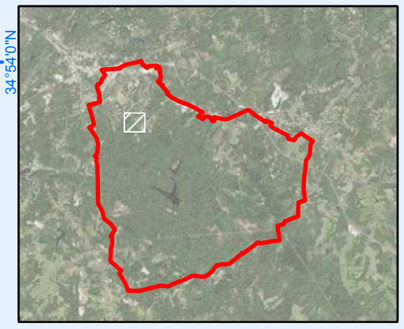
KEY

- PWS-Defined Area of Potential Interest
- Mag & Dig
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

AIR Interpolation Anom / Acre	Mag & Dig Interpolation MD / Acre
0	0
0.1 - 10	0.1 - 100
10.1 - 50	100.1 - 200
50.1 - 100	200.1 - 500
100.1 - 500	500.1 - 1,000
500.1 - 1,000	1,000.1 - 2,000
1,000.1 - 10,000	2,000.1 - 5,000
10,000.1 - 20,000	5,000.1 - 10,000
20,000.1 - 31,322.9	10,000.1 - 23,812.9

N W E S

0 100 200 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

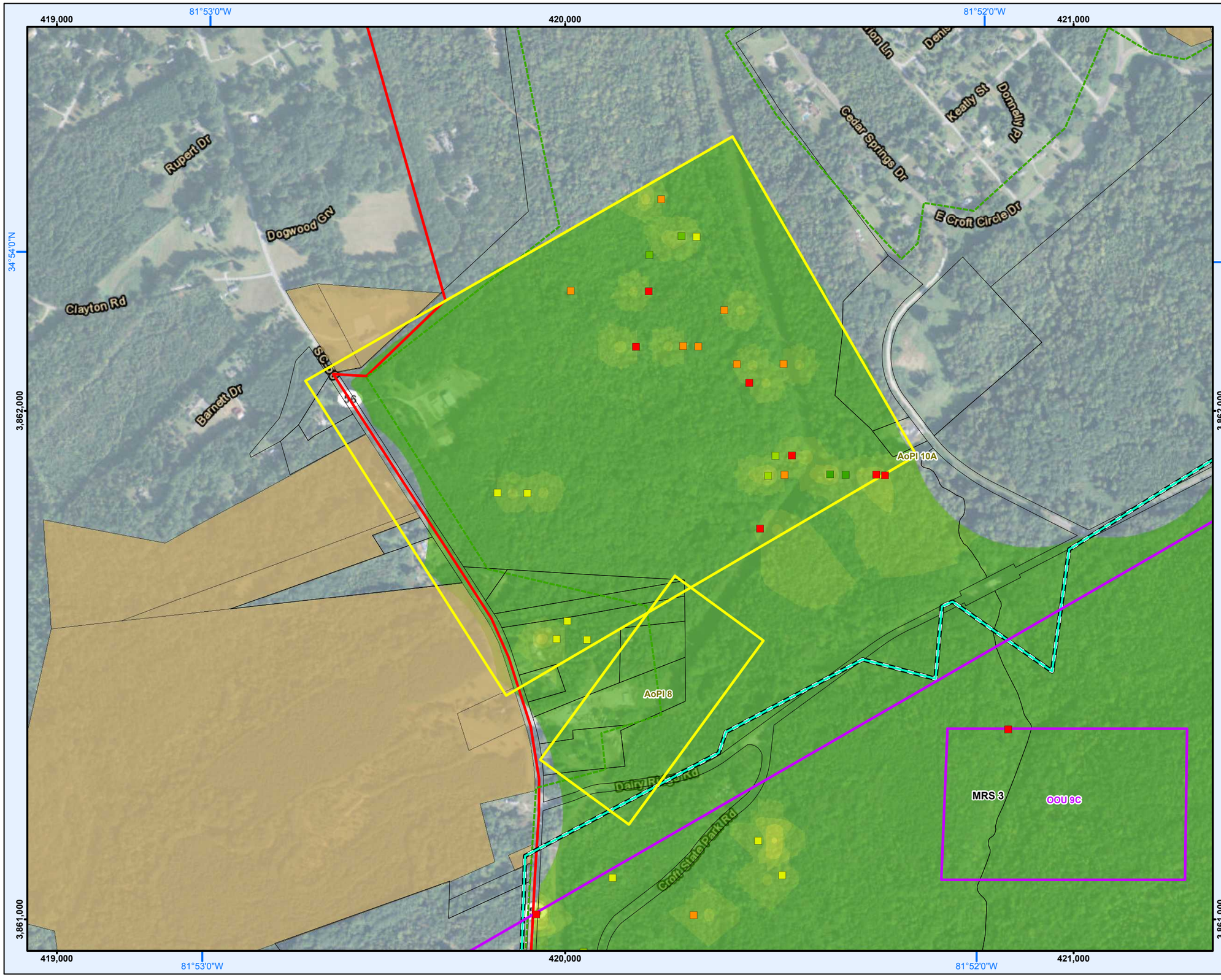
Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 200 '	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MEC & MD Findings - AOPI 8, 10A
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-4



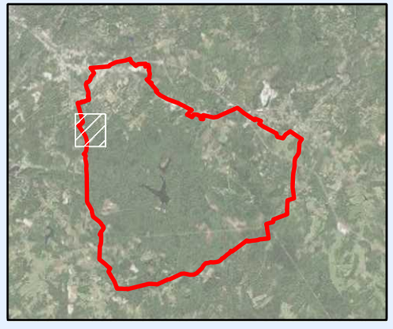
KEY

- Frag / Undifferentiated MD
- Grenade MD
- Mine MD
- Mortar MD
- Projectile MD
- Rocket MD
- Former OOU
- PWS-Defined Area of Potential Interest
- Mag & Dig
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

AIR Interpolation Anom / Acre	Mag & Dig Interpolation MD / Acre
0	0
0.1 - 10	0.1 - 100
10.1 - 50	100.1 - 200
50.1 - 100	200.1 - 500
100.1 - 500	500.1 - 1,000
500.1 - 1,000	1,000.1 - 2,000
1,000.1 - 10,000	2,000.1 - 5,000
10,000.1 - 20,000	5,000.1 - 10,000
20,000.1 - 31,322.9	10,000.1 - 23,812.9

N W E S

0 300 600 feet



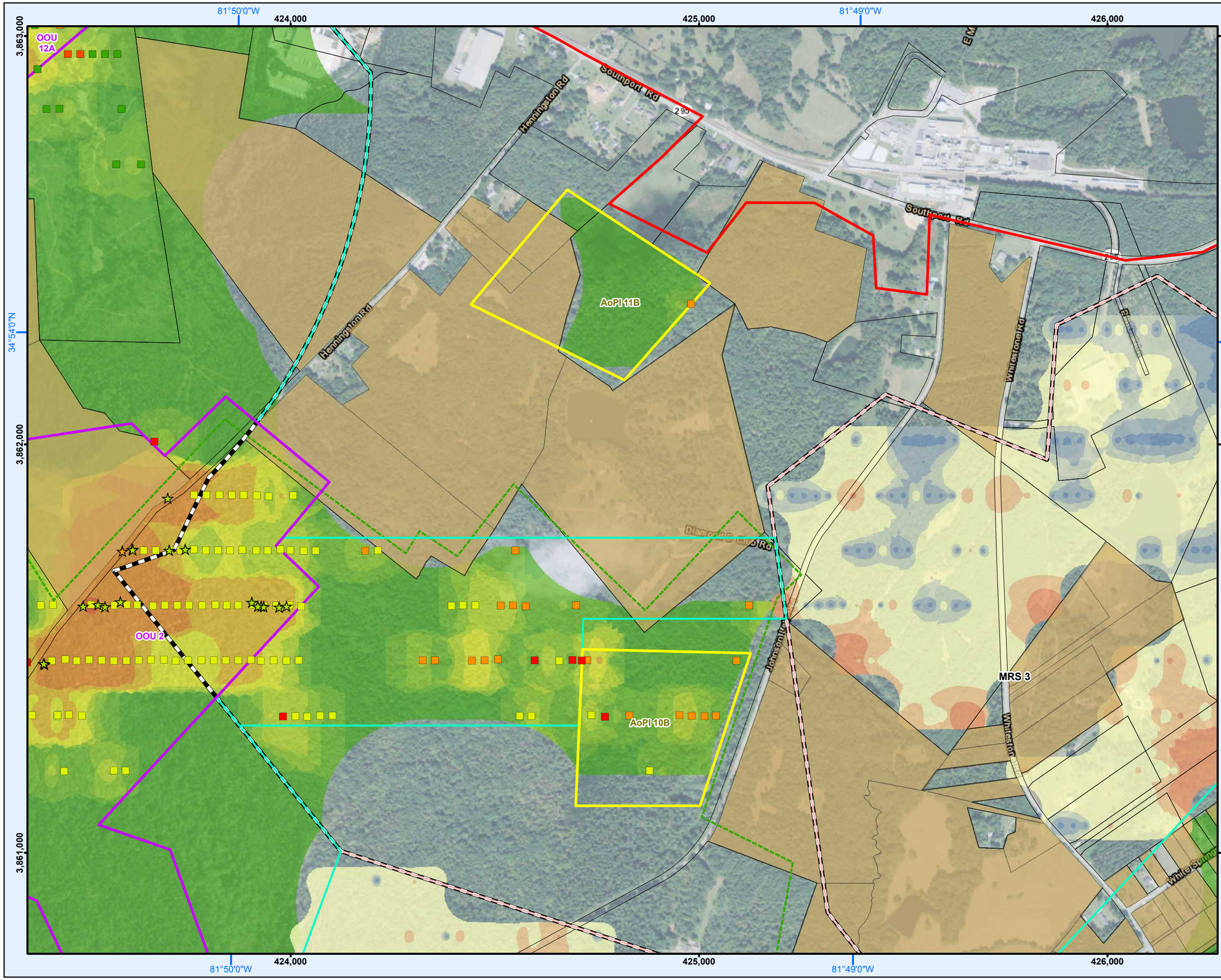
Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 600 '	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816



Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MEC & MD Findings - AOPI 10B, 11B
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-5

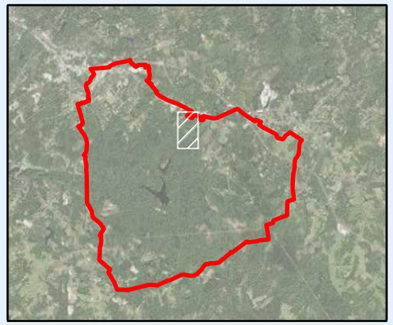
KEY

- UXO, 60 mm Mortar
- UXO, 81 mm Mortar
- Frag / Undifferentiated MD
- Grenade MD
- Mortar MD
- Rocket MD
- Rocket / Mortar MD
- Former OOU
- PWS-Defined Area of Potential Interest
- AIR
- Mag & Dig
- MRS Boundary
- Approximate Croft Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel

AIR Interpolation Anom / Acre	Mag & Dig Interpolation MD / Acre
0	0
0.1 - 10	0.1 - 100
10.1 - 50	100.1 - 200
50.1 - 100	200.1 - 500
100.1 - 500	500.1 - 1,000
500.1 - 1,000	1,000.1 - 2,000
1,000.1 - 10,000	2,000.1 - 5,000
10,000.1 - 20,000	5,000.1 - 10,000
20,000.1 - 31,322.9	10,000.1 - 23,812.9

N W E S

0 375 750 feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 750 '	ATD/EAA

U.S. Army Corps of Engineers
Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

Area Alpha

Area Bravo

Area Charlie

Area Delta

Area Echo

Area Foxtrot

Area Golf

AoPI 10A
AoPI 10B
AoPI 10C
AoPI 11A
AoPI 11B
AoPI 11C
AoPI 11D
AoPI 11E
AoPI 3
AoPI 4
AoPI 5
AoPI 6
OOU 1A
OOU 1B
OOU 1H
OOU 4
OOU 4A/4B
OOU 4B
OOU 7
OOU 8A
OOU 8B
OOU 8C
OOU 9B
OOU 9F
OOU 12A
OOU 12B
Lake Johnson
Lake Craig

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MEC & MD Findings - MRS 3
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-6

KEY

- DMM, Grenade
- UXO, 2.36 in rocket
- UXO, 57 mm Projectile
- UXO, 60 mm Mortar
- UXO, 81 mm Mortar
- UXO, Fuze
- UXO, Grenade
- Frag / Undifferentiated MD
- Grenade MD
- Grenade / Rocket MD
- Mine MD
- Mortar MD
- Projectile MD
- Rocket MD
- Rocket / Mortar MD
- Former OOU
- PWS-Defined Area of Potential Interest
- MRS Boundary
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Accessible Parcel
- Inaccessible Parcel
- Inaccessible Area
- AIR Interpolation Boundary
- Mag & Dig Interpolation Boundary

Clearance Type
- AIR
- DGM (100%)
- Mag & Dig

AIR Interpolation

Anom/Acre
- 0
- 0.1 - 10
- 10.1 - 50
- 50.1 - 100
- 100.1 - 500
- 500.1 - 1,000
- 1,000.1 - 10,000
- 10,000.1 - 20,000
- 20,000.1 - 31,322.9

Mag & Dig Interpolation

MD / Acre
- 0
- 0.1 - 100
- 100.1 - 200
- 200.1 - 500
- 500.1 - 1,000
- 1,000.1 - 2,000
- 2,000.1 - 5,000
- 5,000.1 - 10,000
- 10,000.1 - 23,812.9

N W E S

0 500 1,000 Feet

Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Note(s)
Engineering scale may only be accurate on a map size of 34 x 44.

Checked By	Engineering Scale	Drawn By
JES	1 " = 1,000 '	ATD

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ZAPATA
TRUST · INTEGRITY · QUALITY
6302 Fairview Road, Suite 600 704.358.8240 Phone
Charlotte, North Carolina 28210 704.358.8342 Fax
zapata@zapatainc.com www.zapatainc.com

Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MC Locations
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-7

KEY

- Post BIP Sample Locations
- Background Sample Location
- MRS
- Former OOU
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

*Grid Sample Configuration

2	3
1	4

5

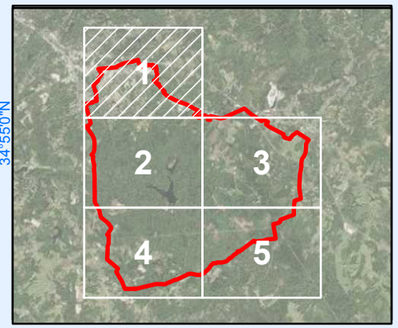
MC Sample Grid Location*

Grid Type
- 10x250
- 50x50
- Collected Along Berm
- Single Location

Note: Number denotes sample ID and location

N W E S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	EAA

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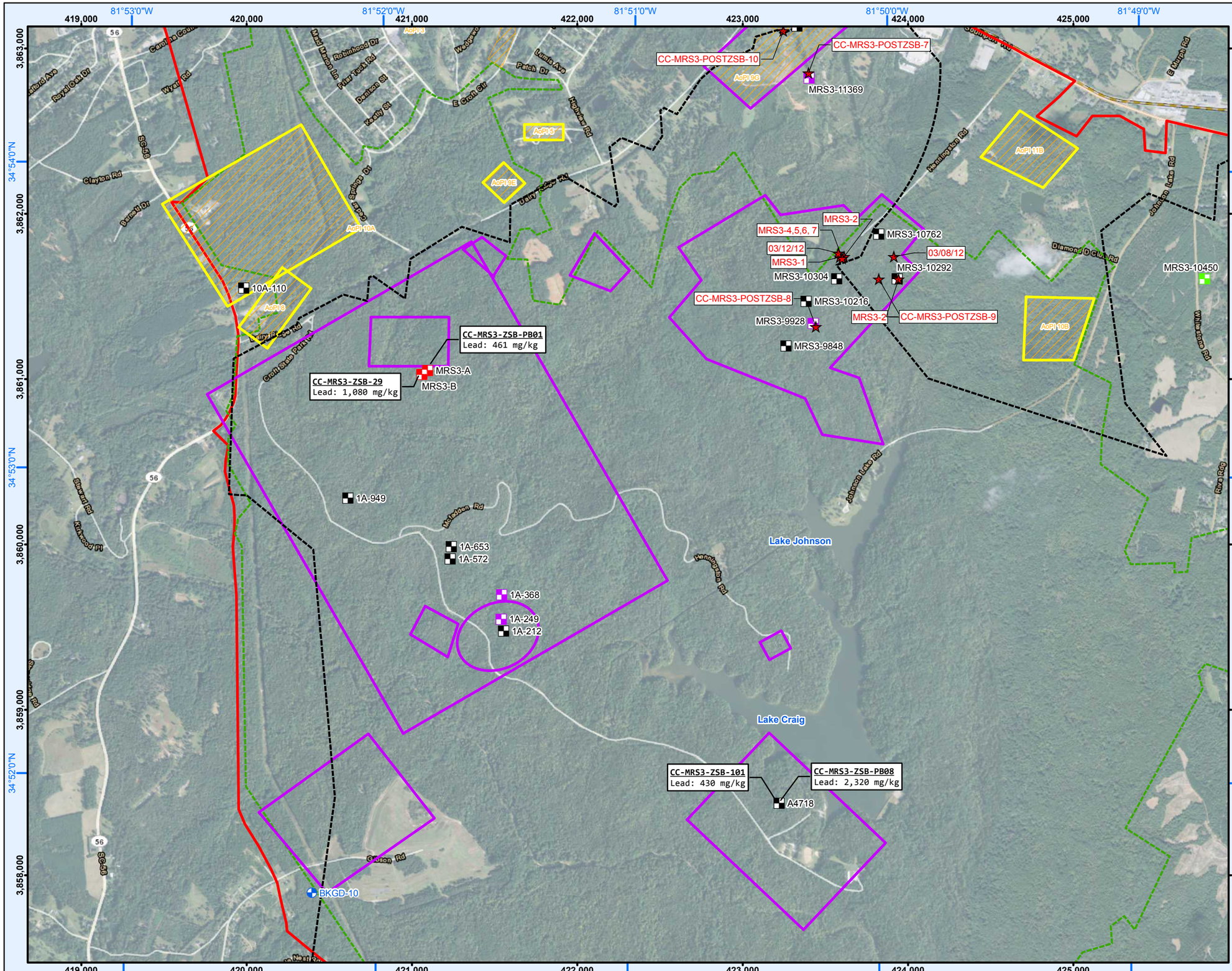


Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MC Locations
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-8

KEY

- Post BIP Sample Locations
- Background Sample Location
- MRS
- Former OOU
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

