FINAL
FEASIBILITY STUDY REPORT

FORMER CAMP CROFT
SPARTANBURG, SOUTH CAROLINA

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.

Signed:

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Signed:

Suzy Cantor-McKinney
Corporate Quality Management Representative

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ABBREVIATIONS AND ACRONYMS

AIR	Analog Instrument-assisted Reconnaissance
AoPI	Area of Potential Interest
ARAR	Applicable or Relevant and Appropriate Requirement
ASR	Archives Search Report
bgs	below ground surface
BIP	Blow-in-Place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAC	Corps of Engineers, Charleston District
CESAW	Corps of Engineers, Wilmington District
CFR	Code of Federal Regulations
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
DDESB	Department of Defense Explosives Safety Board
DGM	Digital Geophysical Mapping
DMM	Discarded Military Munitions
DoD	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EPA	Environmental Protection Agency
FS	Feasibility Study
FUDS	Formerly-Used Defense Site
GRA	General Response Actions
HA	Hazard Assessment
HE	High Explosive
HTRW	Hazardous, Toxic, and Radioactive Waste
IEUBK	Integrated Exposure Uptake Biokinetic
IRTC	Infantry Replacement Training Center
LTM	Long-Term Management
LUC	Land Use Control
MC	Munitions Constituents
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
mm	millimeter
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operation & Maintenance
PDT	Project Delivery Team
PRG	Preliminary Remedial Goals
PWS	Performance Work Statement
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
ROM	Rough Order of Magnitude
RSL	Risk Screening Levels
TBC	To-Be-Considered
TCRA	Time-Critical Removal Action
TOI	Target of Interest
USACE	United States Army Corps of Engineers
UU/UE	Unlimited Use/Unrestricted Exposure
UXO	Unexploded Ordnance
VSP	Visual Sample Plan

1.0 EXECUTIVE SUMMARY

1.0.1 This Feasibility Study (FS) Report was developed in accordance with Military Munitions Center of Expertise (MM CX) Interim Guidance Document (IGD) 06-04, which introduces Engineering Pamphlet (EP) 1110-1-18, Military Munitions Response Process, and United States Environmental Protection Agency (EPA) guidance documents. Zapata Incorporated (ZAPATA) prepared the FS on behalf of the United States Army Corps of Engineers (USACE), as part of a Remedial Investigation/Feasibility Study (RI/FS) being conducted by the USACE at the Former Camp Croft, a Formerly-Used Defense Site (FUDS) in Spartanburg, South Carolina. Response activities undertaken by the USACE as part of the FUDS program that address hazardous substances, pollutants or contaminants are conducted in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

1.0.2 The purpose of this stand-alone FS is to develop, screen and evaluate a range of potential response alternatives to manage the Munitions and Explosives of Concern (MEC) and Munitions Constituents (MC) hazards, and associated risks, to human health and the environment at the Former Camp Croft FUDS. This analysis provides decision makers the information needed to support the appropriate risk-management response alternative(s) for the site.

1.1 BACKGROUND

1.1.1 The Former Camp Croft is located in the upstate of South Carolina, less than 10 miles southeast of downtown Spartanburg, SC. Officially activated in 1941, the entire installation (just over 19,000 acres) was declared surplus in November 1946 and excessed in 1947. The USACE has determined Camp Croft is eligible for the FUDS program. This FUDS Military Munitions Response Program (MMRP) project number is I04SC001603; a single original MRS approximately 12,337 acres in size was established to cover all areas thought to overlap with munitions use. Areas beyond that single MRS are not part of the investigation. That single MRS has subsequently been delineated into numerous areas with various proposed outcomes.

1.2 REMEDIAL INVESTIGATION FINDINGS

1.2.1 Munitions and Explosives of Concern Findings

1.2.1.1 The MEC items and Munitions Debris (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, High Explosive (HE)] , 81mm (training, HE);
- Projectile – 37mm, 57mm, 105mm HE, 105mm Illumination; and
- Rocket – 2.36" Bazooka.

1.2.1.2 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. In these areas, a total of 39 UXO, one Discarded Military Munition (DMM), and thousands of pounds of MD were removed during the RI investigation.

1.2.2 Munitions Constituent Findings

1.2.2.1 For the former Camp Croft sites, constituent concentrations reported in chemical analyses were 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 x-ray fluorescence (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.

1.2.2.2 Lead was detected above its screening level at two locations. Based on the output from EPA Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children that assumes residential exposure assumptions, lead is not a concern at the concentrations measured. Some metal concentrations exceeded 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, the small affected areas comprise only a tiny fraction of overall habitat and home range of receptors. Given the existing data, it is not anticipated that significant adverse risks would occur to local populations of wildlife. No MC hazards were identified in the RI.

1.2.3 Site Delineation Refinement

1.2.3.1 At the onset of the RI, 14 areas had been designated for investigation; those areas included three MRSs and 11 optional 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); those areas totaled approximately 12,337 acres and corresponded to the single MRA presented in the Formerly Used Defense Sites Management Information System (FUDSMIS). Of the 11 optional sites, 10 were defined as "Areas of Potential Interest" (AoPI), and one appeared 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. The AoPIs correspond to areas previously referred to as Ordnance Operable Units (OOUs) in earlier investigations and removal actions; 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. During the planning phase of the RI, some of those designated areas were expanded and realigned, based on historical evidence, resulting in a total remedial investigation area of 12,669.2 acres.

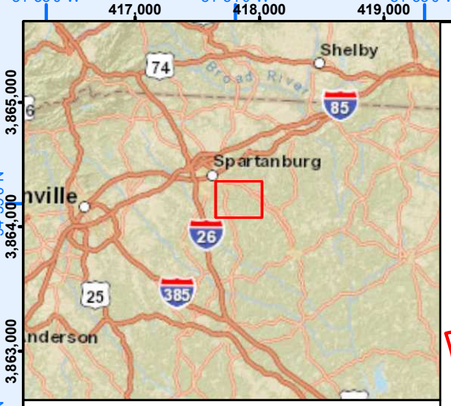
1.2.3.2 Munitions-related items are present in many locations across the former Camp Croft. Historical evidence collected from previous investigations and removal actions were combined with findings from this RI to present a comprehensive understanding of the nature and extent of

MEC and MC at many of the areas included in this investigation. Some property owners denied access and thus, the RI was limited in those areas. The nature and extent of MEC and MC cannot be directly determined on property that was not investigated (e.g., MRS 2 and AoPI 3); however, in some instances, observations made near property boundaries can be inferred on a limited basis across those boundaries. Notwithstanding those inaccessible areas, much of the former camp was accessible and conclusions were drawn from available data. MRS 1 and AoPIs 8, 9E, and 11C appear to be well characterized. Considering the findings in MRS 1, it was recommended for No Further Action and will not be addressed in this Feasibility Study; however, it will be included in subsequent Decision Documents. MRS 2 is unresolved 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 was recommended that AoPI 5, AoPI 8, AoPI 9E, and AoPI 9G not be retained for further consideration and thus, will not be addressed in this Feasibility Study.

1.2.3.3 MRS 3 and five AoPIs were recommended for boundary realignment. It was recommended that MRS 3 be subdivided into seven MRSs (six MRSs where MEC was observed and the Remaining Lands). AoPIs 3, 10A, 10B, 11B, 11C, and 11D were recommended for realignment as five MRSs (AoPIs 10B and 11B were combined into one Proposed MRS). Slight adjustments to the total acreages of each area are necessary based on RI findings. The proposed MRSs (Exhibit 1-1), using the revised designations and acreages listed below, are being used to update FUDSMIS and will be referenced herein. During development of this FS, the USACE discovered the FUDS boundary depicted in project documents since (and including) the Archive Search Reports (ASRs) was incorrect. Upon discovery, the USACE rectified the boundary using real estate information and distributed the corrected boundary to the project team; that corrected FUDS boundary is presented herein.