*Grid Sample Configuration

2	3
1	4

5

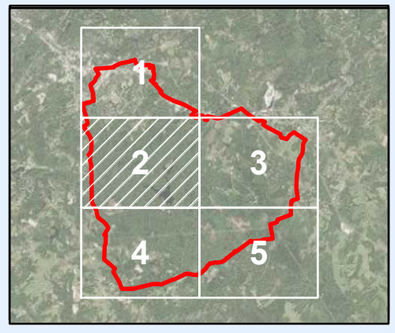
MC Sample Grid Location*

Grid Type
- 10x250
- 50x50
- Collected Along Berm
- Single Location

Note: Number denotes sample ID and location

N W E S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	EAA

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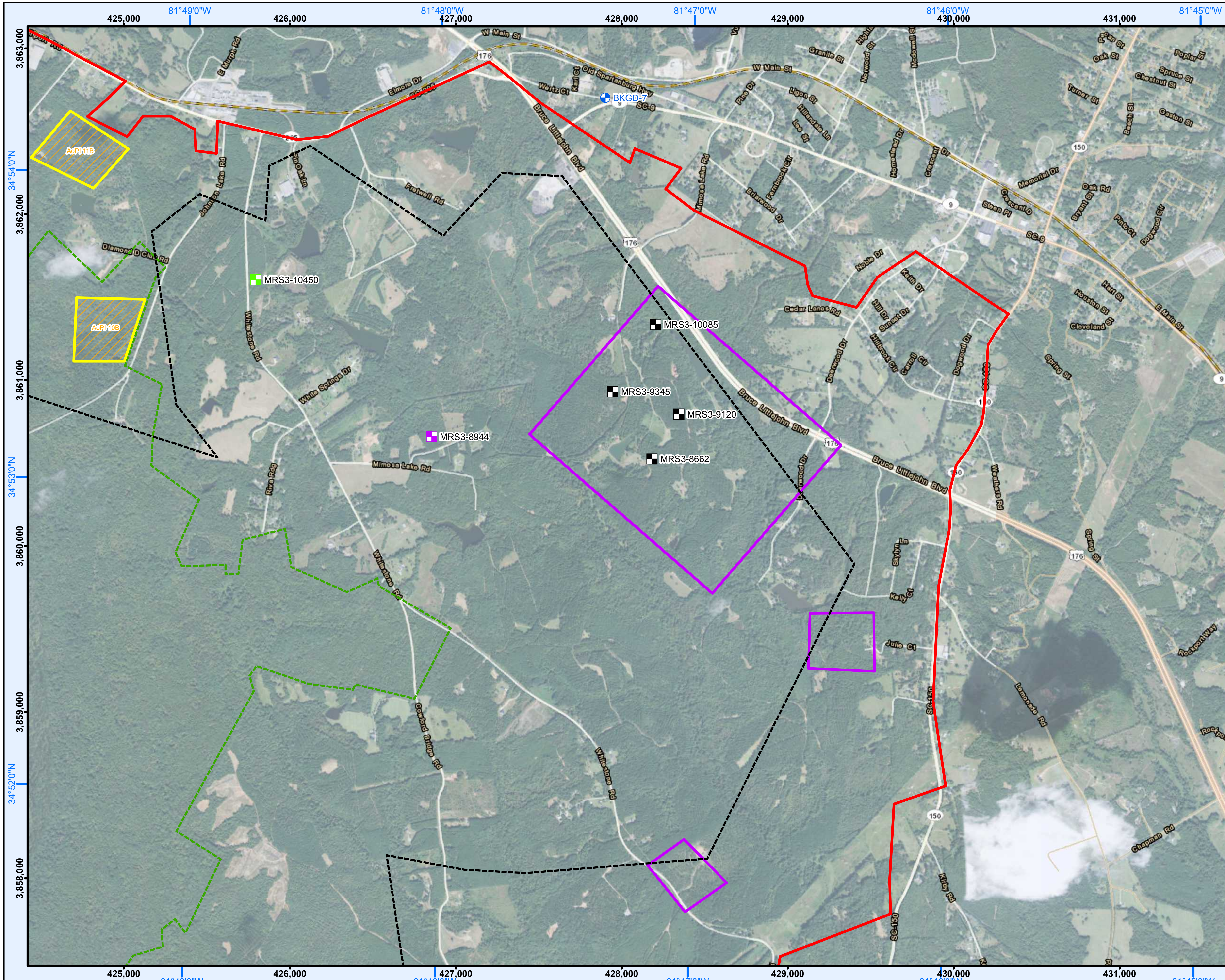
Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MC Locations
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-9



KEY

- Post BIP Sample Locations
- Background Sample Location
- MRS
- Former OOU
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

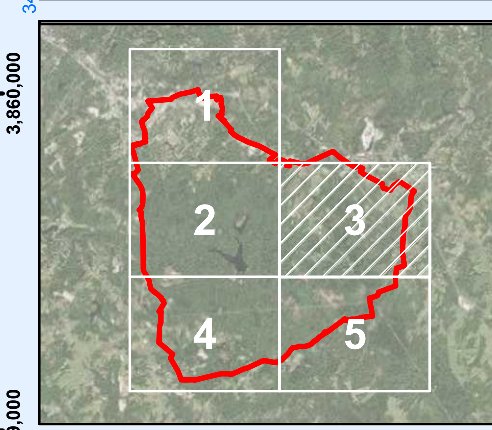
*Grid Sample Configuration

2	3
5	
1	4

MC Sample Grid Location*
Grid Type
- 10x250
- 50x50
- Collected Along Berm
- Single Location

Note: Number denotes sample ID and location

N E S W
0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	EAA

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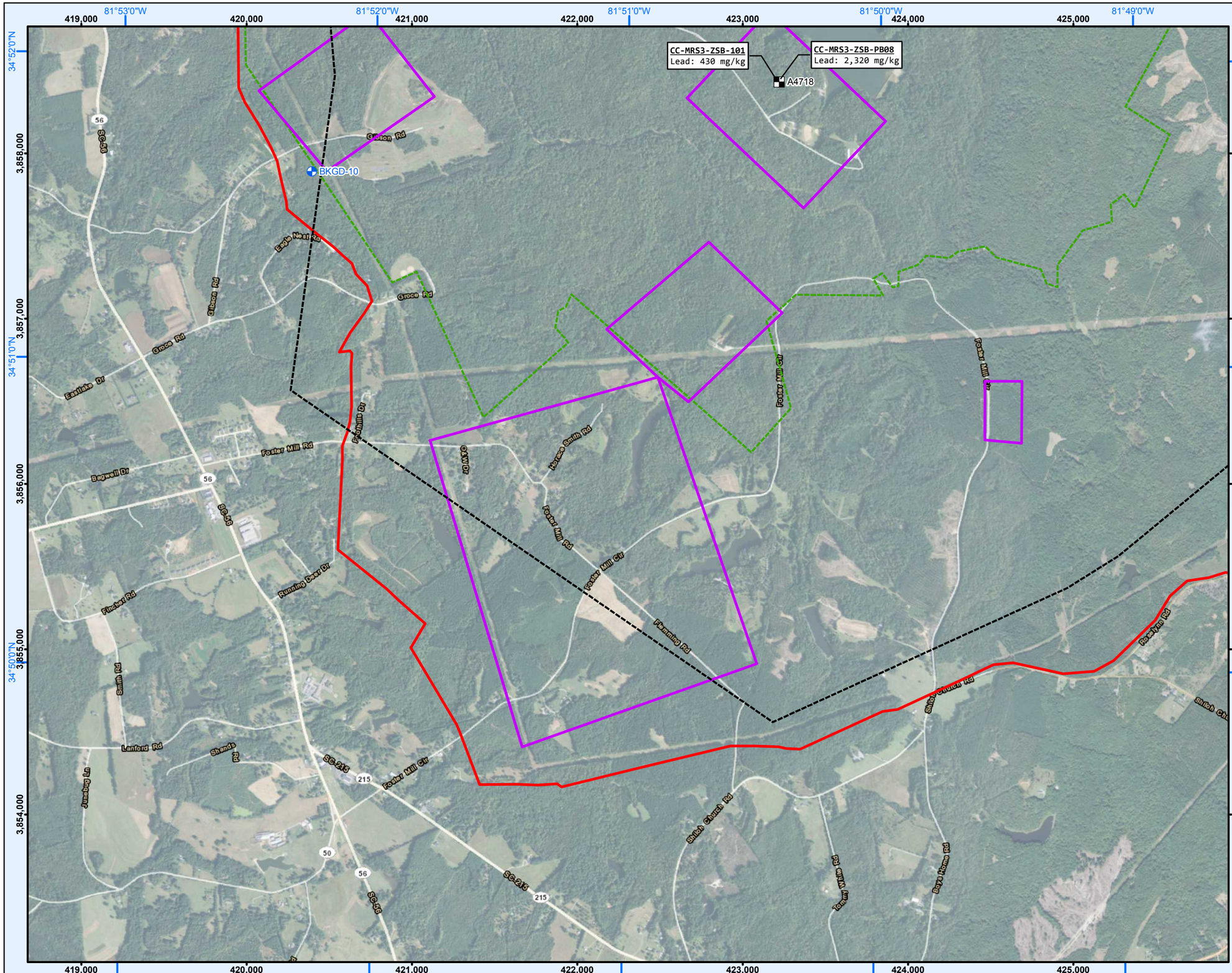


Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MC Locations
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-10

KEY

- Post BIP Sample Locations
- Background Sample Location
- MRS
- Former OOU
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

*Grid Sample Configuration

2	3
5	
1	4

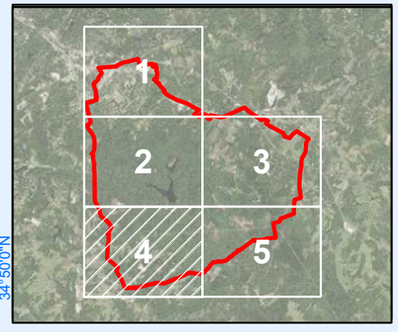
MC Sample Grid Location*

Grid Type
- 10x250
- 50x50
- Collected Along Berm
- Single Location

Note: Number denotes sample ID and location

N W E S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	EAA

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Remedial Investigation/Feasibility Study
Former Camp Croft, Spartanburg, SC
MC Locations
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	5-11

KEY

- Post BIP Sample Locations
- Background Sample Location
- MRS
- Former OOU
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary

*Grid Sample Configuration

2 3
5
1 4

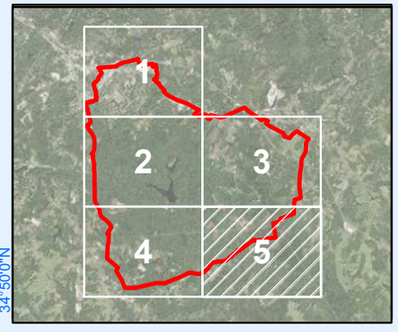
MC Sample Grid Location*

Grid Type
- 10x250
- 50x50
- Collected Along Berm
- Single Location

Note: Number denotes sample ID and location

N W E S

0 750 1,500 Feet



Source(s)
USAESCH, Esri, ZAPATA

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=1,500'	EAA

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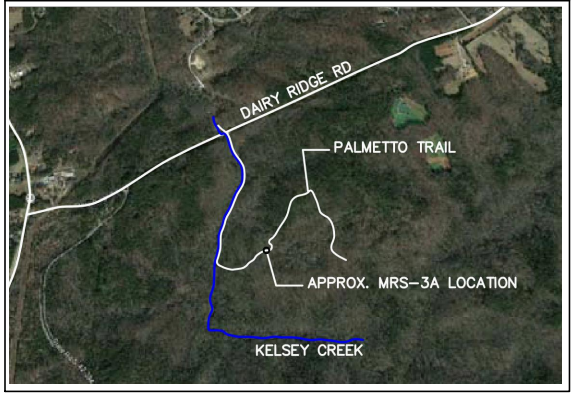
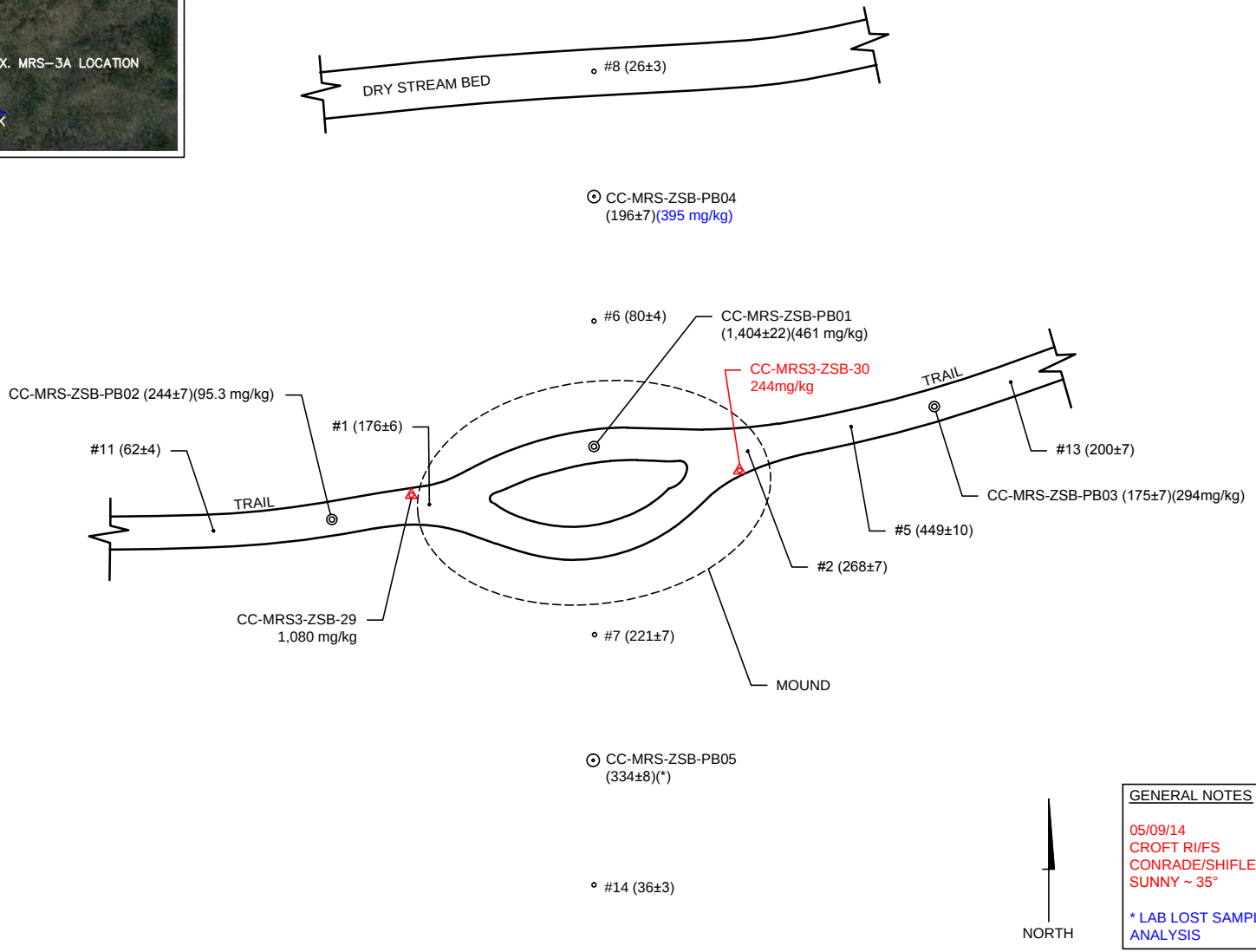
Huntsville, AL 35816

SITE LOCATION



LEGEND

- ◬ ORIGINAL SAMPLE
- (###) FOLLOW-UP LAB RESULTS
- #1 XRF SAMPLE NO.
- • XRF SAMPLE
- ◎ LAB SAMPLE
- (###) XRF RESULT IN PPM



GENERAL NOTES

05/09/14
CROFT RI/FS
CONRADE/SHIFLET
SUNNY ~ 35°

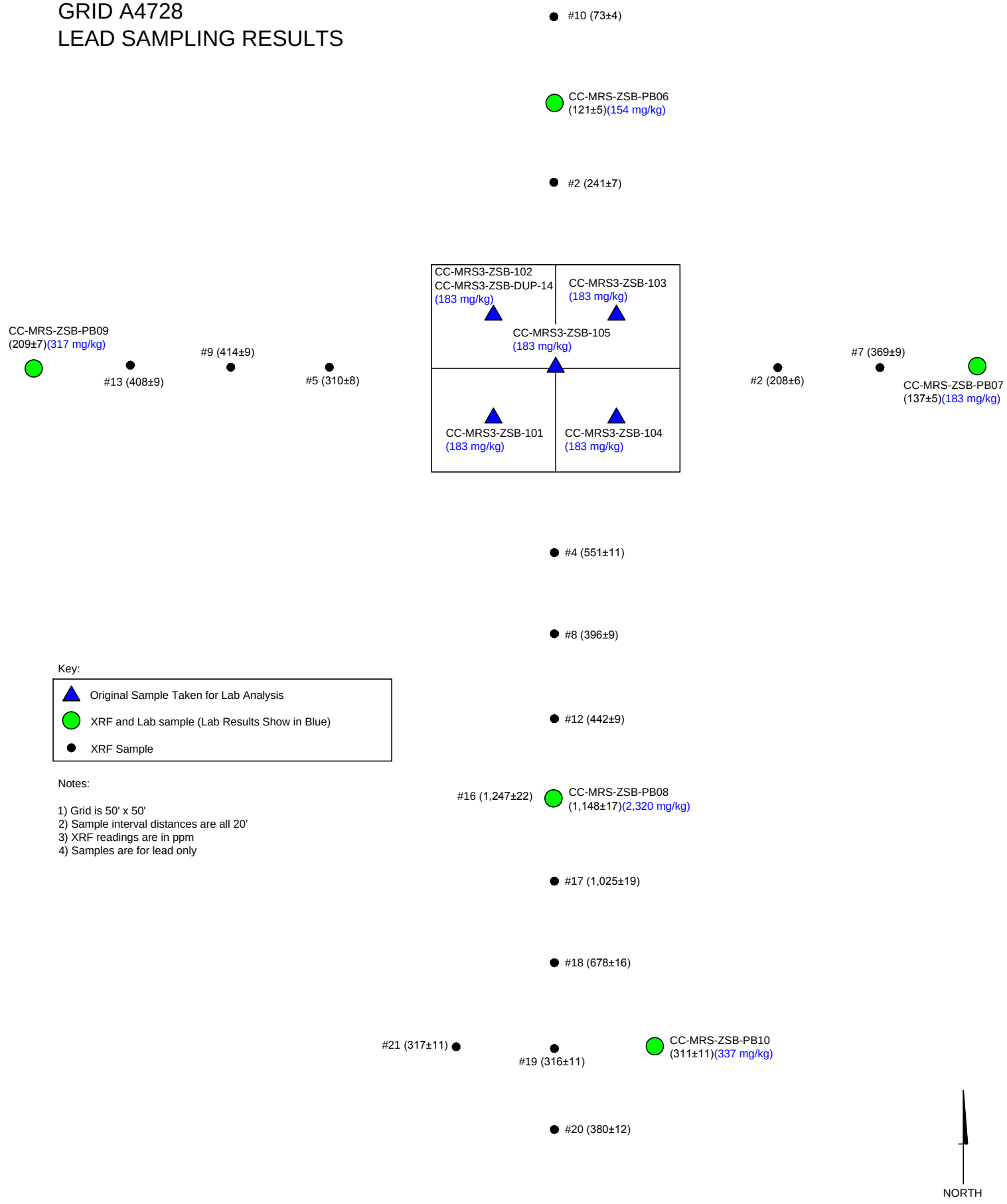
* LAB LOST SAMPLE DURING ANALYSIS

UNITED STATES ARMY
CORPS OF ENGINEERS

MRS3-A *Lead Only
Camp Croft Remdial Investigation Report

FIG 5-12

GRID A4728
LEAD SAMPLING RESULTS



Key:

- Original Sample Taken for Lab Analysis
- XRF and Lab sample (Lab Results Show in Blue)
- XRF Sample

Notes:

1) Grid is 50' x 50'
2) Sample interval distances are all 20'
3) XRF readings are in ppm
4) Samples are for lead only

UNITED STATES ARMY CORPS OF ENGINEERS	Grid A4718 *Lead Only Camp Croft Remdial Investigation Report	FIG 5-13

6.0 CONTAMINANT FATE AND TRANSPORT FOR MEC/MC

6.1 MUNITIONS AND EXPLOSIVES OF CONCERN

a. Transport of MEC is generally not anticipated to be significant at most MEC sites. When present, exposure to only one MEC may result in an acute event.

6.1.1 Primary Source of MEC Contamination

a. Camp Croft was one of several sites utilized for advanced training of most units preparing for combat operations during World War II. Emphasis in training was placed almost entirely on offensive warfare. Infantry training was conducted across numerous established ranges and through the wooded terrain beyond those established ranges.

6.1.2 Contaminant Persistence

a. MEC may remain for long periods of time, as evidenced by the discovery of numerous World War II-era (WWII) MEC and MD items during the RI field investigations.

6.1.3 Contaminant Migration

b. Several factors influence the possible migration of MEC from the site. Human activities can cause subsurface MEC to become exposed at the surface, especially during earth movement activities associated with land development, timber harvest or construction. Much of the former Camp Croft is mixed use, partially developed for residential and industrial purposes. The remaining portions of the site are undeveloped and maintained as the Croft State Natural Area. In areas where development and construction has occurred, intrusive activities have altered the conditions of the land in such a manner that would move MEC or cause it to be exposed at the surface.

c. Natural processes can also play a role in the redistribution of MEC. The former Camp Croft lies in the piedmont region, which is characterized by rolling hills and numerous drainage areas. Erosional processes can expose once buried items at the surface. Erosion of soil to expose munitions is also a slow process unless there is rapid movement of water or mass wasting. Another factor involves the movement of smaller MEC items by overland water flow, particularly in drainages and low-lying areas subject to periodic flooding.

6.2 MUNITIONS CONSTITUENTS

a. No explosives were detected at the former Camp Croft above the laboratory minimum detection limit (MDL). When present, explosives in soil and sediment are generally degraded over time by biotic transformations by bacteria, fungi, and other soil microbes. Degradation of explosives also occurs through abiotic transformations such as alkaline hydrolysis, photolysis, and reduction by iron.

b. Lead was the only metal identified above its respective PAL; lead contamination appears to be localized. Antimony, copper, lead, and zinc were identified in the risk assessment as chemical of potential concern; however, the risk assessment concluded these metals were not a concern at measured concentrations (refer to Section 7 for details).

6.2.1 Primary Source of MC Contamination

a. Munitions constituents contamination would result from past military munitions activities at the site. The primary contaminant media is surface and subsurface soil. Soil samples

collected during the RI fieldwork identified low levels of select metals in surface soils; however, only lead was identified in exceedance of its RSL in localized areas.

6.2.2 Contaminant Persistence

a. Lead alloy is typically used in military munitions as projectiles and casings, and lead compounds (i.e., lead azide, lead styphnate, lead carbonate, lead thiocyanate, lead nitrate, lead sulfide). Typical small arms military bullets are comprised of antimony-hardened lead in a copper jacket. These bullet masses tend to range from 32 to 86 grams per bullet, 96.4% of which is lead (ITRC, 2003). Lead is also found natural, typically as an ore with zinc, silver, and copper. Lead has many anthropogenic uses due to its availability and cost—most of which include the use of lead in the production of batteries, plumbing, ammunition, and in medical instruments. Until its use in gasoline was banned in 1996, lead (tetraethyllead) was added to gasoline to reduce engine knocking. Lead was also used in fruit orchards to control insects before the 1950's, and residential application of lead paint was outlawed in 1978 (ATSDR, 2007).

b. Lead transport in the environment is dependent on the soil chemistry and precipitation at the site. Large pieces of lead (e.g., bullet fragments) typically oxidize (corrode) over time due to their exposure to precipitation and the atmosphere. As large, pure fragments, these oxidized compounds (lead hydroxide and lead carbonate) are insoluble, but become soluble when erosion releases these compounds into the environment. Smaller particles harbor a larger surface area and may become prone to breakdown and leaching. Lead compounds become soluble where acidic conditions abound and likewise, a shift in redox potential can affect lead concentrations by shifting the speciation of lead to a more stable compound. Soil with high organic matter content and clayey soils can decrease leachability of lead since they sorb the lead, forming stable complexes. In contrast, sandy soils tend not to bind with lead nor do they hold groundwater, therefore solubilized lead is more prone to leach to the groundwater (ITRC, 2003).

6.2.3 Contaminant Migration

a. Munitions constituents in surface and subsurface soil are potentially subject to several transport mechanisms. These processes include:

- Atmospheric dispersion through fugitive dust particle transmission;
- Precipitation/ surface runoff; and
- Erosion/ landslides.

b. The behavior of inorganic chemicals (e.g., lead) in the environment is complex. Transport and eventual fate of chemicals through water, air, and soil involve a combination of biological, physical and chemical processes. These processes include:

- Dispersion – the general term applied to the observed spreading of a solute plume and generally attributed to hydrodynamic dispersion and molecular diffusion.
- Adsorption/desorption – the process by which dissolved, chemical species accumulate (adsorption) at an interface or are released from the interface (desorption) into solution.
- Diffusion – the migration of solute molecules from regions of higher concentration to regions of lower concentration.
- Oxidation/reduction – reactions in which electron(s) are transferred between reactants.
- Covalent binding – the formation of chemical bonds with specific functional groups in soil organic solids

- Plant root uptake – the transport of chemicals into plants through the roots.
- Sedimentation – the removal from the water column of suspended particles by gravitational settling.

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7.0 BASELINE RISK ASSESSMENT FOR MC AND HAZARD ASSESSMENT FOR MEC

a. A baseline Human Health Risk Assessment (HHRA) and Screening-level Ecological Risk Assessment (SLERA) were performed to support the former Camp Croft RI. Both risk assessments focused on samples taken from the MRS 3 area, as shown in Exhibit 5-6 through Exhibit 5-10. The purpose of the baseline HHRA and the SLERA is to evaluate potential human health and ecological effects of chronic exposures to compounds detected in surface soil samples collected from the site. The full HHRA and SLERA are included in Appendix O.

7.1 HUMAN HEALTH RISK ASSESSMENT

a. The HHRA for the former Camp Croft has been conducted in accordance with CERCLA and the most current EPA (EPA, 2008; 2009) and USACE (USACE, 1999) guidance. The purpose of the HHRA is to evaluate the potential current and future health effects caused by the release of MC from the site. This HHRA evaluates the August 2012, January 2013, and February 2013 surface soil data to determine if there are any chemicals of potential concern (COPCs) that may require further assessment of exposure and risks. The full risk assessment is contained in Appendix O.

7.1.1 Identification of Chemical of Potential Concern

a. The first step in the risk assessment is to identify those hazardous substances that may pose a threat to human health. The selection of COPCs includes an evaluation of the analytical data, an analysis of the sources of MC contamination and affected areas, and a review of site characteristics. For this HHRA, 120 surface soil samples and 12 duplicates (132 total) were screened for the presence of zinc and explosives, plus nitroglycerin and PETN. A total of 140 samples were screened for antimony and copper, and 141 samples were screened for lead.

b. Surface soil analytical results were compared to EPA RSLs for Residential Soil dated November 2012. The maximum concentration for each constituent was compared to the applicable screening criterion. If a duplicate sample was collected, the average of the parent and duplicate sample was used if the constituent was detected in both samples and the detection was used if only one of the sample results detected the constituent. If the concentration used for screening for a constituent exceeded the conservative risk-based screening level, then the chemical was retained as a COPC and evaluated further in the risk assessment. Results of the surface soil screening indicate that lead is the only COPC.

7.1.2 Exposure Assessment

a. The Exposure Assessment estimates the magnitude and frequency of potential human exposure to COPCs present in media of interest at the site. The first step in the exposure assessment process is determining potential receptors (i.e., people who may contact the impacted environmental media of interest). Potential exposure scenarios identifying appropriate environmental media and exposure pathways for current and potential future site uses are then developed.

b. As discussed, Croft State Natural Area occupies 7,054 of the 19,044-acre FUDS property. The majority of the park is open to the public and primary activities would be recreational including hiking, mountain biking, fishing, boating, and equestrian. Land use on the remainder

of the property is industrial, agricultural, commercial, residential, and privately-owned. These types of land use are likely to continue in the future.

c. An exposure pathway is the mechanism through which a receptor comes in contact with contaminated media. Potential exposure pathways typically include incidental ingestion and dermal contact with soil. Lead contamination is limited to two distinct grid areas: MRS3-A and A4718 shown on Exhibit 3. MRS3-A is represented by six grab samples collected approximately 20 feet apart. They are designated CC-MRS3-ZSB-29, CC-MRS3-ZSB-30, CC-MRS3-ZSB-PB01, CC-MRS3-ZSB-PB02, CC-MRS3-ZSB-PB03, and CC-MRS3-ZSB-PB04; results are shown on Exhibit 5-12. Lead was discovered at concentrations ranging from 95.3 to 1,080 mg/kg. The average concentration at MRS3-A is 428 mg/kg.

d. The area of lead contamination associated with Grid A4718 is represented by a quadrilateral defined by sample points PB06, PB07, PB10 and PB09. Five additional sample locations within this area define this exposure unit. They are samples CC-MRS3-ZSB-101, CC-MRS3-ZSB-102 and its duplicate, CC-MRS3-ZSB-103, CC-MRS3-ZSB-104, and CC-MRS3-ZSB-105. Lead was discovered at concentrations ranging from 154 to 2,320 mg/kg within this area; results are shown on Exhibit 5-11. The average concentration in the Grid A4718 exposure unit is 534 mg/kg.

e. There are no traditional toxicity constants available for lead. Instead, blood-lead concentrations have been accepted as the best measure of exposure to lead. Because young children (especially those under the age of 7 years) are the most vulnerable to lead toxicity, EPA developed an Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children to predict blood-lead levels from chronic exposures of children to lead. When this model is used with site concentration data, and the predicted blood-lead levels in young children (the most vulnerable group in the population) are shown to be acceptable, it is not necessary to also address adult exposure.

f. The arithmetic average concentration of lead in surface soil at MRS3-A (428 mg/kg) and Grid A4718 (534 mg/kg) were input into the latest version of the IEUBK model (EPA, 2010). EPA uses a level of 10 micrograms per deciliter (µg/dL) of lead blood as the benchmark to evaluate individual and population-level lead exposure. EPA's target is for a typical child or group of children exposed to have an estimated risk of no more than 5% of exceeding a blood-lead level of 10 µg/dL. Assuming lead concentrations of 534 and 428 mg/kg lead in soil, the projected blood lead levels for 100 percent of the population are below the 10 µg/dL benchmark. These results indicate that lead is not a MC of concern in surface soil.

7.1.3 Human Health Exposure Summary

a. Maximum and average exposure concentrations of the COPCs were used to compare to conservative residential screening levels. Except for lead, the maximum exposure concentrations were below residential screening levels. Since the dominant exposure scenario would be recreational, potential risks are considered negligible and are not quantified further in the risk assessment process.

b. Lead occurs above its screening level at two locations within the MRS. Based on the output from EPA's IEUBK model for lead in children that assumes residential exposure assumptions, lead is not a concern at these concentrations. In conclusion, there are no threats from concentrations of MC to human health at the MRS 3 at the former Camp Croft FUDS.

7.2 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

a. The purpose of the screening-level ecological risk assessment (SLERA) is to evaluate the potential effects to ecological receptors caused by the release of MC. This SLERA is consistent with Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, 1997) and EM 200-1-4, Volume II Environmental Evaluation (USACE, 2010). The full SLERA is included in Appendix O.

b. The SLERA constitutes steps 1 and 2 of the 8-step ecological risk assessment process (EPA, 1997) and is comprised of a screening-level problem formulation and a screening-level exposure estimate and risk calculation. The outcome of the SLERA will determine if:

- ecological risks are negligible;
- the ecological risk assessment process should continue to determine whether a risk exists (i.e., continue to Step 3); and
- there is a potential for adverse ecological effects and a more detailed assessment incorporating more site-specific information is needed.

c. Terrestrial habitats at the site include open fields, shrub/scrub, as well as both upland and lowland forests. In the northern portion of the FUDS boundary, numerous small wetland and riparian areas ranging from 0.1 to 5 acres in size have been identified, such as a 4.8-acre Freshwater Forested/Shrub located near the north boundary of MRS 3. The southern portion of the Site area contains larger wetland areas, primarily the Freshwater Forested/Shrub type, along Fairforest Creek and in an area located southwest of Lake Craig.

d. Flora species include a diverse variety of grasses, shrubs and trees. Many of the private lands around the natural Area have been planted with loblolly pine or are in cultivation. Wildlife species in the area include soil and aquatic invertebrates, fish, amphibians, reptiles, small mammals, and birds. The site is widely used for hunting and game species such as turkey and deer are common.

e. Only one species is listed by the U.S. Fish and Wildlife Service and that is the Dwarf-flowered Heartleaf (Hexastylis naniflora) which is classified as federally threatened. This plant may occur in very small colonies on rolling hillsides and in ravine areas. There are no State threatened or endangered species.

7.2.1 Contaminant Fate and Transport Mechanisms

a. MC associated with the former military include explosives, antimony, copper, lead, and zinc in the firing range and target areas. The metals are generally found as munitions fragments with a low potential for weathering and leaching. MEC may also be found. Explosives in soil and sediment are generally degraded over time by biotic transformations by bacteria, fungi, and other soil microbes. Degradation of explosives also occurs through abiotic transformations such as alkaline hydrolysis, photolysis, and reduction by iron. There is a slight potential that explosives could be leached into shallow groundwater. However, given that several decades have passed since military operations ceased, it is expected that detections of explosives would be rare.

b. Soil organisms, plants, and ground-dwelling small mammals (e.g., rodents) and ground birds (e.g., quail and wild turkey) are likely to be most exposed to soil MC contamination. In the aquatic environment of the creeks, sediment-dwelling organisms and those that prey on them are

considered most exposed. The toxic mechanisms of MC include direct toxicity by contact and some bioaccumulation through the food chain.

c. Soils within the former firing range and target areas have the potential of being contaminated with MC, either by direct contamination from past military training activities or through localized transport via erosion. However, no source areas were identified with the exception of two small, isolated hotspots of lead located in MRS 3. No surface water or sediment samples were collected because these media were not considered to be of concern at the former Camp Croft.

d. Surface soils and riparian zones support terrestrial receptors across several trophic levels (e.g., primary producers, primary consumers, secondary and tertiary consumers) and feeding guilds (e.g., herbivores, omnivores, and carnivores). The primary exposure routes to these ecological receptors may include the following:

- Uptake by vegetation through roots or leaves;
- Direct contact and inadvertent ingestion of contaminated media; and
- Indirect exposure of predatory wildlife to bioaccumulative contaminants in prey items.

e. Screening-level assessment endpoints include plant and animal populations and communities, habitats, and sensitive environments. Various EPA and other federal soil screening values were used as ecological screening values (ESVs). In addition, ten soil samples representative of background conditions of Camp Croft area were collected. If the conservative ESVs from the literature were less than twice the average background concentration, then the background level was used as the ESV.

7.2.2 Screening-Level Exposure Estimate and Risk Calculation

a. For the SLERA, 120 surface soil samples and 12 duplicates (132 total) were screened for the presence of zinc and explosives, plus nitroglycerin and PETN. A total of 140 samples were screened for antimony and copper, and 141 samples were screened for lead. The maximum detected soil concentration of each chemical was used as the exposure estimate.

b. Screening-level risks to ecological receptors were evaluated by calculating a maximum hazard quotient (HQ) for each detected chemical in each medium. The HQ in this case is the ratio of the site maximum detected concentration (exposure concentration) to the ecological screening value. A HQ less than one indicates that the chemical alone is unlikely to cause adverse effects to ecological receptors. A HQ greater than one indicates a potential for ecological impact from exposure to that chemical and becomes designated as a COPC. The screening-level risk calculation is a very conservative estimate to ensure that potential risk to ecological receptors is not underestimated. The results of this screening calculation serve only to determine whether a chemical presents negligible risk or whether additional site-specific information is warranted.

c. Zinc had two out of 132 samples that exceeded the ESV. Explosive compounds were either not detected or were below their respective ESVs; therefore, no explosives were identified as COPCs. Each of the four metals analyzed were above their respective ESVs, and are retained for further evaluation.

d. The initial screening levels were based on the most conservative ecological receptor assumed to be exposed 100 percent of the time with 100 percent bioavailability. In addition, the

ESVs were based on No-Observed-Adverse-Effect Levels (NOAELs). For the four metal COPCs, a more detailed refinement of the initial ESVs is warranted. Concentrations also assume 100 percent exposure and bioavailability. In general, herbivorous and carnivorous birds and mammals are less sensitive receptors than insectivorous fauna. Most of the toxicity studies with plants are based on laboratory cultivated crops such as lettuce, grains, and corn. Thus, the ESVs likely overestimate potential risks to indigenous plants at the former Camp Croft that is dominated by a forest community.

e. The soil samples were collected in those areas with the highest known densities of MD based on the mag and dig effort and the geophysics data. This biased sampling results in near worst-case exposure concentrations to ecological receptors in highly localized areas (generally less than 0.1 acre at each grid or hub location). The frequency of exceeding the ESVs ranged from 2 percent for zinc to 26 percent for copper indicating that widespread elevated levels of COPCs do not occur.

f. The highest level of antimony was at grid A4718 (CC-MRS3-ZSB-PB-08) with a maximum antimony HQ of 17. The average antimony concentration in this grid was 1.4 mg/kg which resulted in an average HQ of 4.3. This location was also high in copper and had the highest concentration of lead. The second highest antimony concentrations were at grid MRS3-A where the average HQ was 4.2. This location also contained elevated concentrations of copper and lead. Other grids, such as MRS3-10450, 1A-212, and 12A-205 had elevated antimony and other COPCs. The HQs for these areas ranged from 1.7 to 2.4 suggesting low exposure hazards. Given widely scattered locations and very small affected areas (< 0.1 acre), risk to insectivorous mammals is considered negligible. There are no risks to other mammals or soil invertebrates.

g. The highest concentrations of copper were associated with the post-BIP samples at locations 12A-1 and MRS3-1 through 7. These samples are highly localized (< 0.1 acre) and likely reflect shell casing fragments in the soils that are not readily bioavailable. Other areas of elevated copper include grids 12A-187, 12A-205, A4718, and MRS3-A. The HQs for these locations range from 1.1 to 7.6, suggesting relatively low hazards to insectivorous birds and mammals. Grid MRS3-A appears to have some of the highest levels of copper, antimony, and lead. Nevertheless, the relatively low HQs, small affected areas, and scattered/isolated pockets of copper suggest that adverse risks to ecological receptors would be low to negligible.

h. Elevated lead concentrations are often associated with elevated copper and antimony (e.g., Grids A-4718, MRS3-A, 12A-205, 1A-212, and the post-BIP samples as shown in Exhibits 1 through 6. HQs for the most sensitive insectivorous birds and mammals range from 1.1 to 29. Again, these localized elevated lead levels are not expected to adversely affect resident populations. The initial subsamples collected at grids MRS3-A and A4718 were elevated which prompted additional characterization with further samples that increased the size of the affected areas to about 0.5 acres. The average HQs at MRS3-A and A4718 were 5.4 and 6.8, respectively. In general, rodents and ground birds do not directly ingest metal fragments, so risks are considered to be overestimated relative to soluble and bioavailable forms. Risks to ground birds and rodents in these specific areas may be possible but are not expected to significantly affect the local population.

i. The maximum concentration of zinc (1,680 mg/kg) was found in sample CC-MRS3-ZSB-63. This appears somewhat of an anomaly because the zinc concentration was not associated with elevated levels of other COPCs, and the adjacent quadrant sampling results were

not elevated. Therefore, potential localized risk could occur to insectivorous birds and mammals, some plants, and soil invertebrates. However, this potential risk is not considered to be significant to local populations of these receptors. The only other zinc exceedance of the initial screening level was at CC-MRS3-ZSB-63 (164 mg/kg) which was just slightly above background (157 mg/kg). This is not expected to result in significant risk to insectivorous birds and mammals.

7.2.3 Screening-Level Ecological Risk Assessment Conclusion

a. At a few grid locations, most notably at A4718, MRS3-A, 12A-196, and the post-BIP samples, the metal COPC concentrations exceed conservative screening levels protective of insectivorous birds and mammals with hazard quotients generally less than 6.0. Exposure to metal fragments that are not readily bioavailable suggests an overestimation of potential risks. In addition, these small affected areas comprise only a tiny fraction of overall habitat and home ranges of the receptors. Given the existing data, it is not anticipated that significant adverse risks would occur to local populations of wildlife and that remedial actions would not be necessary to protect ecological receptors.