Pre-RI Designation	Pre-RI Acreage	Revised Designation	Revised Acreage	Recommendation*
MRS 1	23.8	MRS 1	23.8	Included in 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	Included in FS
		Maneuver Area	1,276.5	Included in FS
		60mm Mortar Area	303.4	Included in FS
		60/81mm Mortar Area	301.3	Included in FS
		Rocket & Rifle Grenade Area	108.5	Included in FS
		Rocket/Grenade Maneuver Area	126.3	Included in FS
		Remaining Lands (Land)	9,093.4	Included in FS
MRS 3 (Water)	185.6	Remaining Lands (Water)	185.6	Included in FS
AoPI 3	11	Grenade Area	19.2	Included in 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	Included in FS
AoPI 10B	33.6	Grenade Maneuver Area	450.5	Included in FS
AoPI 11B	343.7			
AoPI 11C	23	Practice Grenade Area	6.4	Included in FS
AoPI 11D	15.1	Mortar/Rifle Grenade Area	22.9	Included in FS
SUM =	**12,669.2**	**SUM =**	**13,479.9**	

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



Overview

Feasibility Study Report
Site Location
Former Camp Croft, Spartanburg, SC

Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	1-1

KEY

- Street
- Former Camp Croft Boundary
- 105mm Area (1,399.7 ac.)
- 60/81mm Mortar Area (301.3 ac.)
- 60mm Mortar Area (303.4 ac.)
- Grenade Area (19.2 ac.)
- Grenade Maneuver Area (450.5 ac.)
- MRS 1 (23.8 ac.)
- MRS 2 (24.9 ac.)
- Maneuver Area (1,276.5 ac.)
- Mortar/Rifle Grenade Area (22.9 ac.)
- Practice Grenade Area (6.4 ac.)
- Remaining Lands (9,093.4 ac.)
- Rocket & Rifle Grenade Area (108.5 ac.)
- Rocket Area (93.9 ac.)
- Rocket/Grenade Maneuver Area (126.3 ac.)

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

1.3 REMEDIAL ACTION OBJECTIVES

1.3.1 The remedial action objective for the MRSs at the former Camp Croft is to reduce human health risk from exposure to potential surface and subsurface MEC by preventing residents, landowners, workers, recreational users, and the general public from contacting MEC and thus, minimizing the potential for direct contact exposures.

1.3.2 Exposure pathways of MEC include direct contact with MEC at the ground surface and through intrusive activities. The reduction or elimination of exposure pathways to MEC is incorporated into the RAOs. The RAOs are based on the determination and consideration of all human and ecological receptors available for exposure; potential receptors that may encounter MEC include residents, recreational users (e.g., hikers, bikers, runners, horseback riders, etc.), workers (agricultural, construction, etc. - on private and public property), and the general public.

1.3.3 The general Preliminary Remediation Goals (PRGs) for the Camp Croft MRSs are to manage MEC 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. Based on MEC discovered during the RI, penetration depths are provided in Table 2-4. For areas where MEC was found on the surface only or less than six inches bgs, a minimum penetration depth of six inches was used.

TABLE 1-1 SUMMARY OF MRSPP AND MEC HA SCORING

Area	MRSPP Score	Hazard Level Score	Hazard Level Category
MRS 1	7	N/A	N/A
MRS 2	4	N/A	N/A
Maneuver Area	3	1,000	1
60/81mm Mortar Area	4	965	1
105m Area	3	950	1
Rocket & Rifle Grenade Area	3	905	1
Rocket/Grenade Maneuver Area	4	760	2
Grenade Maneuver Area	4	755	2
60mm Mortar Area	4	705	3
Grenade Area	5	N/A	N/A
Rocket Area	4	N/A	N/A
Practice Grenade Area	4	N/A	N/A
Mortar/Rifle Grenade Area	4	N/A	N/A
Remaining Lands	6	N/A	N/A

N/A: Not applicable. No MEC was found; thus, no MEC Hazard Assessment was performed.

1.4 FEASIBILITY STUDY SUMMARY

1.4.1 As specified in the NCP, the potential alternatives must consist of a range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element, but vary in the degree to which long-term management of residuals or untreated waste is required. As required, a no-action alternative was investigated, as a baseline for comparison.

1.4.2 Based on the risks present at the site and the technologies available to address them, the following 13 alternatives were identified, evaluated, and ranked for MEC-impacted MRSs at the former Camp Croft. Four of these alternatives (bolded) passed the initial alternative screening based on effectiveness, implementability and cost, and were then evaluated against the NCP evaluation criteria. Costs for the alternatives, using a generic 100-acre "conceptual" site, that were retained after being evaluated against the NCP criteria are also shown below (in parentheses) alongside the alternative.

- **No Action Alternative ($0)**
- **Land Use Controls (LUCs; Limited) and Long-Term Management (LTM) Alternative ($362,731)**
- LUCs (Enhanced) and LTM Alternative
- Analog Surface MEC Removal, LUCs (Limited), and LTM Alternative
- Analog Surface MEC Removal, LUCs (Enhanced), and LTM Alternative
- **Analog Surface and Subsurface MEC Removal, LUCs (Limited), and LTM Alternative ($825,141)**
- Analog Surface and Subsurface MEC Removal, LUCs (Enhanced), and LTM Alternative
- Digital Surface and Subsurface MEC Removal, LUCs (Limited), and LTM Alternative
- Digital Surface and Subsurface MEC Removal, LUCs (Enhanced), and LTM Alternative
- **Digital Advanced Classification Surface and Subsurface MEC Removal to Support Unlimited Use/Unrestricted Exposure (UU/UE) Alternative ($666,264)**

2.0 INTRODUCTION

2.1 PURPOSE

2.1.1 The purpose of the FS is to provide the project decision makers with the necessary data to develop, screen, and evaluate a range of potential response alternatives and select a response to manage the HTRW hazards to human health and the environment at the site. This FS is organized in a manner consistent with the NCP, CERCLA of 1980 guidance, EPA Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final (US EPA, 1988), and the requirements outlined in the Performance Work Statement (PWS). The FS presents a range of potential alternatives to manage the hazards and risks. These potential alternatives are then evaluated against the nine criteria outlined in the NCP and then compared against each other. The nine criteria, divided into three categories, include;

- Threshold Criteria
  - Overall protection of human health and the environment,
  - Compliance with ARARs
- Balancing Criteria
  - Long-term effectiveness and permanence,
  - Reduction of toxicity, mobility or volume,
  - Short-term effectiveness
- Modifying Criteria
  - State acceptance, and
  - Community acceptance.

2.1.2 The first two criteria, categorized as "Threshold Criteria," are statutory requirements that must be satisfied to be eligible for further evaluation against the other seven factors. The next five criteria are referred to as "Balancing Criteria" and are the primary criteria upon which the analyses of alternatives are based. The last two criteria are discussed with respect to each individual alternative and are classified as "Modifying Criteria". Evaluation and comparative analysis of alternatives provides the rationale for the selection of the preferred remedial alternative to be implemented at the site.