7.3 MEC HAZARD ASSESSMENT (MEC HA) OVERVIEW

a. This section describes the methodology for conducting, and presents the results of, the MEC Hazard Assessment (HA). The purpose of the MEC HA is to support the hazard management decision-making process by analyzing site-specific information and to support hazard communication. The MEC HA addresses explosives safety concerns posed by MEC to human receptors. It does not address environmental or ecological concerns including potential risks associated with exposure to MC, which are addressed by the HHRA and the SLERA in Subsections 7.1 and 7.2, respectively.

7.3.1 Components of Explosive Hazard

a. The MEC HA framework is comprised of three basic components including severity, accessibility, and sensitivity, Severity evaluates the potential consequences of the effect (injury or death) on a human receptor if a MEC item detonates. Accessibility describes the likelihood that a human receptor will be able to come in contact a MEC item. Sensitivity assesses the likelihood that a MEC item will detonate if a human receptor interacts with it.

b. The severity component is comprised of two input factors including the energetic material type in the MEC items (e.g., high explosive, incendiary) and the location of additional human receptors (i.e., if the MEC item detonates, could it affect one or more secondary receptors, in addition to the individual initiating the detonation).

c. The accessibility of a site affects the likelihood of an individual being exposed to MEC. The accessibility component is described by the following input factors:

- Accessibility (e.g., the presence of structural barriers like fences or natural barriers such as rough terrain, which limits site accessibility);
- Potential Contact Hours (i.e., the number of hours that people use the site each year);
- Minimum depth of MEC relative to the maximum intrusive depth of receptor activity (i.e., the relationship of receptor activity to the location and depth of MEC); and
- Potential for migration of MEC items (e.g., erosion).

d. Sensitivity affects the likelihood of a MEC item functioning as designed when encountered by an individual. The MEC classification (e.g., UXO, fuzed or unfuzed DMM, bulk explosives) and MEC size are input factors used to describe the sensitivity component of the explosive hazard.

e. MEC HA is designed to use numeric values associated with the input factors to assign weighted values that allow scoring which describes the hazards associated with the MEC. The scores are then summed, allowing determination of the hazard level. In order to ensure that the framework may be sensitive enough to distinguish between different removal and remedial alternatives, input factors are weighted. This assures a distinction between the input factors that do, and do not change in response to a cleanup, as well as the input factors that change to reflect different land use activities. The input factor categories each have a corresponding numeric score. The input factor categories reflect site-specific conditions, which result in differing scores reflecting a greater or lesser contribution to the explosive hazards at the site.

7.3.2 Scoring Considerations

a. Once each scenario is assessed using MEC HA, a score is produced which is associated with one of four hazard levels reflecting the interaction between the current and future human activities in an MRS and the types, amounts, and conditions of MEC items within the MRS.

b. MEC HA scoring may be conducted several times for an individual MRS, in order to account for different site condition scenarios. These factors may be changed to reflect conditions after cleanup, different land use activities, or land use controls. Data on the current, determined or reasonably anticipated future land use activities are used to select categories for four input factors as follows:

- Location of Additional Human Receptors;
- Site Accessibility;
- Potential Contact Hours; and
- Minimum MEC Depth Relative to the Maximum Intrusive Depth.

c. Outdoor activities create the greatest exposure to MEC. Each land use type (e.g., residential, industrial or commercial, recreational, and open space) may have associated outdoor activities. Residential users may garden or build an addition onto their home. Construction, agriculture, and mining are by their nature intrusive; examples include upgrading or replacement of buried infrastructure and seasonal plantings or landscape upgrades (USEPA, 2008).

d. Sources of information on future land use scenarios include, but are not limited to, zoning maps, local government master plans, historical land use trends, parcel ownership maps from local government, and public park authorities. MEC HA supports the evaluation of removal or remedial actions that are protective of human health and the environment. The project team using the CERCLA removal or remedial process will often identify two types of removal or remedial alternatives:

- Cleanup of MEC items from the surface and subsurface. The major variation will be the depth and area covered by the cleanup; and
- Identification of LUCs that effectively control potential exposure to any remaining MEC.

e. Response actions can range from removal of MEC items combined with use of Land Use Controls (LUCs) to use of LUCs alone. The NCP remedy preference is that institutional controls

not be the sole remedy unless treatment is impracticable. Removal or remedial alternatives are input factors. Each alternative can affect various input factor categories (USEPA, 2008).

7.3.3 Summary of MEC HA Score

a. As described in Section 5, MEC and MD were discovered in numerous areas; eight of those areas were specified and given temporary identifying name (e.g., Area Alpha, Bravo, etc.). Of the existing MRSs and these special areas with MEC and/or high MD, eight areas contained MEC and thus, required inclusion in the MEC HA. As per the PWS, we have suggested proposed MRS realignment, in coordination with the PDT. MEC data from previous activities were considered along with data collected during this RI, to complete the MEC HA. The corresponding resulting Hazard Level Category and associated Score for each area containing MEC are summarized below; details are provided in Appendix H.

Current Designation	Proposed Designation	Hazard Level Category	Score
MRS 3 (Area Charlie/Delta)	Proposed 105mm Area	1	950
MRS 3 (Area Foxtrot)	Proposed Maneuver Area	1	1000
MRS 3 (Area Golf)	Proposed Mortar/Grenade Area	1	980
MRS 3 (Area Echo)	Proposed 60mm Mortar Area	3	705
MRS 3 (Area Bravo)	Proposed 60/81mm Mortar Area	1	965
MRS 3 (Area Alpha)	Proposed Rocket & Rifle Grenade Area	1	905
MRS 3	Proposed Rocket/Grenade Maneuver Area	2	760
AoPI 10B/11B	Proposed Grenade Maneuver Area	2	755

b. Hazard Level Categories are ranked 1 through 4, with 1 representing the highest potential explosive hazard conditions, 2 representing a high potential explosive hazard condition, and 3 representing a moderate potential explosive hazard condition. Hazard Level Categories are based on the Score; Hazard Level 1 is 1,000 to 840, Hazard Level 2 is 835 to 725, and Hazard Level 3 is 720 to 530.

7.3.4 Munitions Response Site Prioritization Protocol

a. The Munitions Response Site Prioritization Protocol (MRSPP) was established to help the DoD assign a relative priority for response activities across DoD properties (current and former). The potential risk posed by past munitions activities is evaluated using three hazard evaluation modules; those being the Explosive Hazard Evaluation (EHE), Chemical Warfare Material Hazard Evaluation (CHE), and Health Hazard Evaluation (HHE). The modules are developed for each MRS and combined together to determine a MRSPP score for each MRS. Scores range from 1 to 8; the lower the score, the higher the potential risk. The scoring process is iterative and should be revised as new information becomes available.

b. The MRSPP score was calculated for both the remaining original MRSs at the former Camp Croft as well as for the new proposed realigned MRSs. The MRSPP score for MRS 1 was based on the lower Priority score calculated in the CHE module. The MRSPP score for MRS 2 as well as for all of the Proposed MRSs was based on the lower Priority score calculated in the EHE module. The MRSs and their corresponding MRSPP scores are summarized below. Refer to Appendix H for complete MRSPP scoring tables.

Current Designation	Proposed Designation	MRSPP Score
MRS 1	MRS 1	7
MRS 2	MRS 2	4
MRS 3 (Area Charlie/Delta)	Proposed 105mm Area	3
MRS 3 (Area Foxtrot)	Proposed Maneuver Area	3
MRS 3 (Area Echo)	Proposed 60mm Mortar Area	4
MRS 3 (Area Bravo)	Proposed 60/81mm Mortar Area	4
MRS 3 (Area Alpha)	Proposed Rocket & Rifle Grenade Area	3
MRS 3	Proposed Rocket/Grenade Maneuver Area	4
MRS 3	Proposed Remaining Lands	6
AoPI 3	Proposed Grenade Area	5
AoPI 10A	Proposed Rocket Area	4
AoPI 10B/11B	Proposed Grenade Maneuver Area	4
AoPI 11C	Proposed Practice Grenade Area	4
AoPI 11D	Proposed Mortar/Rifle Grenade Area	4

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8.0 SUMMARY OF RESULTS

a. The nature and extent of MEC and MC at the former Camp Croft was significantly refined during the RI investigation. Despite access restrictions at some parcels, much of the area designated for investigation was accessible and was covered, as designed, by the field investigation team. Transects were investigated using a combination of mag-and-dig and AIR methods. Grids were established using information obtained from the transects and those grids were investigated using a combination of mag-and-dig and DGM methods. Soil samples were collected in areas of medium to high MD density to determine the nature and extent of potential MC contamination.

b. As per the PWS, the need for significant realignment of MRSs became apparent following the investigation. MRS 1 and MRS 2 boundaries remain unchanged. MRS 3 was divided into nine smaller areas; seven of those areas were given temporary designation (e.g., Area Alpha through Area Golf) for identification purposes. Four AoPIs remain unchanged, as no MEC or MD were observed. Six AoPIs are recommended for realignment as five MRSs (AoPI 10B/11B are combined into one MRS). Refer to Table 8-1 for proposed boundary realignment details.

8.1 NATURE AND EXTENT OF MEC AND MC

8.1.1 MEC Summary

a. The MEC items and MD identified throughout this investigation can be classified into one of five categories (i.e., grenade, landmine, mortar, projectile, or rocket). The MD items found that could not be classified into one of these categories is simply referred to as "Undifferentiated MD"; these fragments were recognized as fragments from a type of munitions, but they were too small or too deteriorated to make a positive identification. A list of items discovered during the RI field investigation, associated with the appropriate category, is provided below:

- Grenade – MK I hand grenade (practice), Mk II hand grenade, M15 hand grenade (smoke), and M19 rifle grenade (illumination);
- Landmine – M1 anti-tank;
- Mortar – 60mm (training, illumination, HE) , 81mm (training, HE);
- Projectile – 37mm, 57mm, 105mm HE, 105mm Illumination; and
- Rocket – 2.36" Bazooka.

b. Over the entire MRS, small arms, low quantities of MD and one MEC item were discovered in areas apparently disconnected from former ranges. These findings indicate that southern parts of the former Camp Croft were used sporadically for various training exercises, but none apparently heavily used. However, eight areas are identified as containing MEC and/or very high MD concentrations that are directly accessible to humans; seven of those areas are in MRS 3. In these areas, a total of 39 MEC, one DMM, and thousands of pounds of MD were removed during the RI investigation. Those eight areas are listed below and are shown on Exhibits 5-4 and 5-6.

- AoPI 10A (Exhibit 5-4) – an area located within the eastern half of the AoPI;
- Area Alpha (Exhibit 5-6) – southeast of AoPI 9G and Dairy Ridge Road, within the area formerly known as OOU12A;

- Area Bravo (Exhibit 5-6) – along Henningston Road, just inside Croft State Natural Area property and east of AoPI 10B;
- Area Charlie (Exhibit 5-6) – an area west of and adjacent to Highway 176, centrally-located within the area formerly known as OOU6A/B;
- Area Delta/Echo (Exhibit 5-6) – two areas along Whitestone Road, one centered near the intersection with Cow Ford Bridge Road (Delta) and another further south, at the southern extent of MRS 3 (Echo);
- Area Foxtrot (Exhibit 5-6) – along Croft State Park Road, within the area formerly known as OOU1A; and
- Area Golf (Exhibit 5-6) – north of Croft State Park Road, within the area formerly known as OOU7.

8.1.2 MC Summary

a. Lead was the only MC detected above its RSL in surface soil samples collected from the former Camp Croft. These samples were collected from grids MRS3-A and A4718 located in MRS 3. As shown by subsequent samples and XRF field testing performed on samples collected from areas outside the grids, lead contamination appears to be localized and limited to these grids and the areas immediately surrounding them.

8.2 RISK ASSESSMENT

8.2.1 Human Health Risk Assessment

a. Maximum and average exposure concentrations of the COPCs were used to compare to conservative residential screening levels. Except for lead, the maximum exposure concentrations were below residential screening levels. Since the dominant exposure scenario would be recreational, potential risks are considered negligible and are not quantified further in the risk assessment process.

b. Lead occurs above its screening level at two locations within the MRS. Based on the output from EPA's IEUBK model for lead in children that assumes residential exposure assumptions, lead is not a concern at these concentrations. In conclusion, there are no threats from concentrations of MC to human health at the MRS 3 at the former Camp Croft FUDS.

8.2.2 Screening-Level Ecological Risk Assessment

a. At a few grid locations, most notably at A4718, MRS3-A, 12A-196, and the post-BIP samples, the metal COPC concentrations exceed conservative screening levels protective of insectivorous birds and mammals with hazard quotients generally less than 6.0. Exposure to metal fragments that are not readily bioavailable suggests an overestimation of potential risks. In addition, these small affected areas comprise only a tiny fraction of overall habitat and home ranges of the receptors. Given the existing data, it is not anticipated that significant adverse risks would occur to local populations of wildlife.

8.2.3 MEC HA and MRSPP Scoring

a. As described in Section 5, MEC and MD were discovered in numerous areas; eight of those areas were specified and given temporary identifying name (e.g., Area Alpha, Bravo, etc.). Of the existing MRSs and these special areas with MEC and/or high MD, seven areas contained

MEC and thus, required inclusion in the MEC HA. As per the PWS, we have suggested proposed MRS realignment, in coordination with the PDT. MEC data from previous activities were considered along with data collected during this RI, to complete the MEC HA. The corresponding resulting Hazard Level Category and associated Score for each area containing MEC are summarized below; details are provided in Appendix H.

Current Designation	Proposed Designation	Hazard Level Category	Score
MRS 3 (Area Charlie/Delta)	Proposed 105mm Area	1	950
MRS 3 (Area Foxtrot)	Proposed Maneuver Area	1	1000
MRS 3 (Area Echo)	Proposed 60mm Mortar Area	3	705
MRS 3 (Area Bravo)	Proposed 60/81mm Mortar Area	1	965
MRS 3 (Area Alpha)	Proposed Rocket & Rifle Grenade Area	1	905
MRS 3	Proposed Rocket/Grenade Maneuver Area	2	760
AoPI 10B/11B	Proposed Grenade Maneuver Area	2	755

b. Hazard Level Categories are ranked 1 through 4, with 1 representing the highest potential explosive hazard conditions, 2 representing a high potential explosive hazard condition, and 3 representing a moderate potential explosive hazard condition. Hazard Level Categories are based on the Score; Hazard Level 1 is 1,000 to 840, Hazard Level 2 is 835 to 725, and Hazard Level 3 is 720 to 530.

c. The MRSPP score was calculated for both the remaining original MRSs at the former Camp Croft as well as for the new proposed realigned MRSs. The MRSPP score for MRS 1 was based on the lower Priority score calculated in the CHE module. The MRSPP score for MRS 2 as well as for all of the Proposed MRSs was based on the lower Priority score calculated in the EHE module. The MRSs and their corresponding MRSPP scores are summarized below. Refer to Appendix H for complete MRSPP scoring tables.

Current Designation	Proposed Designation	MRSPP Score
MRS 1	MRS 1	7
MRS 2	MRS 2	4
MRS 3 (Area Charlie/Delta)	Proposed 105mm Area	3
MRS 3 (Area Foxtrot)	Proposed Maneuver Area	3
MRS 3 (Area Echo)	Proposed 60mm Mortar Area	4
MRS 3 (Area Bravo)	Proposed 60/81mm Mortar Area	4
MRS 3 (Area Alpha)	Proposed Rocket & Rifle Grenade Area	3
MRS 3	Proposed Rocket/Grenade Maneuver Area	4
MRS 3	Proposed Remaining Lands	6
AoPI 3	Proposed Grenade Area	5
AoPI 10A	Proposed Rocket Area	4
AoPI 10B/11B	Proposed Grenade Maneuver Area	4
AoPI 11C	Proposed Practice Grenade Area	4
AoPI 11D	Proposed Mortar/Rifle Grenade Area	4

8.3 CONCLUSIONS AND RECOMMENDATIONS

a. Munitions-related items are present in many locations across the former Camp Croft. Historical evidence collected from previous investigations and removal actions were combined with findings from this RI to present a comprehensive understanding of the nature and extent of MEC and MC at many of the areas included in this investigation. Some areas were inaccessible; the potential for MEC and MC to exist at those parcels is unknown (e.g., MRS 2 and AoPI 3). Notwithstanding those inaccessible areas, much of the former camp was accessible and conclusions can be drawn from available data.

b. MRS 3 and five AoPIs are recommended for boundary realignment. It is recommended that MRS 3 be divided into nine MRSs. Slight adjustments to the total acreage are necessary based on RI findings (see Table 8-1). AoPIs 3, 10A, 10B, 11B, 11C, and 11D are recommended for realignment as five MRSs (AoPIs 10B and 11B are combined into one Proposed MRS). Refer to Exhibits 8-1 through 8-19 for proposed boundary realignment details.

8.3.1 MRS 1 – Gas Chamber

a. MRS 1 was accessible and investigated, as planned (Exhibits 5-1 and 8-1). Transects were surveyed using AIR methods and five grids were established in the area thought to correspond to the former gas chamber and evaluated using mag-and-dig methods. No MEC or MD were observed during the RI and thus, no media samples were collected for MC analyses. Considering the findings in MRS 1, it is recommended for No Further Action and will not require inclusion in the Feasibility Study; however, it will be included in subsequent Decision Documents.

8.3.2 MRS 2 – Grenade Court

a. The majority of MRS 2 was not accessible during this investigation, as rights-of-entry were not granted (Exhibits 5-1 and 8-2). MRS 2 should maintain its current status and, assuming rights-of-entry can be obtained at some point in the future, the property should be investigated.

8.3.3 Proposed 105mm Area

a. These areas are within MRS 3 and roughly corresponds to the former Combat Range #15 and OOU6A/B area; the majority of these areas were investigated, as planned, with one minor modification (Exhibits 5-6, 5-9, and 8-3). Several small parcels were inaccessible, as rights-of-entry were not granted.

b. The eastern part of the area is largely composed of 340 acres of privately-owned land that is partially used as a landfill. Numerous activities (e.g., TCRAs, EE/CAs, etc.) have been conducted at this area, as described in previous sections. A wide range of MEC has been removed from this area; examples include numerous 105mm projectiles and 81mm and 61mm mortars. Thousands of pounds of MD have reportedly been removed from various areas across the site. Despite these previous activities, this area was observed to have some of the highest concentrations of MD following the RI field activities.

c. For the majority of the eastern part of the area, transects were surveyed using mag-and-dig methods. However, an abnormally high concentration of MD was encountered along numerous transects and grids in the central portion of the eastern part of the area. In these areas, anomaly counts requiring intrusive investigation were so high, the PDT allowed the field teams to briefly convert the mag-and-dig transects to AIR transects. While no MEC were encountered,

it should be noted that the highest MD concentrations exist in the area formerly known as OOU6. Small arms were encountered along transects in several locations. Four 50 ft by 50 ft grids were established in areas where elevated concentrations of MD were observed. Those grids were evaluated and all anomalies were intrusively investigated. Five soil samples were collected from each of the four grids. No explosives were detected. Various metals were detected, none above corresponding PALs.

d. The western part of the area is bisected (approximately) by Whitestone Road. Along with several large parcels of land, there are numerous smaller residential parcels. Transects were surveyed using mag-and-dig methods and one 10 ft by 250 ft grid was established in an area where elevated concentrations of MD were observed; that grid was evaluated using an EM-61 and all anomalies were intrusively investigated. Numerous MD items were encountered across the area; fragments resembled variously-sized projectiles. Small arms were encountered along transects in several locations. Five soil samples were collected from the grid. No explosives were detected. Various metals were detected, none above corresponding PALs.

e. Considering the findings summarized above, this area is recommended for realignment as the 105mm Area MRS and should be carried forward in the Feasibility Study.