2.1.3 The FS is organized into six sections, as follows:

- Section 1.0 – Executive Summary –
- Section 2.0 – Introduction – summarizes the scope of the FS; describes the site background; and summarizes the results of the RI.
- Section 3.0 – Identification and Screening of Technologies – identifies the remedial action objectives (RAOs) and applicable remedy technologies.
- Section 4.0 – Development and Screening of Alternatives – identifies remedial alternatives for further evaluation.
- Section 5.0 – Detailed Analysis of Alternatives – presents a detailed analysis of those alternatives against the nine required criteria and presents a comparison analysis of each retained alternative in relation to other retained alternatives to identify advantages and disadvantages of each alternative.
- Section 6.0 – References – provides the references used in preparing this document.

2.1.4 This FS evaluates various alternatives but does not select an alternative for future response actions; that selection must be made by the stakeholders following a review of the FS. A preferred alternative will be identified in a subsequent document, the Proposed Plan, which will be prepared separately for public comment. A Decision Document, often known as a Record of Decision (ROD), will then be issued to present the selected remedy.

2.2 SUMMARY OF REMEDIAL INVESTIGATION FINDINGS

2.2.1 Previous Investigations

2.2.2 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 in the southern portion of the property and a troop housing area with attached administrative headquarters, with housing for 20,000 trainees and support personnel, in the northern cantonment area. 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. The training range impact areas comprised 16,929 acres; a 175-acre grenade court was also located at the camp.

2.2.3 Since the mid-1980s, many investigation and removal actions have been conducted at various locations within the former Camp Croft property. 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. Following that survey were a series of ASRs, Preliminary Assessments, Time-Critical Removal Actions (TCRAs), Interim Removal Actions (IRAs), and Engineering Evaluations/Cost Analyses (EE/CAs). As areas potentially impacted by former military activities were discovered, Ordnance Operable Units (OOUs) were established; these were a precursor to Munition Response Sites (MRSs). For this Remedial Investigation, areas were designated as MRSs or Areas of Potential Interest (AoPIs); many of these overlapped with former OOUs.

2.2.1 Remedial Investigation Site Delineation Background

2.2.1.1 Three MRSs and 11 other sites of varying sizes were established at the former Camp Croft for the RI. 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 were defined as AoPIs, and one was associated with MRS 3, that being the Lake Craig and Lake Johnson Range Complex.

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

2.2.1.3 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. The PDT agreed to proceed with the RI within the refined boundaries.

2.2.2 Remedial Investigation Activities

2.2.2.1 Remedial Investigation 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.

2.2.2.2 The RI field investigation teams received signed rights-of-entry (ROE) to much of the former Camp Croft. Areas where access was granted include 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. Areas that denied rights-of-entry include MRS 2, portions of MRS 3, AoPI 3, AoPI 5, AoPI 9G, AoPI 11B, and AoPI 11D.

2.2.2.3 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. 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. 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.

2.2.2.4 UXO Technicians who met the standards of DDESB TP-18 excavated and positively identified anomalies in DGM and mag-and-dig areas and counted subsurface anomalies in AIR areas.

2.2.2.5 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). 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.

2.2.3 Munitions and Explosives of Concern Findings

2.2.3.1 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). Of the MEC items found, approximately one third were intact fired items; the majority of the remaining items had

no fuze (presumably sheared off during improper functioning). A small percentage of the MEC items were only fuzes. 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.

2.2.3.2 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 UXO, one DMM, and thousands of pounds of MD were removed during the RI investigation. Penetration depths of MEC ranged from the surface to 15 inches below ground surface. However, approximately 90% of MEC items were found within the top eight inches of the soil profile.

2.2.4 Munitions Constituent Findings

2.2.4.1 For the former Camp Croft sites, constituent concentrations reported in chemical analyses were 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. No MC hazards were identified in the RI.

2.2.5 Site Delineation Refinement

2.2.5.1 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 were drawn from available data. MRS 1 and AoPIs 8, 9E, and 11C appear to be well characterized. Considering the findings in MRS 1, was recommended for No Further Action and will not be addressed in this Feasibility Study; however, it will be included in subsequent Decision Documents. MRS 2 is unresolved 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 was recommended that AoPI 5, AoPI 8, AoPI 9E, and AoPI 9G not be retained for further consideration and thus, will not be addressed in this Feasibility Study.

2.2.5.2 MRS 3 and five AoPIs were recommended for boundary realignment. It was recommended that MRS 3 be subdivided into seven MRSs (six MRSs where MEC was observed and the Remaining Lands). AoPIs 3, 10A, 10B, 11B, 11C, and 11D were recommended for realignment as five MRSs (AoPIs 10B and 11B were combined into one Proposed MRS). Slight adjustments to the total acreage are necessary based on RI findings.

2.2.5.3 Considering the area refinements described above, the following areas are addressed in this Feasibility Study; bolded items indicate where MEC or very high concentrations of MD were observed during the Remedial Investigation (see Exhibit 2-1 through Exhibit 2-12, at the end of this section):

- **105mm Area (1,399.7 acres)**
- **60mm Mortar Area (303.4 acres)**
- **60/81mm Mortar Area (301.3 acres)**
- Grenade Area (19.2 acres)
- **Grenade Maneuver Area (450.5 acres)**
- **Maneuver Area (1,276.5 acres)**
- Mortar/Rifle Grenade Area (22.9 acres)
- Practice Grenade Area (6.4 acres)
- Remaining Lands (9,093.4 acres)
- Rocket Area (93.9 acres)
- **Rocket/Grenade Maneuver Area (126.3 acres)**
- **Rocket & Rifle Grenade Area (108.5 acres)**

2.2.6 Conceptual Site Model

2.2.6.1 Conceptual Site Models (CSMs) are used to summarize pertinent characteristics about a project site; these characteristics are revised over the course of project activities in an iterative process. The CSMs are used to communicate sources of MEC, land use, receptors, potential source/receptor interactions, and a summary of risk. For the former Camp Croft, MC has been determined to not present a risk. Thus, the Croft CSMs (tabular and graphical) are presented for the areas, with respect to MEC/MD. Refer to Table 2-1 for a graphical representation of the MEC CSM and Table 2-4 for the tabular representation.