8.3.4 Proposed Maneuver Area

a. These areas are within MRS 3 and roughly correspond to the former OOU1A, OOU1B, OOU7, and OOU9B; these areas were investigated, as planned (Exhibits 5-6, 5-8, and 8-4). The entry roadway into the State Park winds through this area and many of park facilities (e.g., campgrounds, trails, and horse stable) are within or near this area.

b. Since the late 1990's, numerous investigations and remedial actions have been conducted over portions of these areas, as described in previous sections. For those, numerous MEC, MD and elevated concentrations of small arms have been observed (Exhibit 2-4). Historical finds include MEC (60/81mm, MKII, 105mm) and MD (60/81mm, 2.36" M9) as reported by EE/CAs 1996 ESE and 1998 QST.

c. During the RI, transects were surveyed using mag-and-dig methods. Following transect observations, 36 grids of various sizes (e.g., 50 ft by 50 ft and 10 ft by 250 ft) were established; 24 grids in the northern part and 12 grids in the southern part of this area. These grids were established in areas where elevated concentrations of MEC and MD were observed, and were evaluated using an EM-61. All anomalies selected from the EM-61 data were intrusively investigated. Numerous MEC and MD (grenade, projectile, mortar) were encountered in these areas, along with heavily concentrated small arms on the surface, in some areas. Chemical analytical samples were collected at five 50 ft by 50 ft grids, two 10 ft by 250 ft grids, and at two discrete locations along a trail (see Exhibit 5-8). Lead was detected above its RSL in grid A4718 (in the southern part of this area) and at the two discrete locations (i.e., MRS3-A and MRS3-B) along the trail. Additional follow-on XRF field screening was performed and analytical samples were collected using a step-out procedure around those locations; concentrations of lead were significantly lower in samples further from the original locations, lead contamination appears to be localized and limited to these grids and the areas immediately surrounding them.

d. Considering the findings summarized above, this area is recommended for realignment as the Maneuver Area MRS and should be carried forward in the Feasibility Study.

8.3.5 Proposed 60mm Mortar Area

a. This area is located along the southeastern boundary of MRS 3 and immediately north and west of the former OOU11A; this area was investigated, as planned (Exhibits 5-6 and 8-5). Approximately half of this area lies with the former Combat Range #15 and half extends beyond that former boundary, to the south. Transects within the accessible northern portion of this area were surveyed using mag-and-dig methods and five 50 ft by 50 ft grids established in areas where elevated concentrations of MEC and MD were observed; those grids were evaluated using an EM-61 and all anomalies were intrusively investigated.

b. As reported in a 1998 EE/CA, 2.36" M1 MD was observed within OOU11A. Those parcels were not accessible during the RI fieldwork, as rights-of-entry were not granted. Within accessible parcels to the west and north of the former OOU11A, one 60mm MEC item and numerous mortar and fragmentation MD were observed, including along the furthest accessible transect to the south. It is possible through inference that MD and potential MEC exists in the southern portion of this area. No media samples were collected for MC analyses.

c. Considering the findings summarized above, this area is recommended for realignment as the 60mm Mortar Area MRS and should be carried forward in the Feasibility Study.

8.3.6 Proposed 60/81mm Mortar Area

a. This area is within MRS 3 and roughly corresponds to the former OOU2; this area was investigated, as planned (Exhibits 5-5, 5-6, 5-8, and 8-6). A small portion of this area (i.e., the easternmost point) lies beyond the MRS 3 boundary. During the RI fieldwork, transects in this area were extended to the east and merged with those in former AoPI 10B, based on heavy concentrations of MD observed by the field teams. Transects were surveyed using mag-and-dig methods and sixteen 50 ft by 50 ft grids established in areas where elevated concentrations of MEC and MD were observed; those grids were evaluated using an EM-61 and all anomalies were intrusively investigated.

b. Heavy concentrations of MEC have been observed in this area during previous investigations. During the RI fieldwork, numerous MEC and MD were encountered, corroborating previous findings. Some MEC were observed just south of Henningston Road, which bisects this area. Rights-of-entry to an adjacent parcel north of Henningston Road were not granted. It is possible through inference that MD and potential MEC exists on the inaccessible parcel north of Henningston Road.

c. Five soil samples were collected from each of six grids within this area. No explosives were detected. Various metals were detected, none above corresponding PALs.

d. Considering the findings summarized above, this area is recommended for realignment as the 60/81mm Mortar Area MRS and should be carried forward in the Feasibility Study.

8.3.7 Proposed Rocket & Rifle Grenade Area

a. During the planning stages of the RI, a corridor connecting AoPI 9G with MRS 3 was recommended for inclusion in the investigation. The following paragraph addresses this corridor and part of MRS 3, while the area north of the corridor, AoPI 9G, is addressed in Section 8.3.14.

b. This area is located along the northeastern boundary of MRS and roughly corresponds to the former OOU12A; this area was investigated, as planned (Exhibits 5-1, 5-6, 5-7 and 8-7). Transects were surveyed using mag-and-dig methods and three 50 ft by 50 ft grids established in

areas where elevated concentrations of MEC and MD were observed; those grids were evaluated using an EM-61 and all anomalies were intrusively investigated.

c. Various MD and MEC were discovered during the RI field investigations; those items are generally categorized as rockets and grenades, and include 2.36-inch fuzes, rockets, and warheads, M9 and M9A1 rifle grenades, and Mk II grenades. Numerous MD items (and hundreds of pounds of metal) were removed from the site and properly disposed. Three MEC items were detonated in place. Based on the substantial MEC and MD findings during the RI investigation, the expansion area to the east of AoPI 9G and a portion of MRS 3 recommended for an IRA, which was conducted between May and July 2013, as described above in Section 5.1.3.d and Appendix P.

d. During the IRA, approximately 50 acres were intrusively investigated using hand-held magnetometers to a depth of six inches bgs; 100% of the area was inspected. The following items were discovered and removed from within the TCRA boundary:

- 173 MEC items were discovered and destroyed. Those items included 2.36-inch fuzes, rockets, and warheads, M9 and M9A1 rifle grenades, and Mk II grenades.
- Approximately 1,200 MD items were deemed to be intact versions of the items listed above, but were not MEC; those items were detonated along with the MEC items.
- Approximately 9,900 pounds of MD were removed from the site and properly disposed.
- Four small pits, varying in size from approximately 550 ft^2 to 6,115 ft^2, with large quantities of metallic debris were identified.

e. A single explosive was detected in one surface soil sample; PETN was detected in soil sample CC-MRS3-ZSB-18 collected from grid 12A-187 (Exhibit 5-6) at 1,240 µg/kg, below the RSL of 120,000 µg/kg. Various metals were detected, none above corresponding PALs.

f. Considering the findings summarized above, this area is recommended for realignment as the Rocket & Rifle Grenade Area MRS and should be carried forward in the Feasibility Study.

8.3.8 Proposed Rocket/Grenade Maneuver Area

a. This area is within the southern portion MRS 3 and roughly corresponds to the former OOU12B (Exhibits 5-6 and 8-8). This area was originally part of a larger area thought to be far south of the firing points along Dairy Ridge Road (beyond the range fans) and thus, designated for AIR evaluation along transects. During RI fieldwork, the USACE agreed to change the method of investigation along a portion of the transects to mag-and-dig. Following the transect evaluation, four 50 ft by 50 ft grids were established in areas where elevated concentrations of MEC and MD were observed; those grids were evaluated using an EM-61 and all anomalies were intrusively investigated.

b. As reported in a 1998 EE/CA, one M9A1 MEC item was encountered in OOU12B during previous field investigations. During the RI, minimal grenade MD and other fragments were observed. However, two fuzes were encountered in the southern portion of this area; these appeared to be unique, in that no real evidence of training was found in close proximity to these items. No media samples were collected for MC analyses.

c. Considering the findings summarized above, this area is recommended for realignment as the Rocket/Grenade Maneuver Area MRS and should be carried forward in the Feasibility Study.

8.3.9 Proposed Remaining Lands

a. This area is within MRS 3 and is composed of all of the remaining area not included in the proposed boundary realignments herein (Exhibits 5-6 and 8-9). This area was investigated, as planned using both mag-and-dig and AIR transects. Following the transect evaluations, thirty-six 50 ft by 50 ft grids were established is areas where elevated MD concentrations along mag-and-dig transects and anomaly concentrations along AIR transects were observed. Those grids were investigated using an EM-61 or mag-and-dig methods, for mag-and-dig or AIR transects, respectively. No MEC were encountered in this area. Three soil samples were collected from a grid established along a berm that was observed adjacent to Whitestone Road. No explosives were detected. Various metals were detected, none above corresponding PALs.

b. Considering this area is the remainder of MRS 3, not included in areas proposed herein, and the findings summarized above, this area is recommended for realignment as the Remaining Lands MRS and should be carried forward in the Feasibility Study.

8.3.10 Proposed Grenade Area

a. This area surrounds the Wedgewood subdivision and is primarily composed of golf course property. Since the late 1990's, numerous investigations and remedial actions have been conducted in the Wedgewood subdivision. During those actions, numerous MEC items and thousands of pounds of MD have been removed (Exhibit 2-3). MEC items encountered include M15 white phosphorous (WP) grenades, Mk II practice grenades, and Mk II fragmentation grenades.

b. During the RI design phase, the PWS-defined boundary was shifted to a buffer zone around the neighborhood, beyond where removal actions had been performed (Exhibits 5-2, 5-7, and 8-10). The majority of this area was not accessible, as rights-of-entry were not granted. However, a small portion of residential parcels located in the southern portion of this area were investigated, as planned. Transects were surveyed using mag-and-dig methods. No MEC or MD were observed during the RI and thus, no grids were established and no media samples were collected for MC analyses. Considering the findings adjacent to this area in previous investigations, it is recommended that this area be realigned as the Grenade Area MRS and should be carried forward in the Feasibility Study.

8.3.11 Area of Potential Interest (AoPI) 5

a. The northern portion of AoPI 5 was accessible and investigated, as planned (Exhibits 5-3 and 8-11); the southeastern portion was not accessible during this investigation, as rights-of-entry were not granted. Transects were surveyed using mag-and-dig methods. Despite reported limited MD frag (60/81mm) during the 1996 EE/CA by ESE, no MEC or MD were observed during the RI and thus, no grids were established and no media samples were collected for MC analyses. Considering the findings in AoPI 5, it is recommended for No Further Action and will not require inclusion in the Feasibility Study; however, it will be included in subsequent Decision Documents.

8.3.12 Area of Potential Interest (AoPI) 8

a. AoPI 8 was accessible and investigated, as planned (Exhibits 5-4 and 8-12). Transects were surveyed using mag-and-dig methods. No MEC or MD were observed during the RI and thus, no grids were established and no media samples were collected for MC analyses. Considering the findings in AoPI 8, it is recommended for No Further Action and will not

require inclusion in the Feasibility Study; however, it will be included in subsequent Decision Documents.

8.3.13 Area of Potential Interest (AoPI) 9E

a. AoPI 9E was accessible and investigated, as planned (Exhibits 5-3 and 8-13). Transects were surveyed using mag-and-dig methods. No MEC or MD were observed during the RI and thus, no grids were established and no media samples were collected for MC analyses. Considering the findings in AoPI 9E, it is recommended for No Further Action and will not require inclusion in the Feasibility Study; however, it will be included in subsequent Decision Documents.

8.3.14 Area of Potential Interest (AoPI) 9G

a. AoPI 9G is a 6.6-acre area composed of private residential property. During the planning stages of the RI, additional investigation was recommend for a corridor connecting AoPI 9G with MRS 3. The following paragraph addresses the 6.6-acre AoPI 9G, while the expanded corridor to the south is addressed as part of the Proposed Rocket & Rifle Grenade Area (Section 8.3.7).

b. The southern portion of AoPI 9G was accessible and investigated, as planned (Exhibits 5-1 and 8-14); the northern portion was not accessible during this investigation, as rights-of-entry were not granted. Transects were surveyed using mag-and-dig methods. No MEC or MD were observed during the RI and thus, no grids were established and no media samples were collected for MC analyses. Considering the findings in AoPI 9G, it is recommended for No Further Action and will not require inclusion in the Feasibility Study; however, it will be included in subsequent Decision Documents.

8.3.15 Proposed Rocket Area

a. This area corresponds to AoPI 10A, which was investigated, as planned (Exhibits 5-4 and 8-15). Transects were surveyed using mag-and-dig methods and eight 50 ft by 50 ft grids were established in the areas where elevated concentrations of MD were observed; those grids were evaluated using an EM-61 and all anomalies were intrusively investigated. Numerous munitions items have been reported at this site since site closure; those include grenades, mortars, landmines, rockets, and small arms. No MEC was discovered during the RI field investigation. A total of 33 various MD were discovered during the RI field investigation, corroborating findings presented in the 1998 EE/CA investigation; those items are generally categorized as rockets, grenades, landmines, mortars, projectiles, and undifferentiated MD. Specific examples of items found include parts of Mk II hand grenades, 2.36-inch rockets, and M1 landmines. The majority of the findings appear to be in the eastern half and southwestern corner of the area. Five analytical samples were collected from one 50 ft by 50 ft grid established in the southwestern corner of the area. No explosives were detected. Various metals were detected, none above corresponding PALs. Considering the findings summarized above, AoPI 10A is recommended for realignment as the Rocket Area MRS and should be carried forward in the Feasibility Study.

8.3.16 Proposed Grenade Maneuver Area

a. This area encompasses AoPI 10B and AoPI 11B, along with the area between and an area just west of AoPI 10B (Exhibits 5-5 and 8-16). The northern tip and southern half of this area were investigated, as planned, using mag-and-dig transects. During the RI fieldwork, transects

for AoPI 10B were extended to the west, based on MD observations. A large parcel making up most of the northern half of this area was inaccessible, as rights-of-entry were not granted. Various MD were observed along transects corroborating previous historical findings (Exhibit 2-4); the majority of the fragments were attributed to grenades and mortars. Four 50 ft by 50 ft grids were established, three in AoPI 10B and one in AoPI 11B. No media samples were collected for MC analyses. Considering the findings summarized above, this area is recommend for realignment as the Grenade Maneuver Area MRS and should be carried forward in the Feasibility Study.

8.3.17 Proposed Practice Grenade Area

a. This area corresponds approximately to AoPI 11C, which was shifted east during the design phase of the RI and investigated, as planned (Exhibits 5-2 and 8-17). Transects were surveyed using mag-and-dig methods across the residential portion of the area. Minimal grenade-related MD were encountered, which corroborates previous findings on adjacent parcels (Exhibit 2-3). Digital geophysical data were collected on the adjacent ball fields; no MD were observed. One 50 ft by 50 ft grid was established (based on mag-and-dig transects) in an area where MD were observed. Based on the minimal MD observed, no media samples were collected for MD analyses. Considering the findings summarized above, this area is recommended for realignment as the Practice Grenade Area MRS and should be carried forward in the Feasibility Study.

8.3.18 Proposed Mortar/Rifle Grenade Area

a. This area corresponds approximately to AoPI 11D, which was shifted to the northwest during the design phase of the RI and partially investigated as planned (Exhibits 5-2 and 8-18). The central portion of this area is a golf course fairway and was not accessible during the RI, as rights-of-entry were not granted. Transects were surveyed using mag-and-dig methods. Six MD items (i.e., mortar fragments) were discovered in the southeastern corner of the area investigated during the RI; this corroborates previous findings reported to the Sheriff since site closure, namely one rifle grenade and several mortars. No grids were established and media samples were collected for MC analyses. Considering the findings summarized above, this area is recommended for realignment as the Mortar/Rifle Grenade MRS and should be carried forward in the Feasibility Study.

TABLE 8-1 PROPOSED BOUNDARY REALIGNMENT

Current Designation	Size (acres)	Proposed Designation	Size (acres)	Comment	Exhibit
MRS 1	23.8	MRS 1	23.8	No MEC/MD observed	8-1
MRS 2	24.9	MRS 2	24.9	Minimal access; Suspected grenade court	8-2
MRS 3 (Area Charlie/Delta)	12,102.4	105mm Area	1,399.7	105mm projectile area	8-3
MRS 3 (Area Foxtrot)	12,102.4	Maneuver Area	1,276.5	Mixed munitions use	8-4
MRS 3 (Area Echo)	12,102.4	60mm Mortar Area	303.4	Mixed munitions use; Primarily mortars	8-5
MRS 3 (Area Bravo)	12,102.4	60/81mm Mortar Area	301.3	Mixed munitions use; Primarily mortars	8-6
MRS 3 (Area Alpha)	12,102.4	Rocket & Rifle Grenade Area	108.5	Mixed munitions use	8-7
MRS 3	12,102.4	Rocket/Grenade Maneuver Area	126.3	Mixed munitions use	8-8
MRS 3	12,102.4	Remaining Lands	9,093.4	No MEC and minimal MD observed	8-9
AoPI 3	11.0	Grenade Area	19.2	Minimal access; Suspected grenade court	8-10
AoPI 5	5.5			No MEC/MD observed	8-11
AoPI 8	23.9			No MEC/MD observed	8-12
AoPI 9E	7.6			No MEC/MD observed	8-13
AoPI 9G	6.6			No MEC/MD observed	8-14
AoPI 10A	171.5	Rocket Area	93.9	Mixed munitions use; Primarily rockets	8-15
AoPI 10B	33.6	Grenade Maneuver Area	450.5	Mortar (and grenade) area	8-16
AoPI 11B	34.7				
AoPI 11C	23.0	Practice Grenade Area	6.4	Grenade area	8-17
AoPI 11D	15.1	Mortar/Rifle Grenade Area	22.9	Mortar (and grenade) area	8-18

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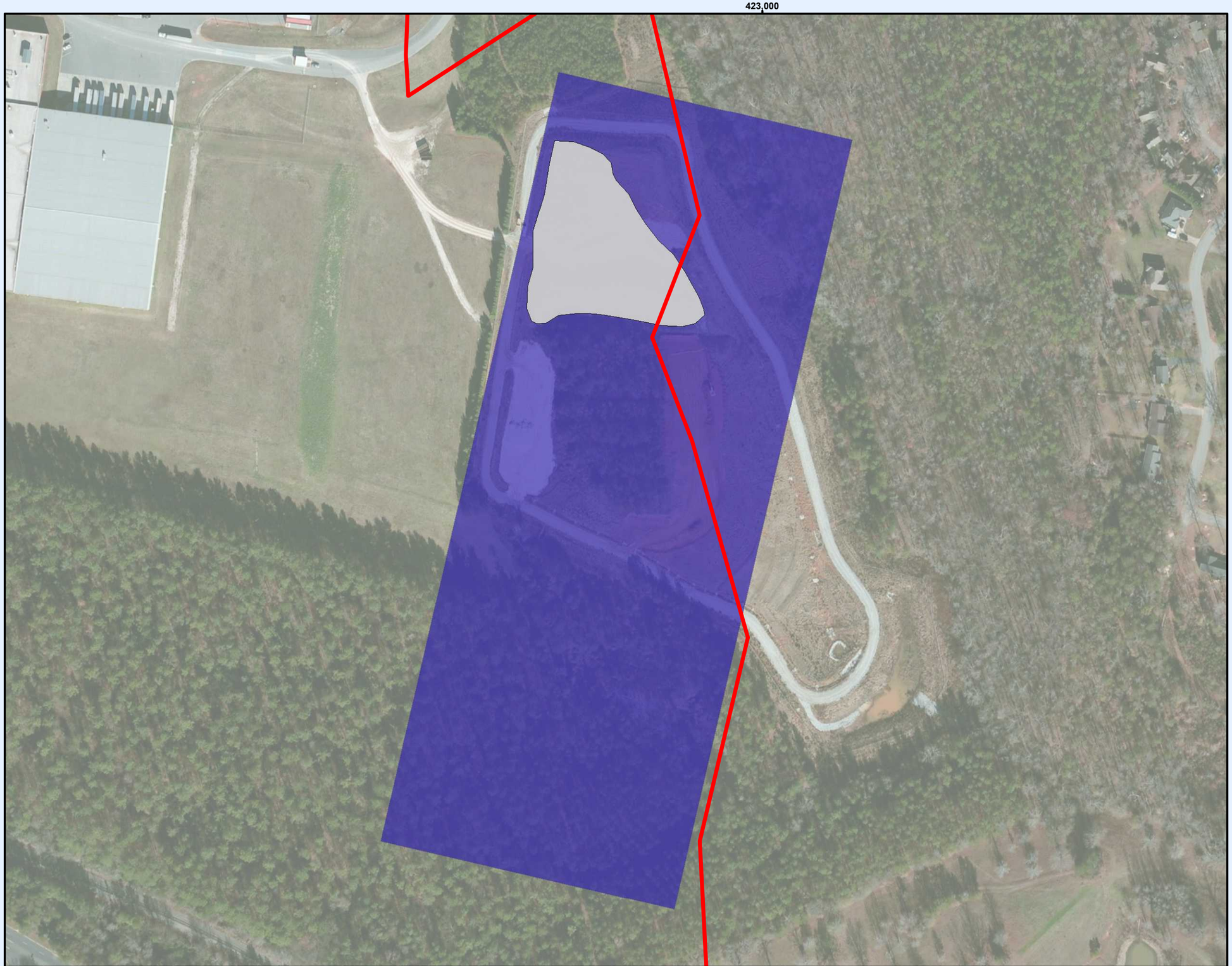

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Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed MRS 1
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-1

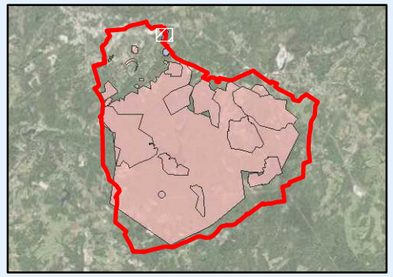
KEY

- Former Camp Croft Boundary
- Inaccessible Area
- MRS 1

Note: No boundary change recommended for MRS 1.