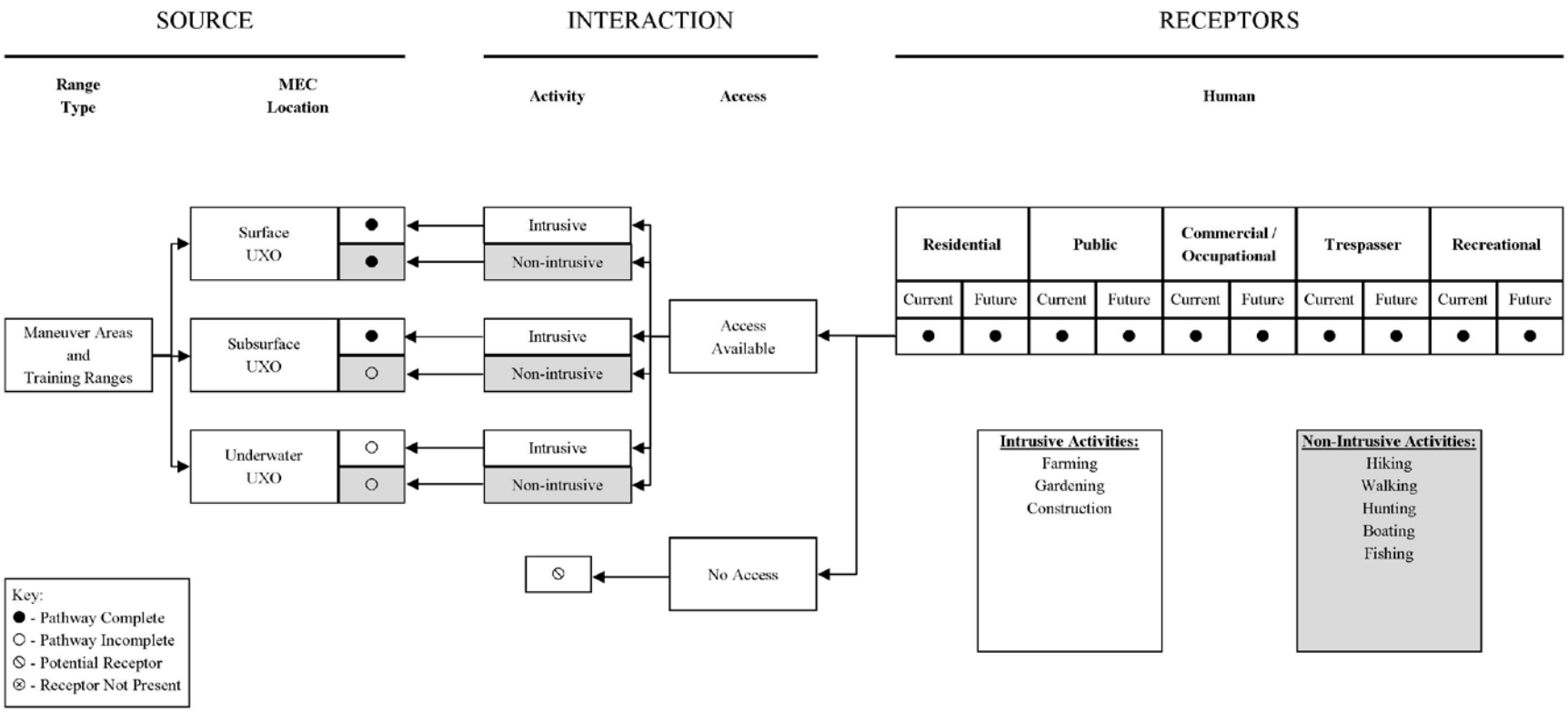
2.2.7 Baseline MEC Hazard Assessment Summary

2.2.7.1 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 Hazard Assessment (MEC HA). MEC data from previous activities were considered along with data collected during this RI to complete the MEC HA for the refined boundaries. The corresponding resulting Hazard Level Category and associated Score for each area containing MEC are summarized below.

2.2.7.2 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.

TABLE 2-1 GENERALIZED MUNITIONS AND EXPLOSIVES OF CONCERN GRAPHICAL CONCEPTUAL SITE MODEL



Range Types: Machine Gun, Air-to-Air, Live Fire, Mortar, Grenade, Gas Chamber, OB/OD
Other Receptors/Descriptors: Visitor/Trespasser, Construction, Jogger, Hunter, Fisher, Hiker, Swimmer, Gardener, Adult, Child, Adolescent, Geriatric, Sensitive, Infant, Toddler, Pregnant

TABLE 2-2 MUNITIONS AND EXPLOSIVES OF CONCERN HAZARD ASSESSMENT SUMMARY

Area Designation	Hazard Level Category	Score
105mm Area	1	950
60mm Mortar Area	3	705
60/81mm Mortar Area	1	965
Grenade Maneuver Area	2	755
Maneuver Area	1	1,000
Rocket/Grenade Maneuver Area	2	760
Rocket & Rifle Grenade Area	1	905

2.2.8 Baseline Munitions Response Site Prioritization Protocol (MRSPP)

2.2.8.1 The MRSPP score was calculated for previous and refined MRSs at the former Camp Croft (see Appendix H of the RI Report). 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. The MRSs and their corresponding MRSPP scores are summarized below.

TABLE 2-3 MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL SUMMARY

Area Designation	MRSPP Score
105mm Area	3
60mm Mortar Area	4
60/81mm Mortar Area	4
Grenade Area	5
Grenade Maneuver Area	4
Maneuver Area	3
Mortar/Rifle Grenade Area	4
Practice Grenade Area	4
Remaining Lands	6
Rocket Area	4
Rocket/Grenade Maneuver Area	4
Rocket & Rifle Grenade Area	3

2.2.9 Baseline MC Risk Assessment Summary

2.2.9.1 Human Health Risk Assessment

2.2.9.1.1 Maximum and average exposure concentrations of the Chemicals of Potential Concern (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.

2.2.9.1.2 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.

2.2.9.2 Ecological Risk Assessment

2.2.9.2.1 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.

Feasibility Study Report
Former Camp Croft, Spartanburg, SC
105mm Area (1,399.7 ac.)

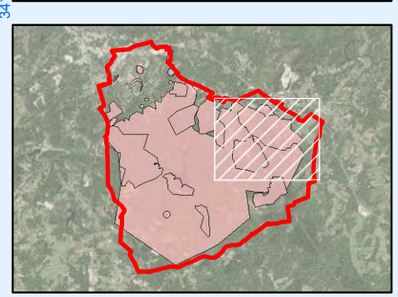
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-1

KEY

- Street
- 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
- 105mm Area
- Croft State Park Boundary
- Former Camp Croft Boundary
- Area Boundary

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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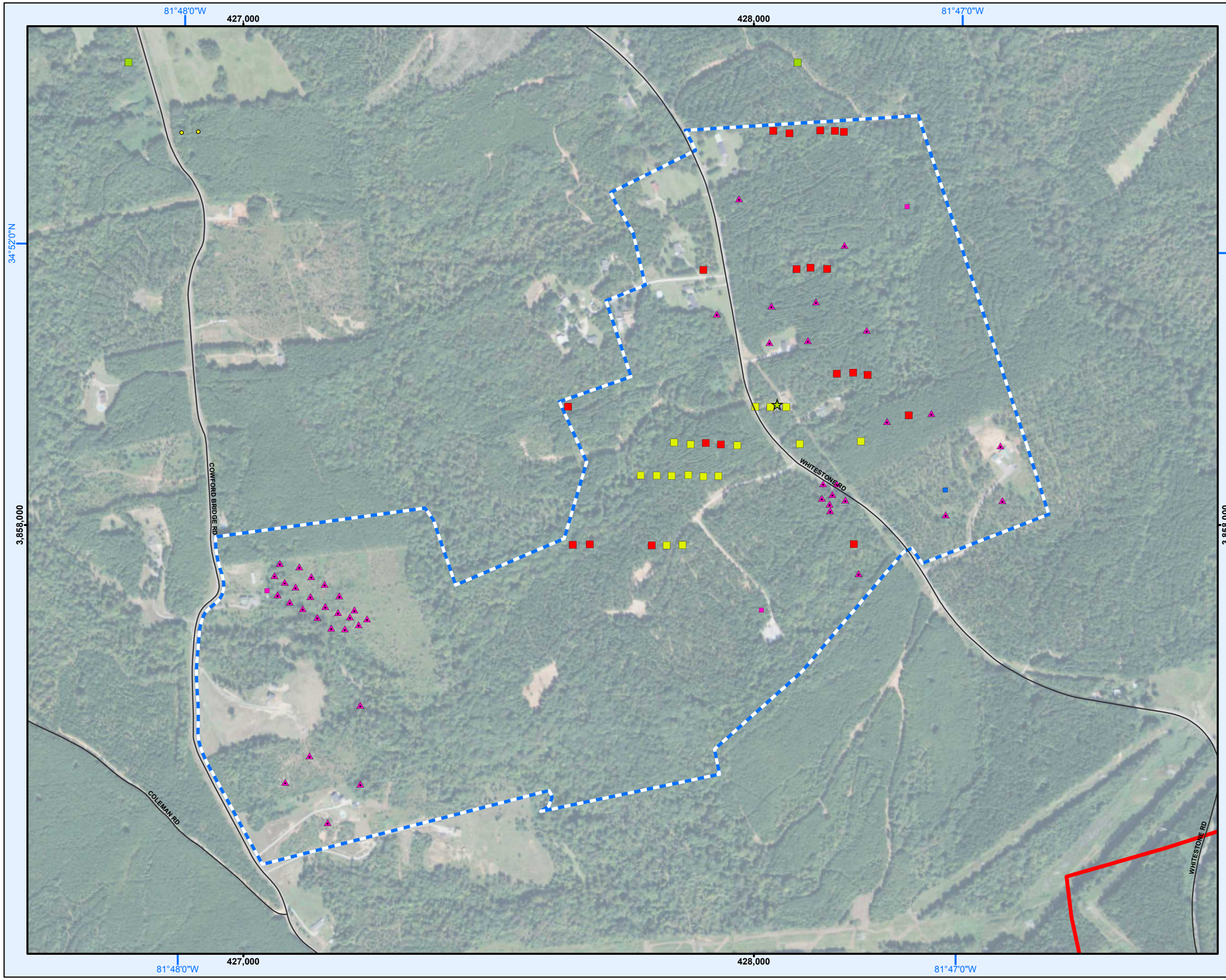