N
W E
S

0 100 200 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 200 '	ATD

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Huntsville, AL 35816

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Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed MRS 2
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-2

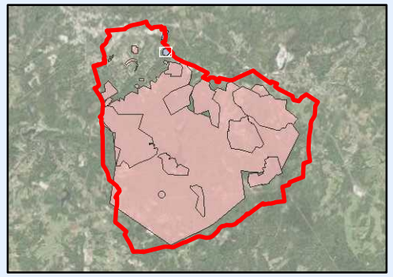
KEY

- Former Camp Croft Boundary
- Inaccessible Parcel
- MRS 2

Note: No boundary change recommended for MRS 2.

N
W E
S

0 75 150 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
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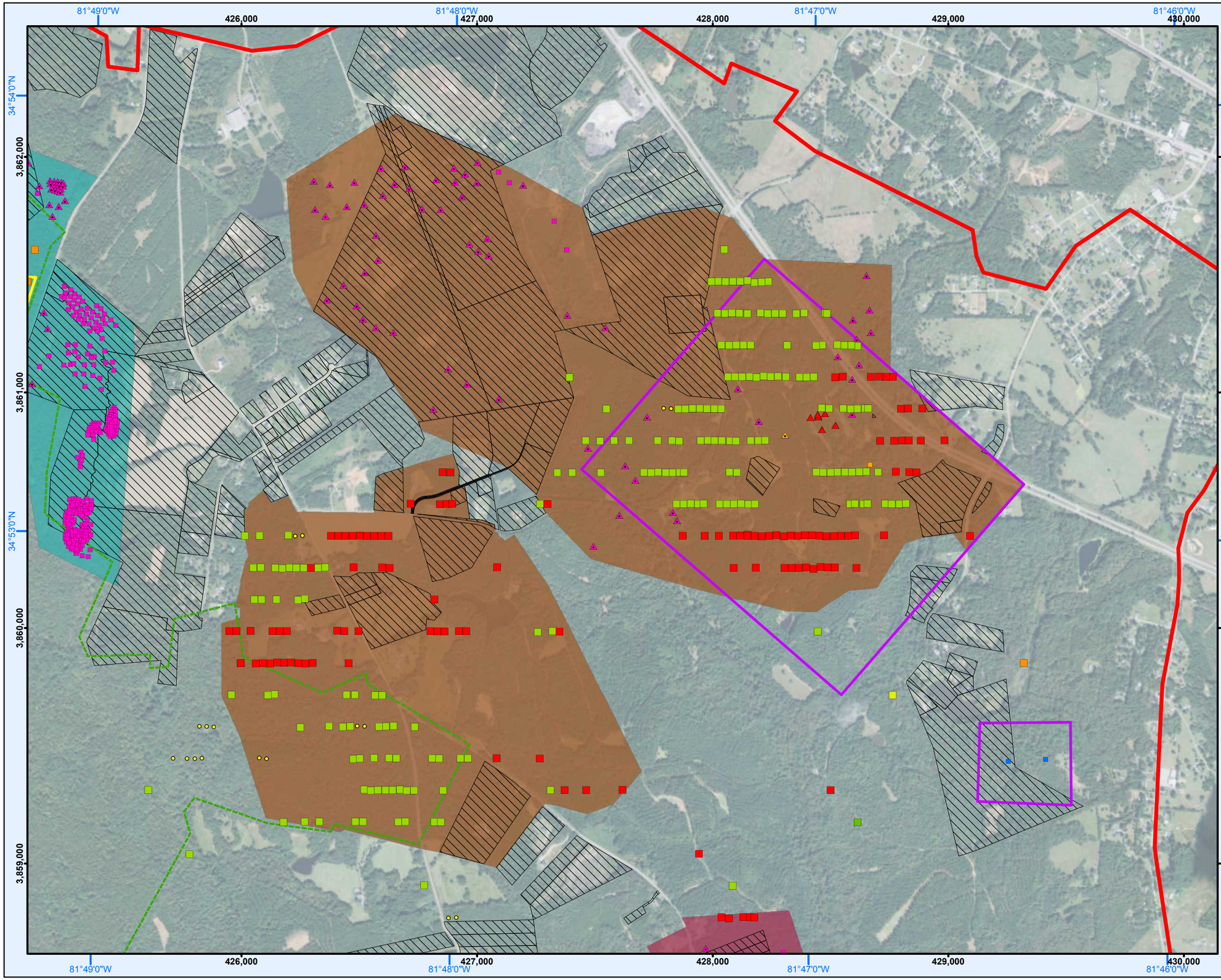


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed 105mm Area
Revision 2

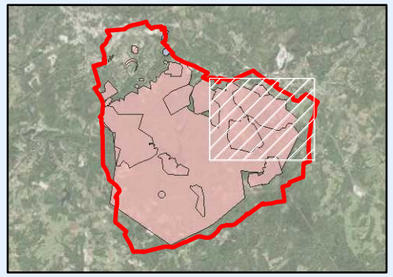
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-3

KEY

- Frag / Undifferentiated MD
- Grenade MD
- Mine MD
- Mortar MD
- Projectile MD
- MEC from 1954 Dedudding Maps
- MD from 1954 Dedudding Maps
- MEC from EE/CA 1996 (ESE; 60/81 mm, MKII, 105 mm)
- MD from EE/CA 1996 (ESE; 60/81 mm)
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- UXO (Historical Find from Other Source)
- Small Arms Concentrations
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- 105mm Area
- 60mm Mortar Area
- Grenade Maneuver Area

N W E S

0 625 1,250 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 1,300 '	ATD

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Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Maneuver Area
Revision 2

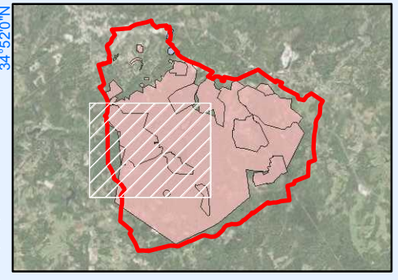
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-4

KEY

- DMM, Grenade
- UXO, 57 mm
- UXO, 60 mm
- Frag / Undifferentiated MD
- Grenade MD
- Mortar MD
- Projectile MD
- MEC from 1954 Dedudding Maps
- MD from 1954 Dedudding Maps
- MEC from RA Report 1997 (HFA; 60 mm)
- MEC from EE/CA 1996 (ESE; 60/81 mm, MKII, 105 mm)
- MD from EE/CA 1996 (ESE; 60/81 mm)
- MEC from EE/CA 1998 (QST; M9A1, M9, M6A3)
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- Small Arms Concentrations
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- 60/81mm Mortar Area
- AoPI 8
- Grenade Maneuver Area
- Maneuver Area
- Rocket/Grenade Maneuver Area
- Inaccessible Area

N, W, E, S

0 750 1,500 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 1,500 '	ATD

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Support Center Huntsville
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81°48'0"W
427,000
428,000
81°47'0"W
34°52'0"N
3,858,000

Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed 60mm Mortar Area
Revision 2

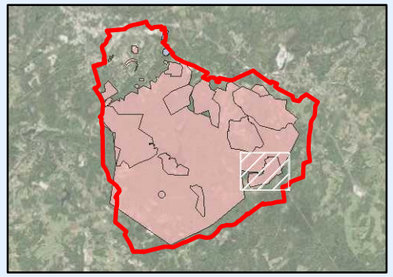
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-5

KEY

- UXO, 60 mm
- Frag / Undifferentiated MD
- Mortar MD
- Projectile MD
- MEC from 1954 Dedudding Maps
- MD from 1954 Dedudding Maps
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- Small Arms Concentrations
- Former OOU
- Former Camp Croft Boundary
- Inaccessible Parcel
- 60mm Mortar Area

N
W E
S

0 300 600 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
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Checked By	Engineering Scale	Drawn By
JES	1 " = 600 '	ATD

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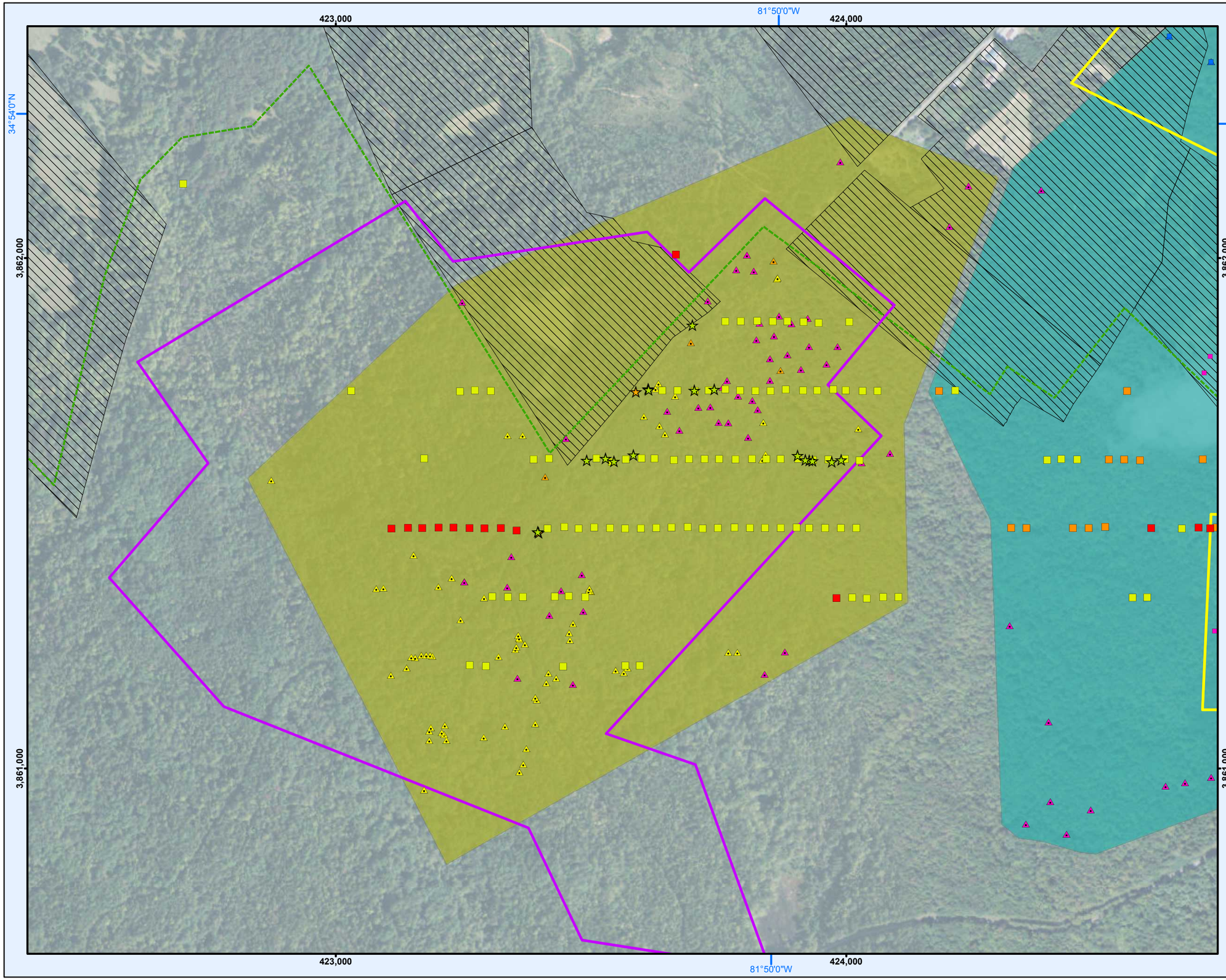


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed 60/81mm Mortar Area
Revision 2

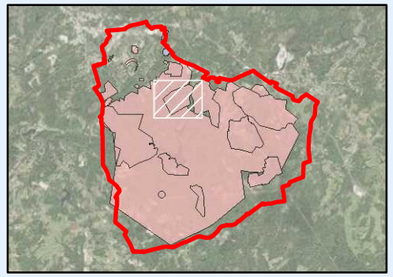
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-6

KEY

- UXO, 60 mm
- UXO, 81 mm
- Frag / Undifferentiated MD
- Grenade MD
- Mortar MD
- MEC from 1954 Dedudding Maps
- MD from 1954 Dedudding Maps
- MEC from RA Report 1997 (HFA; 60 mm)
- MEC from EE/CA 1996 (ESE; 60/81 mm, MKII, 105 mm)
- MEC from EE/CA 1998 (QST; M9A1, M9, M6A3)
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- 60/81mm Mortar Area
- Grenade Maneuver Area

N W E S

0 300 600 Feet



Source(s)
USAESCH, Esri

Projection
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Notes
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Checked By	Engineering Scale	Drawn By
JES	1 " = 600 '	ATD

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81°50'0"W

3,863,000

Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Rocket & Rifle Grenade Area
Revision 2

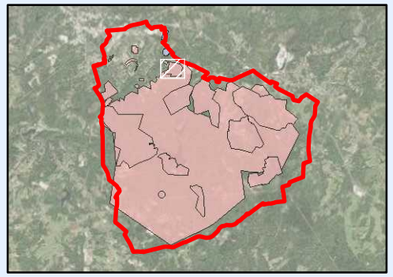
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-7

KEY

- 2.36 in Rocket from TCRA
- Hand Grenade from TCRA
- Rifle Grenade from TCRA
- UXO, 2.36 in Rocket
- UXO, Grenade
- Grenade MD
- Grenade / Rocket MD
- Rocket MD
- Rocket / Mortar MD
- MEC from 1954 Dedudding Maps
- MD from 1954 Dedudding Maps
- MEC from EE/CA 1998 (QST; M9A1, M9, M6A3)
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- TCRA Boundary
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Former Camp Croft Boundary
- Inaccessible Parcel
- AoPI 9G
- Rocket & Rifle Grenade Area

N W E S

0 150 300 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
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Checked By	Engineering Scale	Drawn By
JES	1 " = 300 '	ATD

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81°50'0"W
424,000
425,000
81°49'0"W
3,857,000
34°51'0"N
3,856,000

Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Rocket/Grenade Maneuver Area
Revision 2

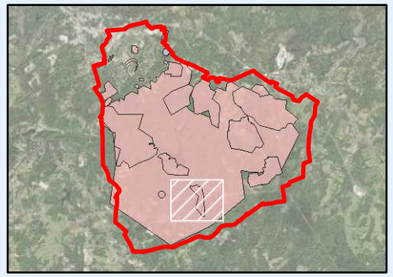
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-8

KEY

- UXO, Fuze
- Frag / Undifferentiated MD
- Grenade MD
- Mine MD
- MEC from EE/CA 1998 (QST; M9A1, M9, M6A3)
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- Rocket/Grenade Maneuver Area

N
W E
S

0 325 650 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
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Checked By	Engineering Scale	Drawn By
JES	1 " = 650 '	ATD

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4820 University Square
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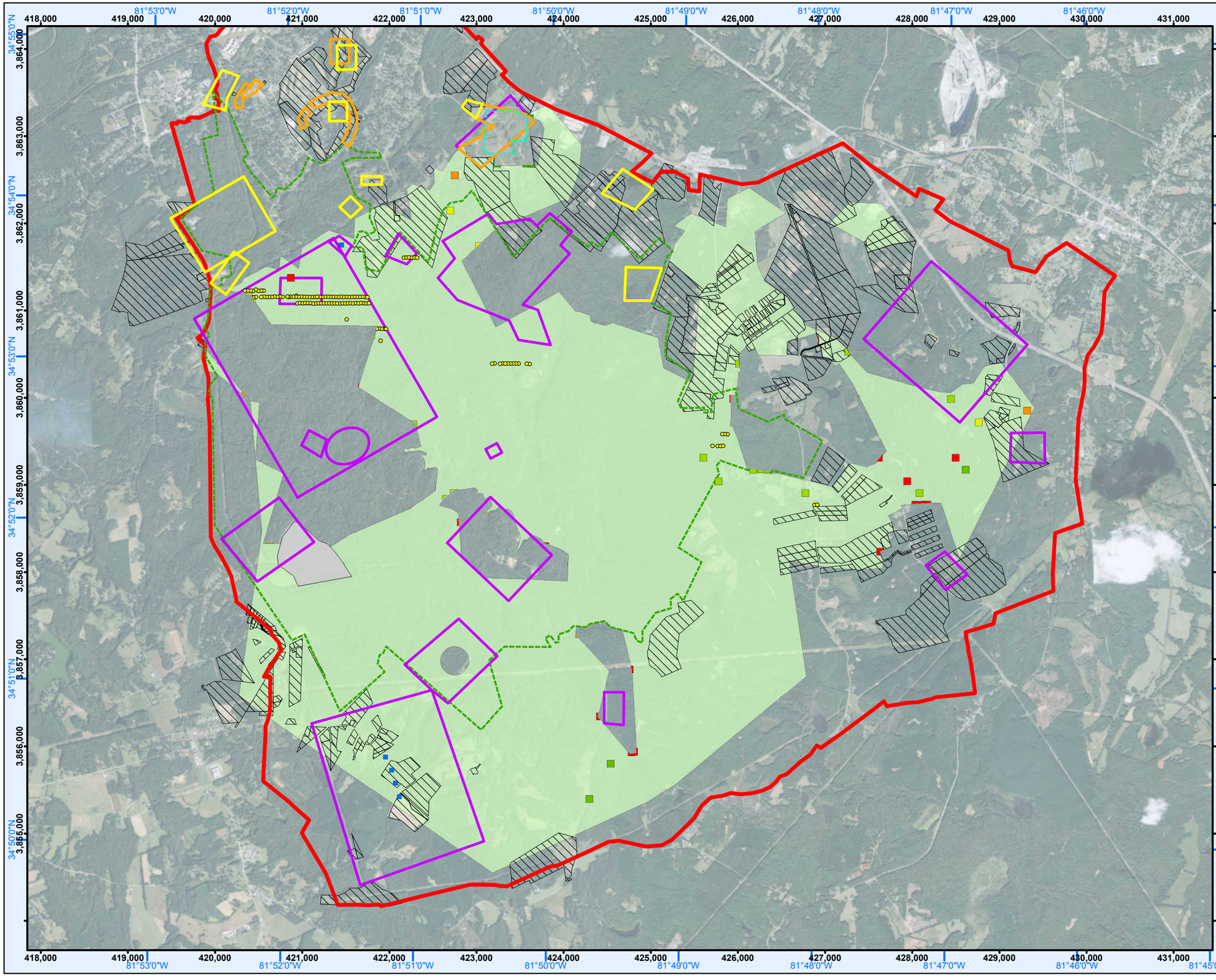