Feasibility Study Report
Former Camp Croft, Spartanburg, SC
60mm Mortar Area (303.4 ac.)

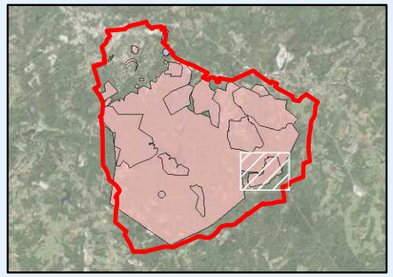
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-2

KEY

- Street
- 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
- 60mm Mortar Area
- Former Camp Croft Boundary

N W E S

0 300 600 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 " = 600 '	ATD

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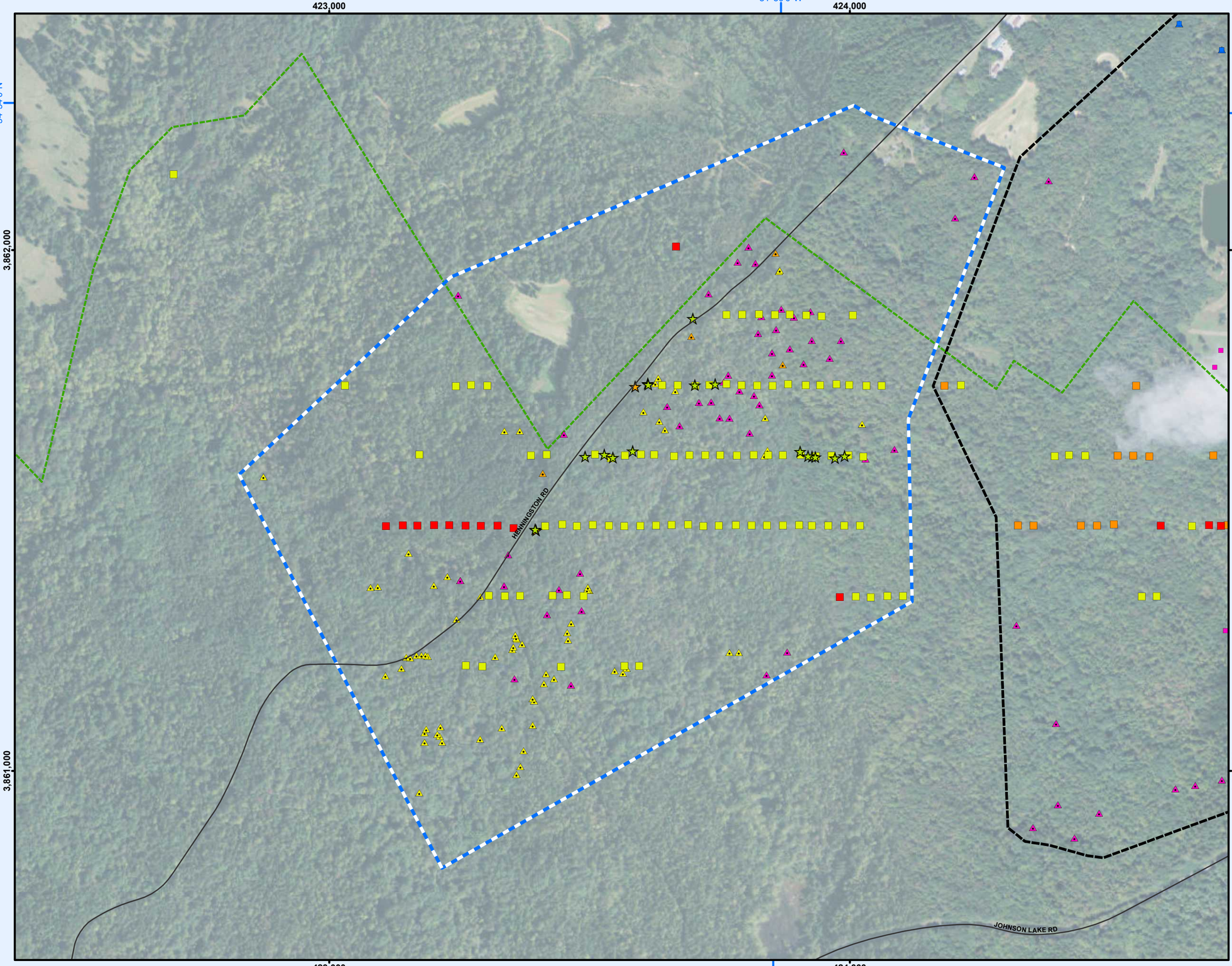


Feasibility Study Report
Former Camp Croft, Spartanburg, SC
60/81mm Mortar Area (301.3 ac.)

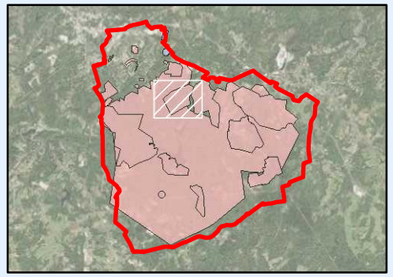
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-3

KEY

- Street
- 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)
- 60/81mm Mortar Area
- Croft State Park Boundary
- Former Camp Croft Boundary
- Area Boundary