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Remaining Lands
Revision 2

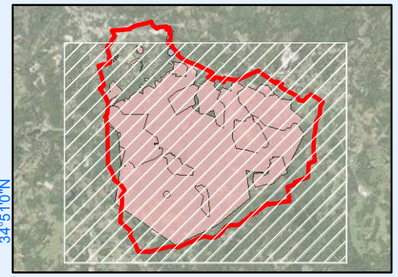
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-9

KEY

- Frag / Undifferentiated MD
- Grenade MD
- Grenade / Rocket MD
- Mine MD
- Mortar MD
- Projectile MD
- Rocket MD
- MD from 1954 Dedudding Maps
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- Small Arms Concentrations
- TCRA Boundary
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- Inaccessible Area
- Remaining Lands

N W E S

0 1,750 3,500 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 3,500 '	ATD

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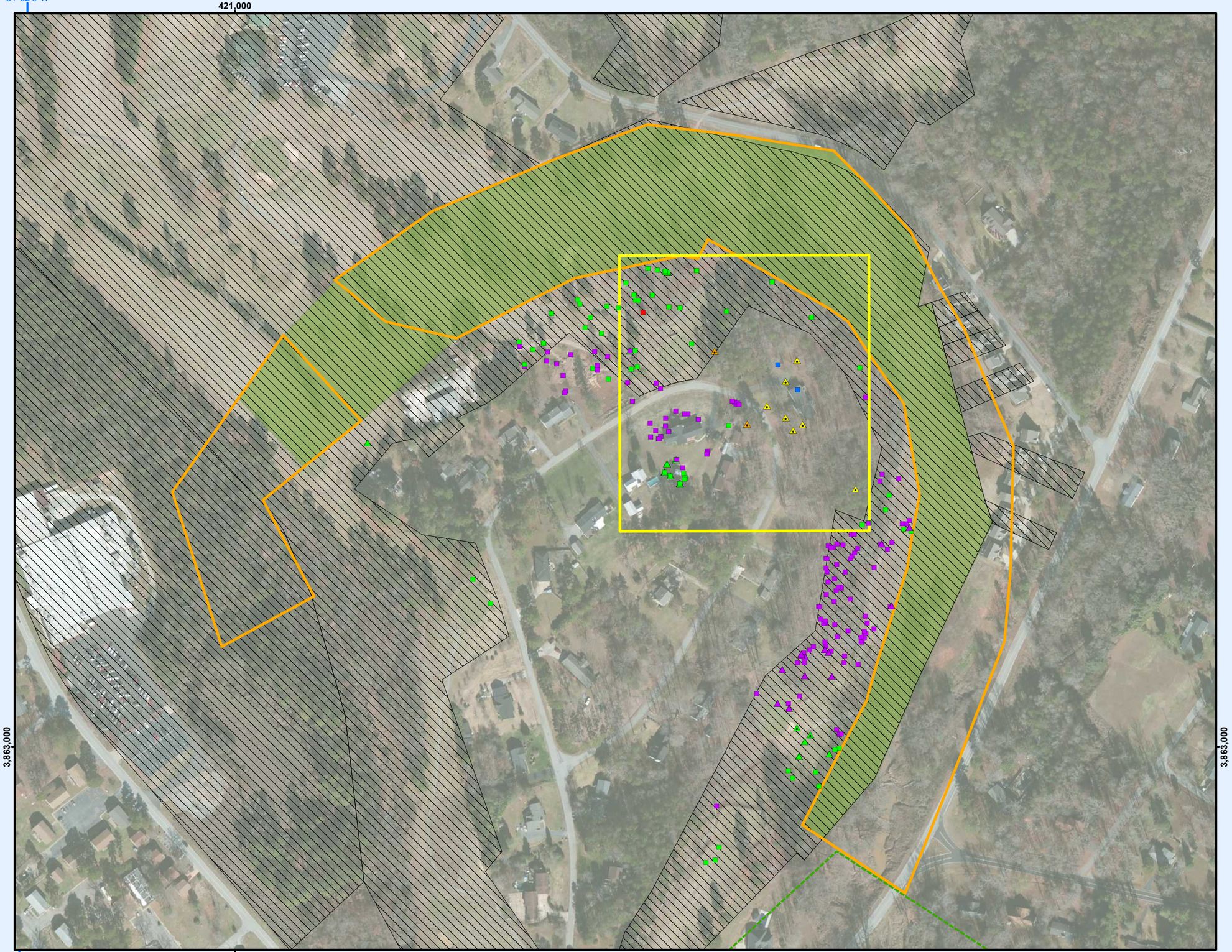
4820 University Square
Huntsville, AL 35816

81°52'0"W

421,000



3,863,000

421,000

81°52'0"W

Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Grenade Area
Revision 2

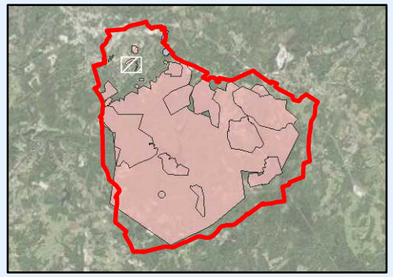
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-10

KEY

- MEC from RA Report 1997 (HFA; 60 mm)
- MEC from EE/CA 1996 (ESE; 60/81 mm, MKII, 105 mm)
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- MEC (Historical Find from 2005; MKII)
- UXO (Historical Find from 2005; M15, MKII)
- MD (Historical Find from 2005; MKII)
- UXO (Historical Find from 2006; MKII)
- MD (Historical Find from 2006; MKII)
- MD (Historical Find from Other Source)
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- Grenade Area

N W E S

0 125 250 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 250 '	ATD

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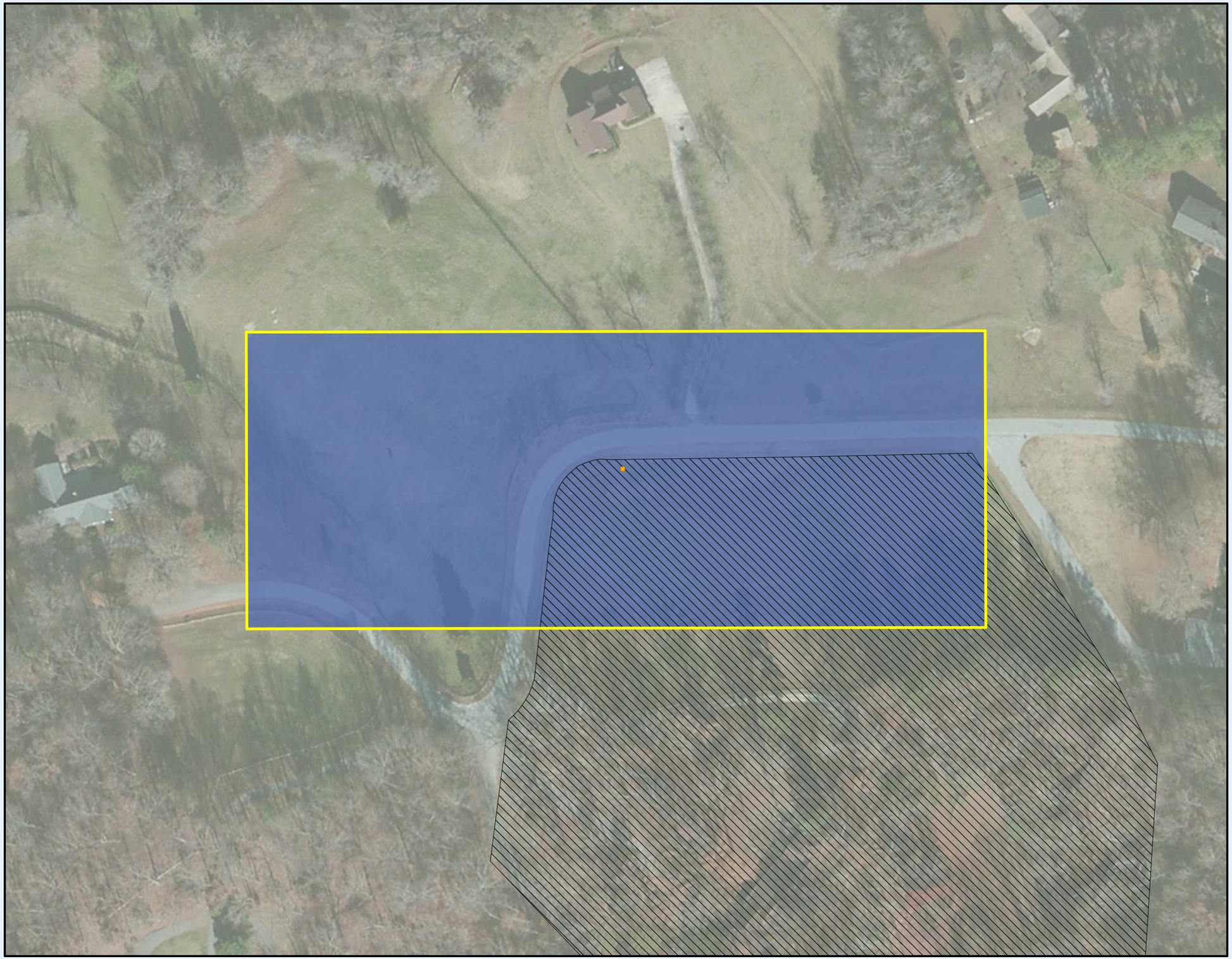


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed AoPI 5
Revision 2

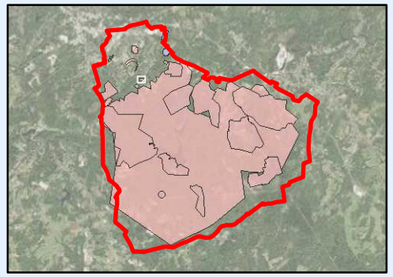
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-11

KEY

- MD from EE/CA 1996 (ESE; 60/81 mm)
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former Camp Croft Boundary
- Inaccessible Parcel
- AoPI 5

N
W E
S

0 50 100 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 100 '	ATD

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420,000

420,000

Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed AoPI 8
Revision 2

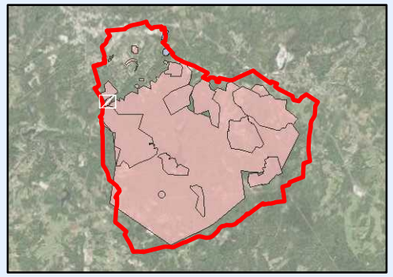
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-12

KEY

- Mortar MD
- Small Arms Concentrations
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- AoPI 8
- Rocket Area

N
W E
S

0 100 200 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 200 '	ATD

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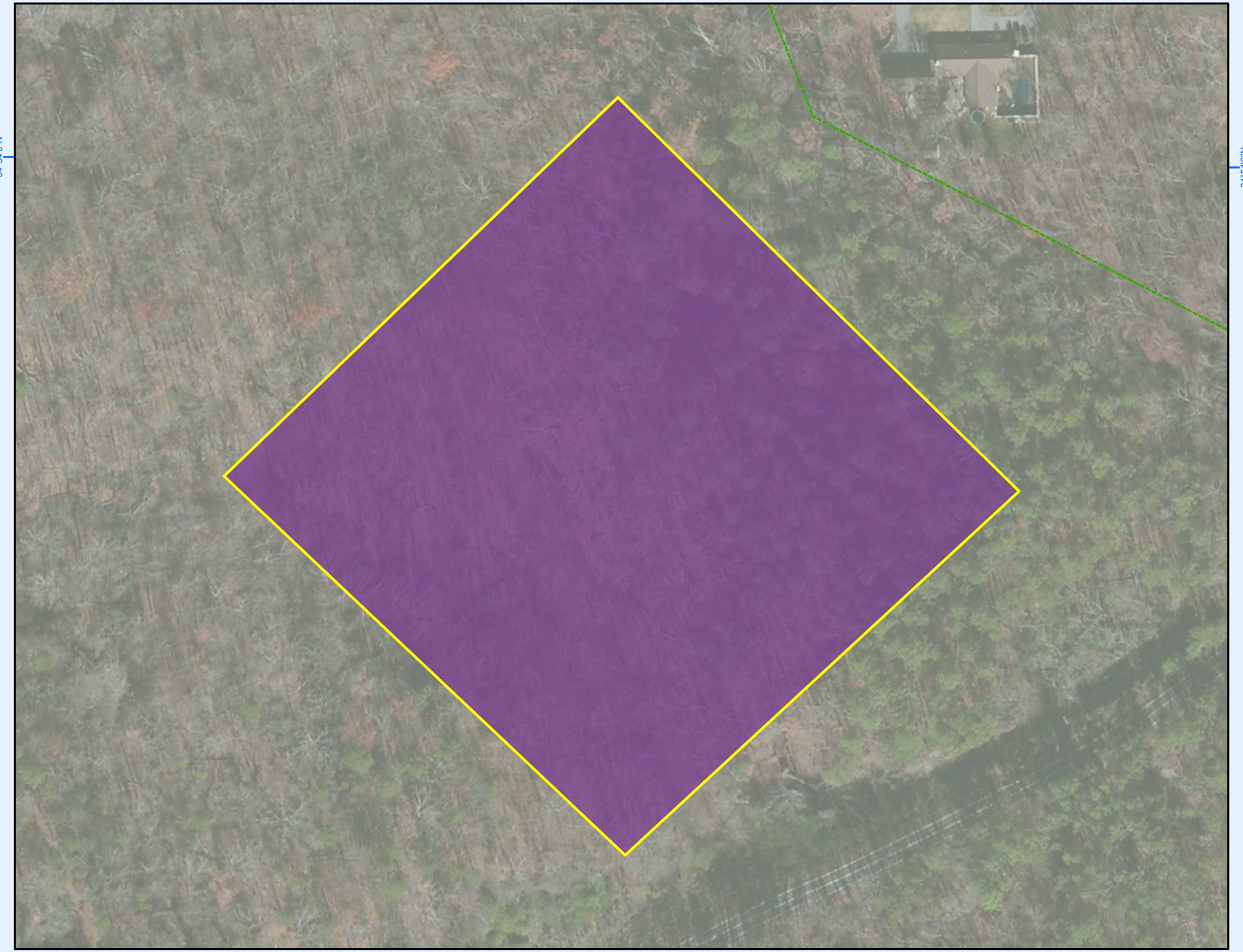


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed AoPI 9E
Revision 2

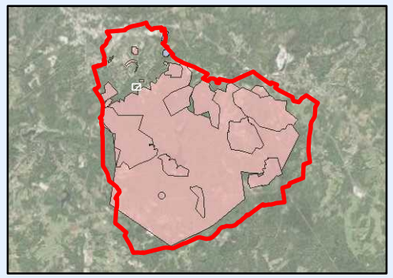
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-13

KEY

- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- AoPI 9E

N
W E
S

0 50 100 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 100 '	ATD

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423,000

423,000

Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed AoPI 9G
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-14

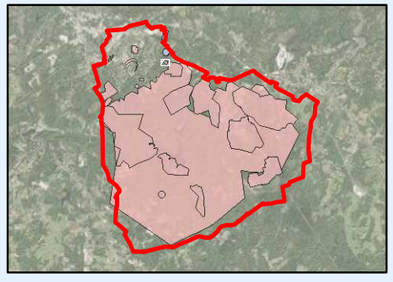
KEY

- UXO, Grenade
- Grenade MD
- Rocket MD
- TCRA Boundary
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Former Camp Croft Boundary
- Inaccessible Parcel
- AoPI 9G
- Rocket & Rifle Grenade Area

Note: No boundary change recommended for AoPI 9G.

N
W E
S

0 50 100 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 100 '	ATD

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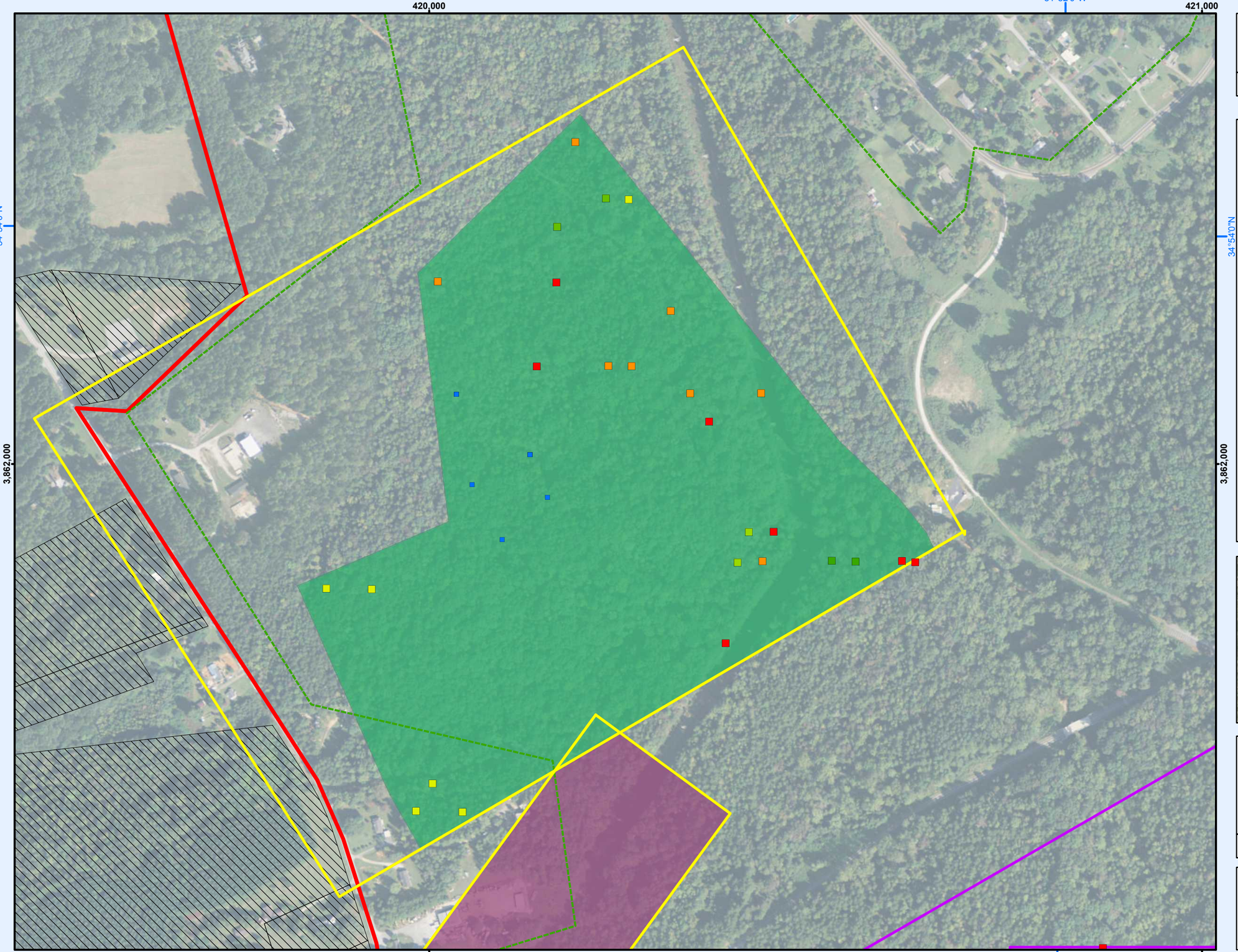


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Rocket Area
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-15

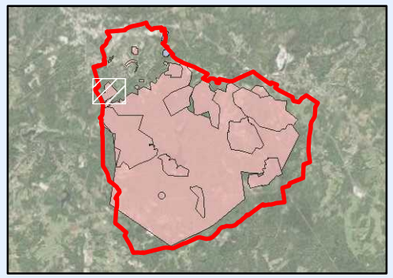
KEY

- Frag / Undifferentiated MD
- Grenade MD
- Mine MD
- Mortar MD
- Projectile MD
- Rocket MD
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- AoPI 8
- Rocket Area

Note: No boundary change recommended for Rocket Area.

N W E S

0 200 400 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 400 '	ATD

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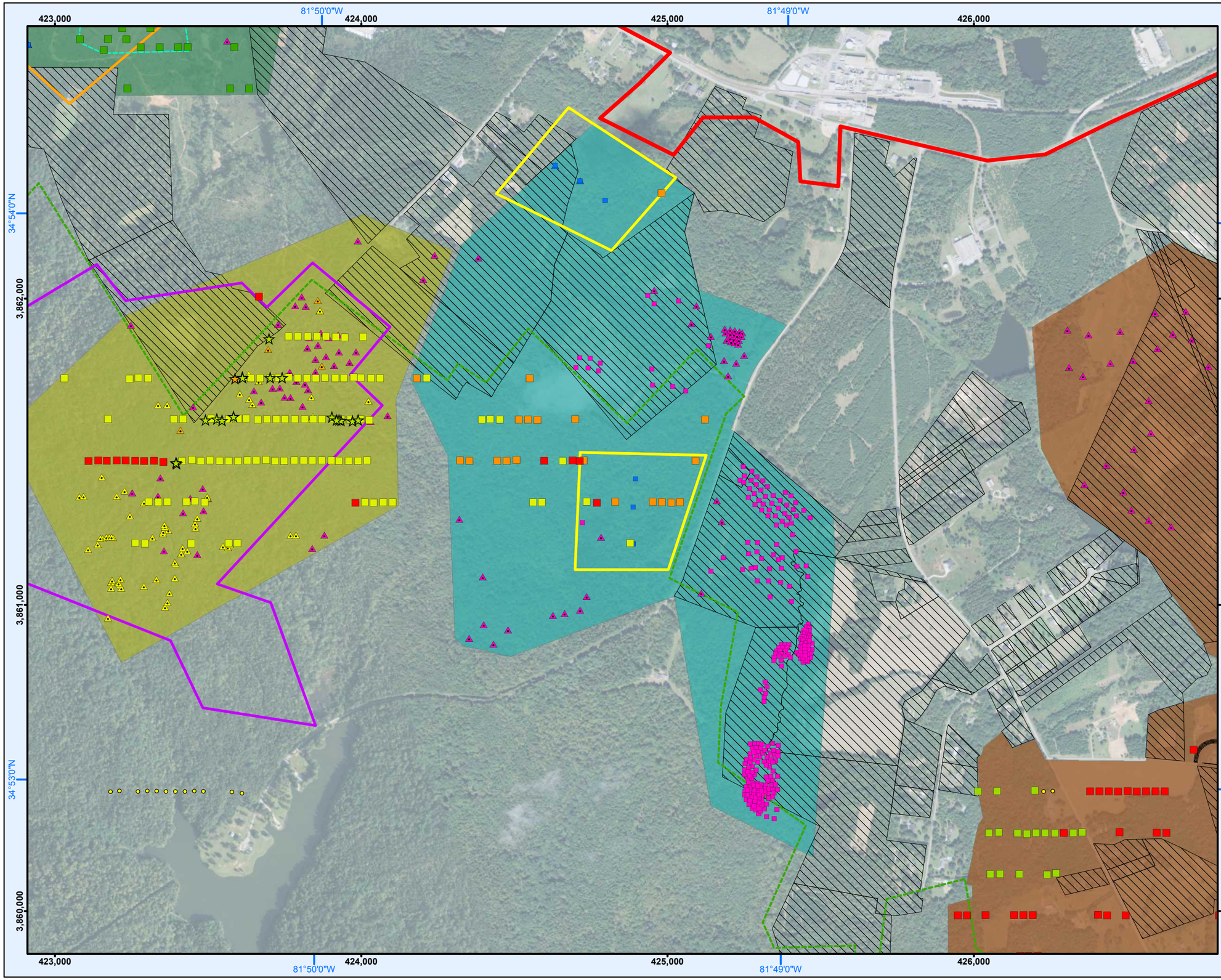
Huntsville, AL 35816



Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Grenade Maneuver Area
Revision 2

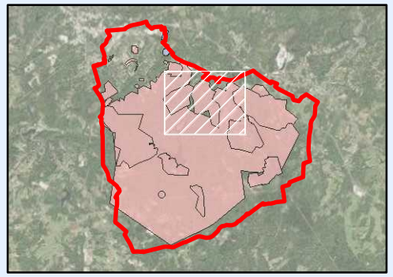
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-16

KEY

- UXO, 60 mm
- UXO, 81 mm
- Frag / Undifferentiated MD
- Grenade MD
- Mortar MD
- Projectile MD
- Rocket MD
- MEC from 1954 Dedudding Maps
- MD from 1954 Dedudding Maps
- MEC from RA Report 1997 (HFA; 60 mm)
- MEC from EE/CA 1996 (ESE; 60/81 mm, MKII, 105 mm)
- MEC from EE/CA 1998 (QST; M9A1, M9, M6A3)
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- Small Arms Concentrations
- TCRA Boundary
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former OOU
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- 105mm Area
- 60/81mm Mortar Area
- Grenade Maneuver Area
- Rocket & Rifle Grenade Area

N W E S

0 500 1,000 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 1,000 '	ATD

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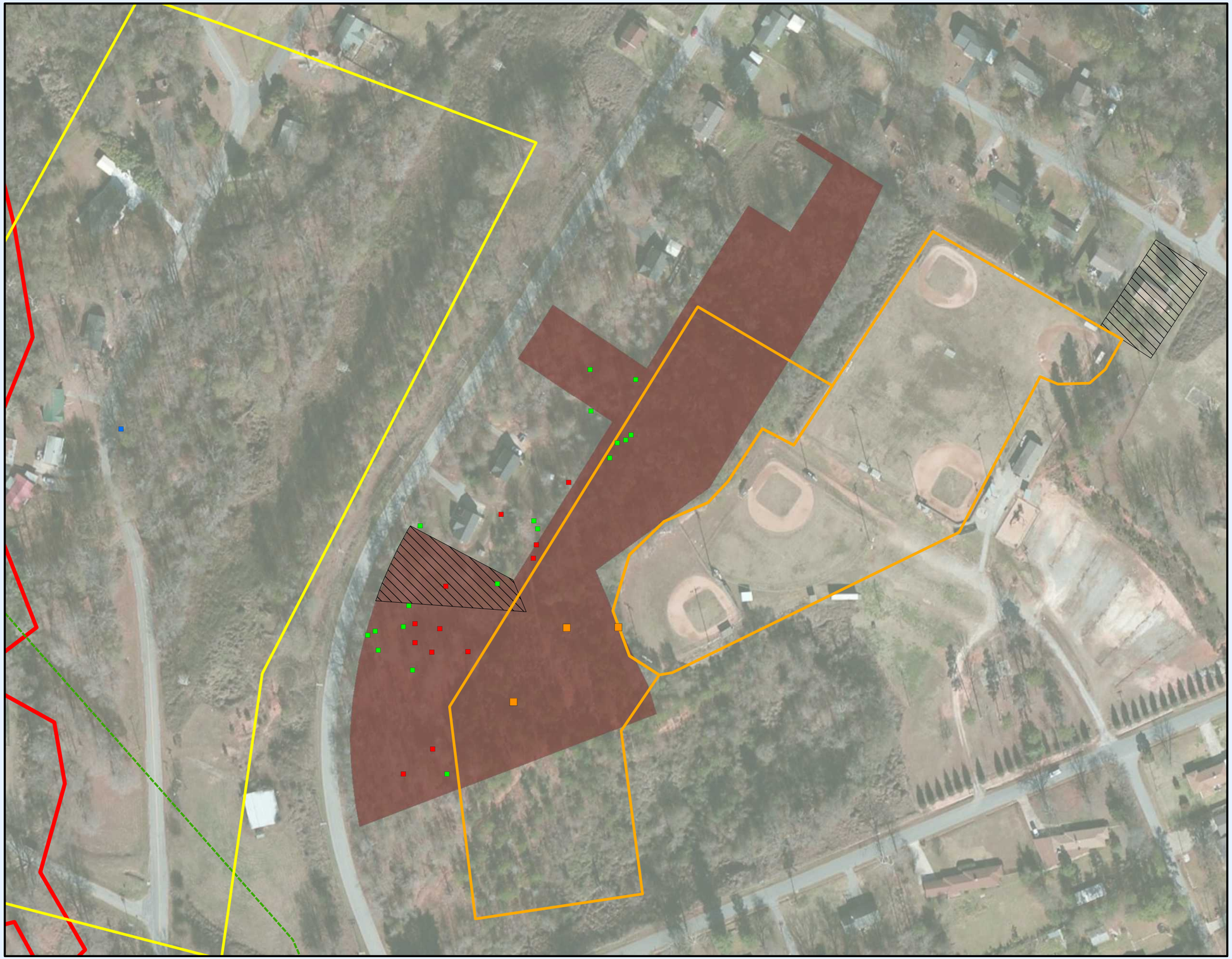


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Practice Grenade Area
Revision 2

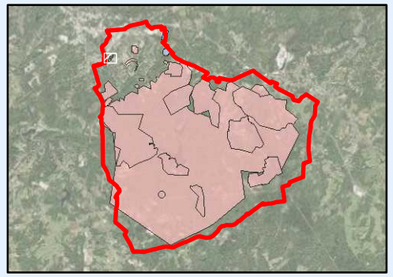
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-17

KEY

- Grenade MD
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- MD (Historical Find from 2005; MKII)
- MD (Historical Find from Other Source)
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Approximate Croft State Natural Area Boundary
- Former Camp Croft Boundary
- Inaccessible Parcel
- Practice Grenade Area

N
W E
S

0 75 150 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 150 '	ATD

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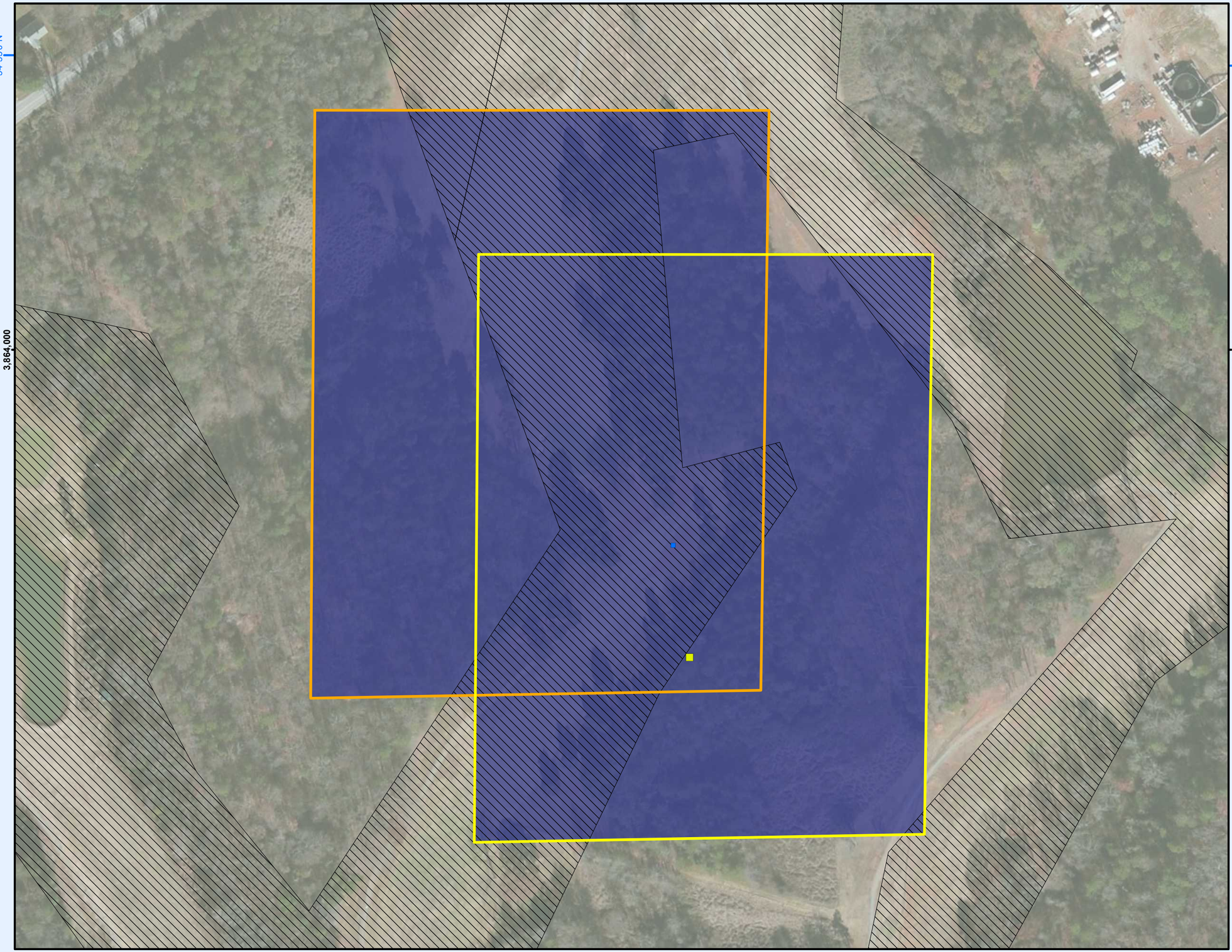


Remedial Investigation Report
Proposed Boundary Realignment
Former Camp Croft, Spartanburg, SC
Proposed Mortar/Rifle Grenade Area
Revision 2

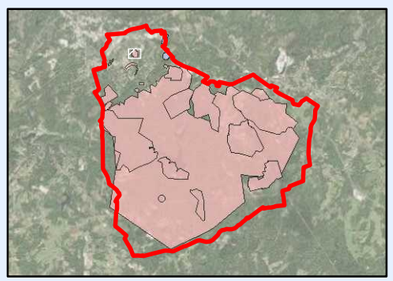
Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-18

KEY

- Mortar MD
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- Former Camp Croft Boundary
- Inaccessible Parcel
- Mortar/Rifle Grenade Area

N
W E
S

0 75 150 Feet



Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1 " = 150 '	ATD

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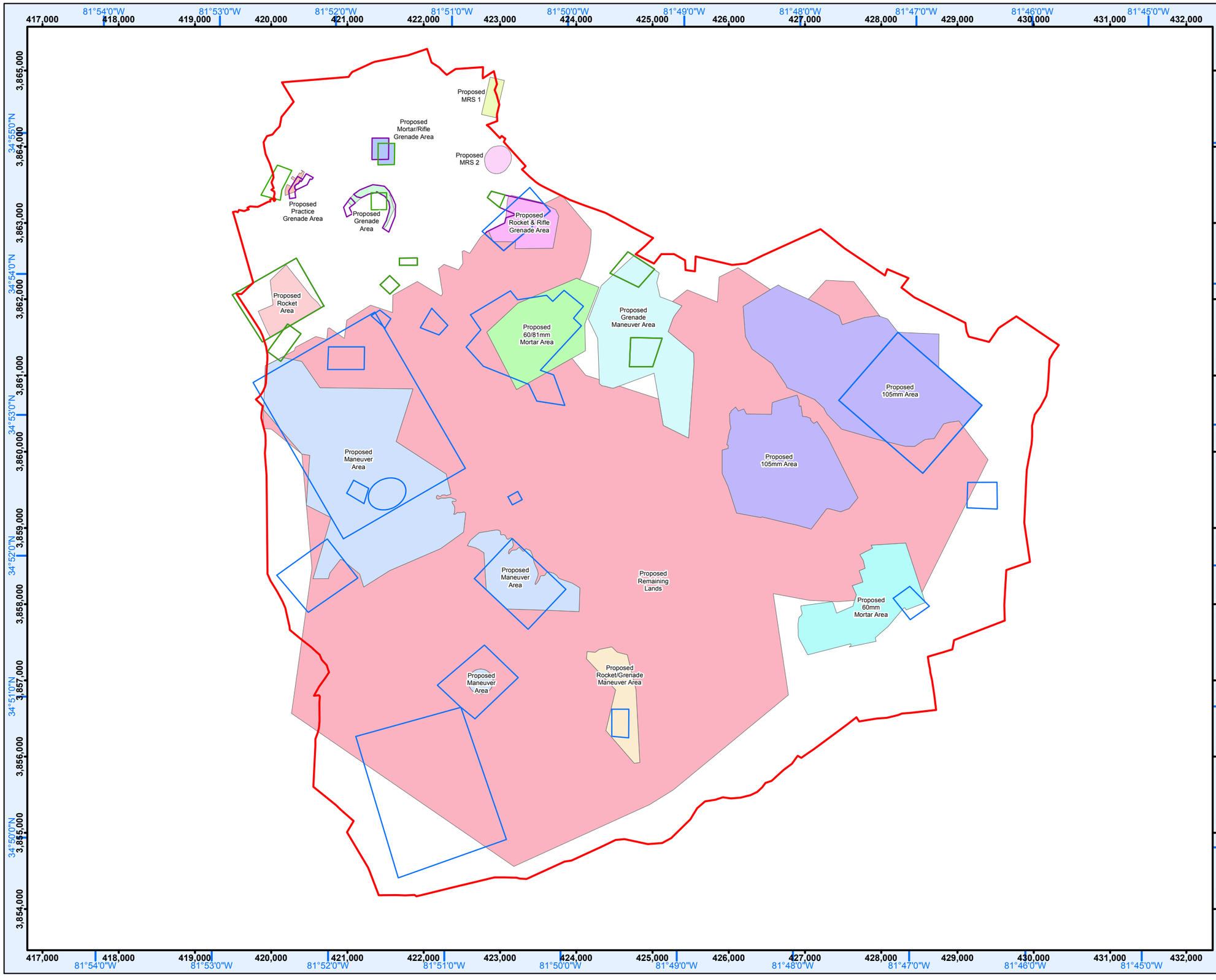

Remedial Investigation Report
Proposed MRSs
Former Camp Croft, Spartanburg, SC
Revision 2

Project Number	Date	Exhibit
00017	SEPTEMBER 2015	8-19

KEY

- Former Camp Croft Boundary
- Former OOU
- PWS-Defined Area of Potential Interest
- RI-Defined Area of Potential Interest
- MRS 1
- MRS 2
- 105mm Area
- 60/81mm Mortar Area
- 60mm Mortar Area
- Grenade Area
- Grenade Maneuver Area
- Maneuver Area
- Mortar/Rifle Grenade Area
- Practice Grenade Area
- Remaining Lands
- Rocket & Rifle Grenade Area
- Rocket Area
- Rocket/Grenade Maneuver Area

N
W E
S

0 2,000 4,000 Feet

Source(s)
USAESCH, Esri

Projection
NAD 1983 UTM Zone 17N

Notes
Engineering scale may only be accurate on a map size of 11 x 17.

Checked By	Engineering Scale	Drawn By
JES	1"=4,000'	ATD

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