N W E S

0 300 600 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 " = 600 '	ATD

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Support Center Huntsville
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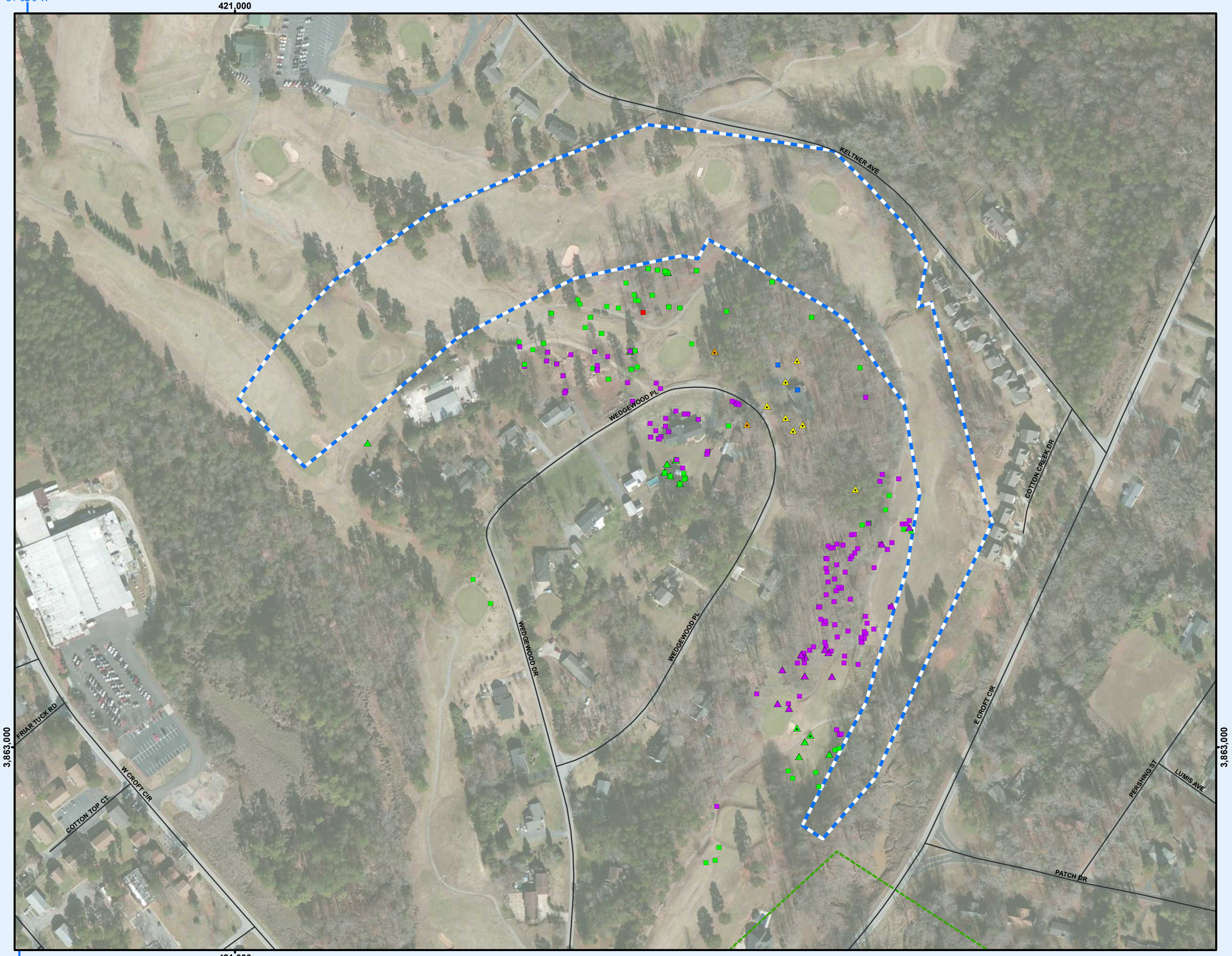
Huntsville, AL 35816

81°52'0"W

421,000



3,863,000

421,000

81°52'0"W

Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Grenade Area (19.2 ac.)

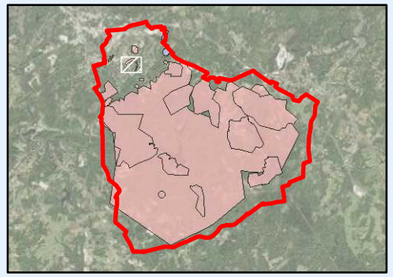
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-4

KEY

- Street
- 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)
- Grenade Area
- Croft State Park Boundary
- Former Camp Croft Boundary

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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Support Center Huntsville
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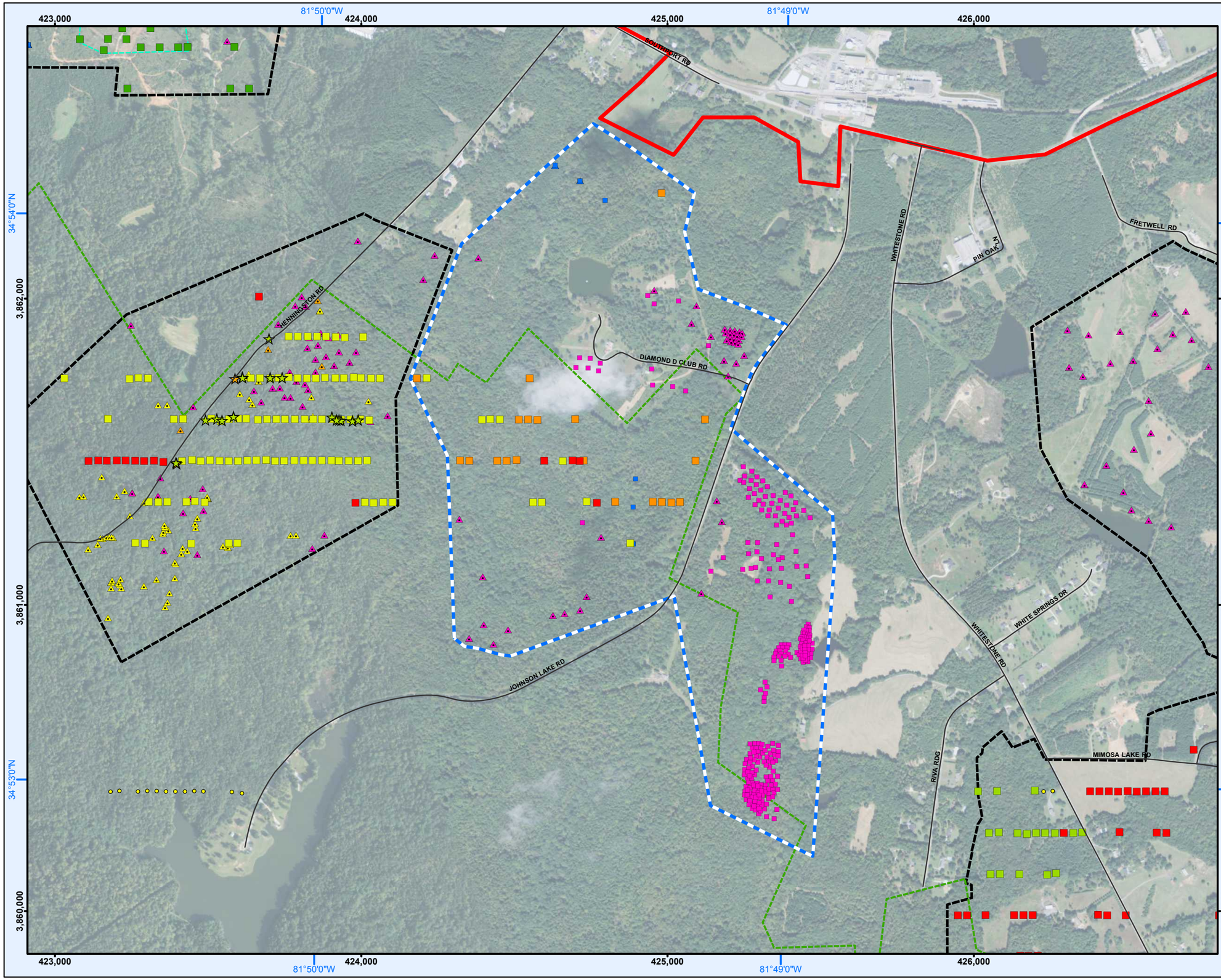


Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Grenade Maneuver Area (450.5 ac.)

Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-5

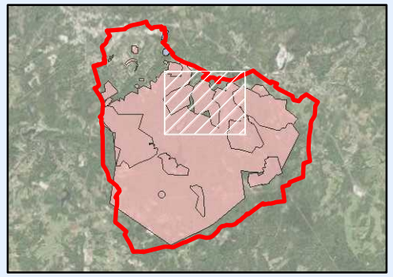
KEY

- Street
- 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
- Grenade Maneuver Area
- TCRA Boundary
- Croft State Park Boundary
- Former Camp Croft Boundary
- Area Boundary

Note: No boundary change recommended for Grenade Maneuver 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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Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Maneuver Area (1,276.5 ac.)

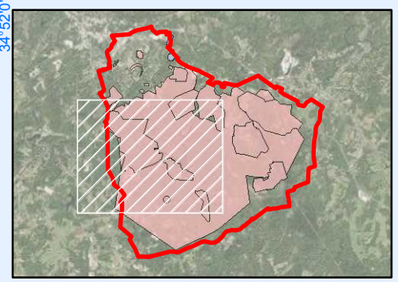
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-6

KEY

- Street
- DMM, Grenade
- UXO, 57 mm
- UXO, 60 mm
- UXO, 81 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
- Maneuver Area
- Croft State Park Boundary
- Former Camp Croft Boundary
- Area Boundary
- Inaccessible Area

N W E S

0 850 1,700 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 " = 1,800 '	ATD

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Support Center Huntsville
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Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Mortar/Rifle Grenade Area (22.9 ac.)

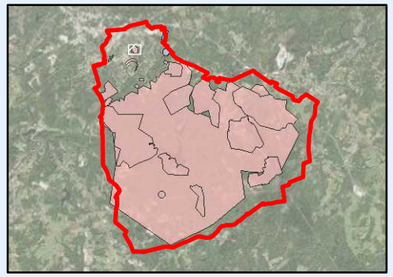
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-7

KEY

- Street
- Mortar MD
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- Mortar/Rifle Grenade Area
- Former Camp Croft Boundary

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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Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Practice Grenade Area (6.4 ac.)

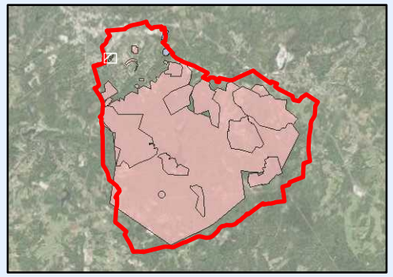
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-8

KEY

- Street
- Grenade MD
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- MD (Historical Find from 2005; MKII)
- MD (Historical Find from Other Source)
- Practice Grenade Area
- Croft State Park Boundary
- Former Camp Croft Boundary

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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Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Remaining Lands (9,093.4 ac.)

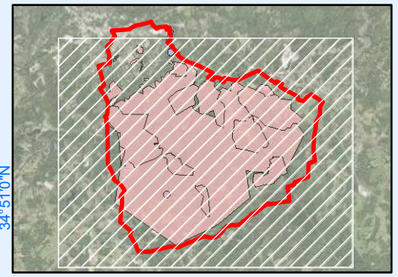
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-9

KEY

- Street
- 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
- Inaccessible Area
- Remaining Lands
- TCRA Boundary
- Croft State Park Boundary
- Former Camp Croft Boundary
- Area Boundary

N W E S

0 1,800 3,600 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 " = 3,650 '	ATD

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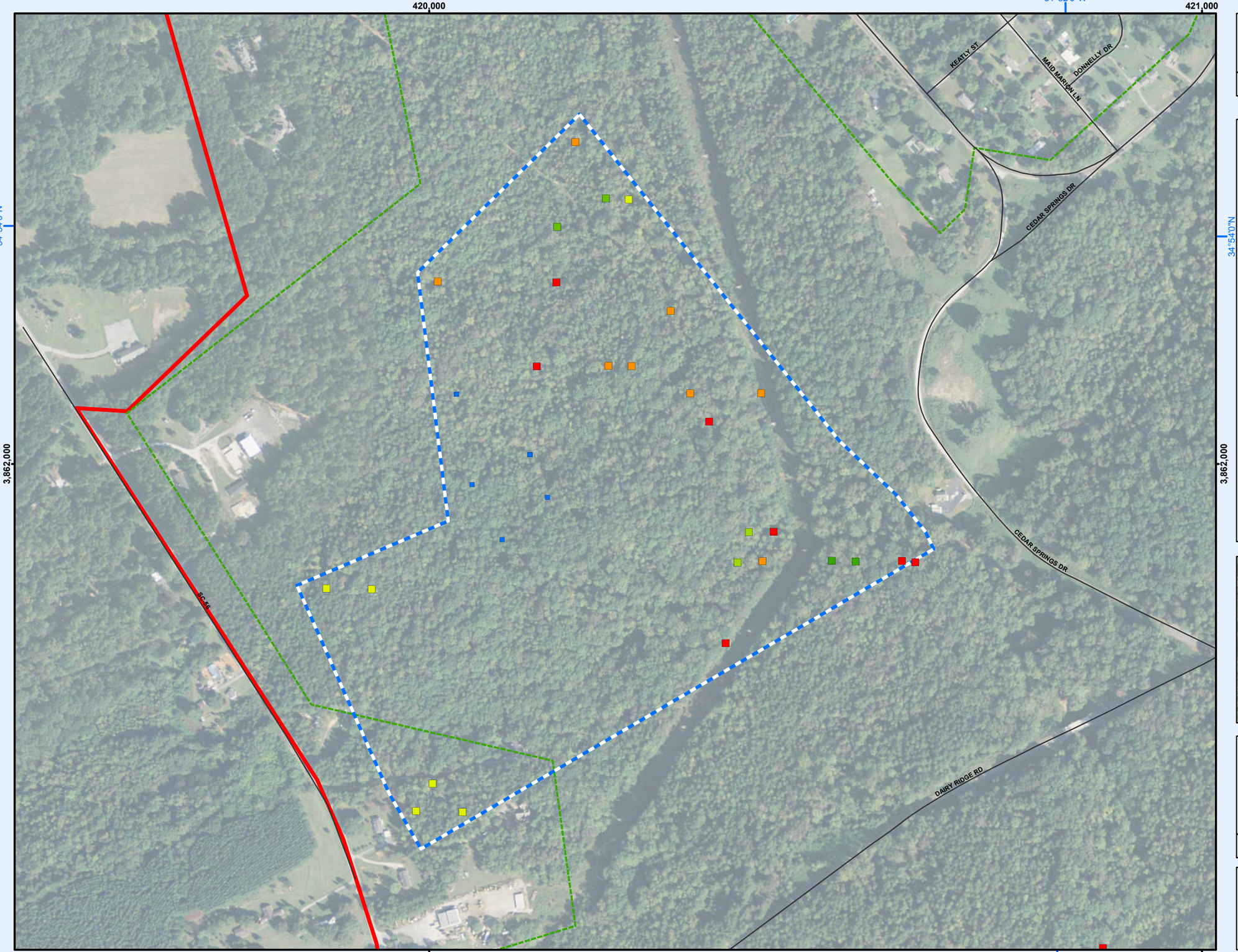
Huntsville, AL 35816



Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Rocket Area (93.9 ac.)

Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-10

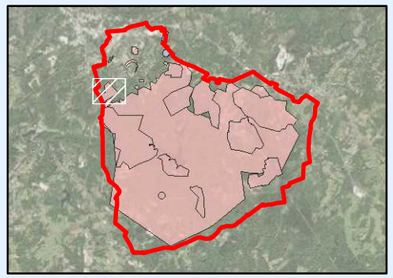
KEY

- Street
- Frag / Undifferentiated MD
- Grenade MD
- Mine MD
- Mortar MD
- Projectile MD
- Rocket MD
- MD from EE/CA 1998 (QST; M9, 2.36", M1)
- Rocket Area
- Croft State Park Boundary
- Former Camp Croft Boundary

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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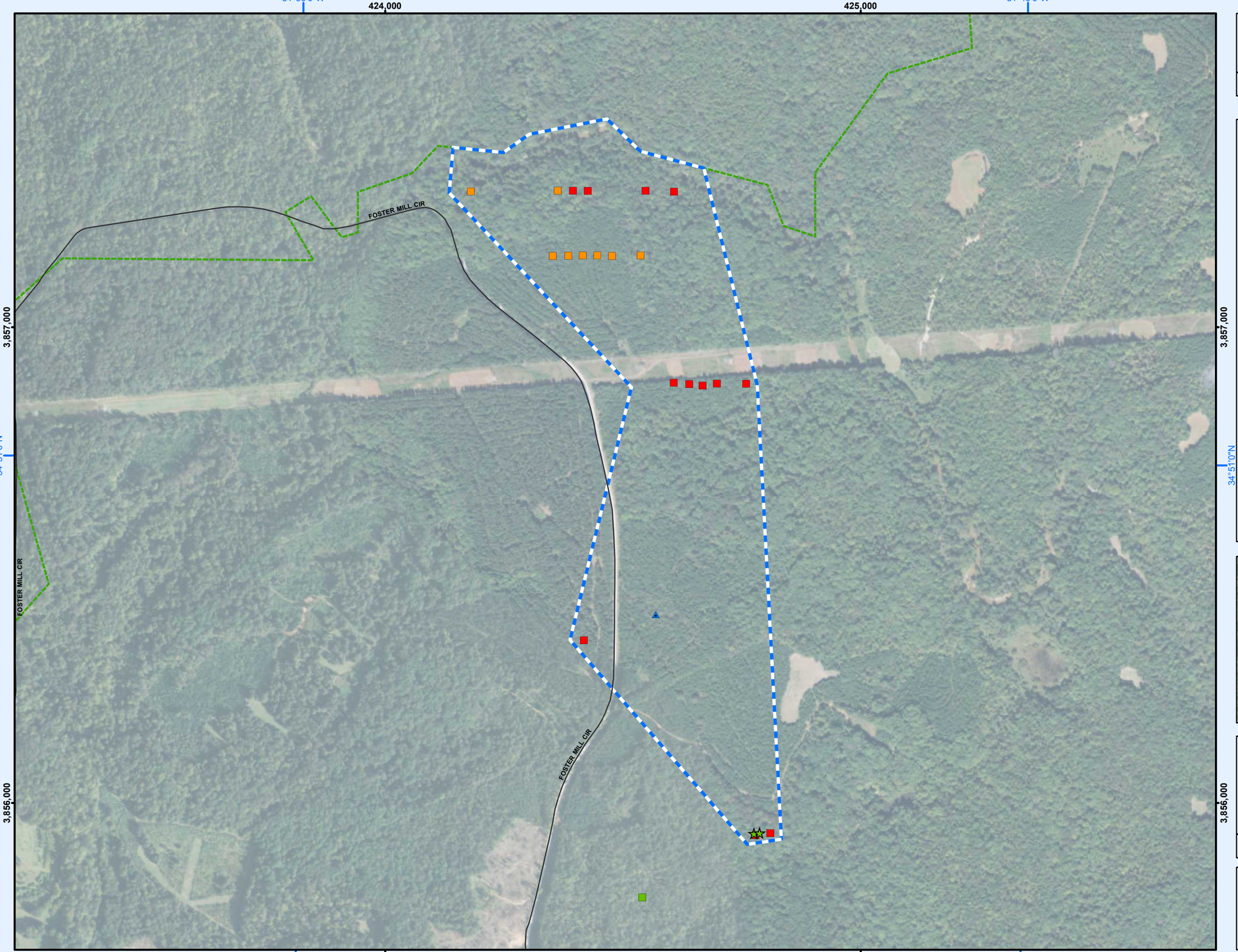


Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Rocket/Grenade Maneuver Area (126.3 ac.)

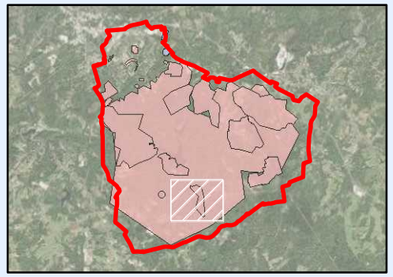
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-11

KEY

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

N W E S

0 325 650 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 " = 650 '	ATD

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Engineering and
Support Center Huntsville
4820 University Square
Huntsville, AL 35816

423,000

81°50'0"W

3,863,000

HICKORY HILL RD

DAIRY RIDGE RD

SOUTHPORT RD

MOUNT CALVERY CHURCH RD

Feasibility Study Report
Former Camp Croft, Spartanburg, SC
Rocket & Rifle Grenade Area (108.5 ac.)

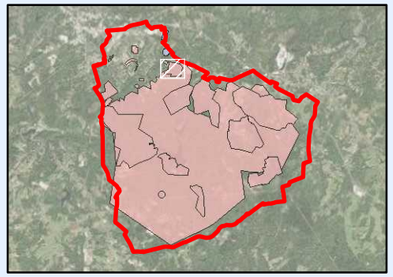
Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	2-12

KEY

- Street
- 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)
- Rocket & Rifle Grenade Area
- TCRA Boundary
- Former Camp Croft Boundary

N W E S

0 150 300 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 " = 300 '	ATD

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

TABLE 2-4 CONCEPTUAL SITE MODEL SUMMARY

Area (Acres)	Observed MEC / MD	Land Use	Potential Receptors	Potential Source/Receptor Interactions	MEC HA Hazard Level Category (Hazard Level Score) / MRSPP Score
105mm Area (1,399.7 acres)	Historical: **MEC** (60mm and 81mm mortars, 105mm and 155mm projectiles, MKII grenades); **MD** (60mm and 81mm mortars, 105mm and 155mm projectiles, M9 and M1 mines, 2.36" rockets) Remedial Investigation: **MD, very high concentrations** (60mm and 81mm mortars, 105mm projectiles, M1 mine, grenades, and undifferentiated fragments) Maximum depth of detection of **MEC** estimated (from historical data) to be 24 inches below ground surface (bgs).	Private residential and commercial and Croft State Park. Public roadways and rights-of-way throughout the site. Portions of the site have been reworked including the small landfill on the western side of the site and the construction and debris landfill on the eastern side of the site. Small ponds exist on some properties, scattered throughout the area.	Recreational users (e.g., hikers, bikers, camping, and horseback riding), residents, landowners, workers, and general public.	Private owners have full access over their property, without restrictions. Access to public roadways and rights-of-way is not restricted. Some timber harvest 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/receptor interaction remains unclear. However, because of the close proximity to MEC finds, those properties were included in area.	1 (950) / 3
60mm Mortar Area (303.4 acres)	Historical: **MEC** (60mm mortars); **MD** (60mm mortars, M9 mines, 2.36" rockets) Remedial Investigation: **MEC** (60mm mortars); **MD** (60mm mortars, projectiles, and undifferentiated fragments) **MEC** discovered during the RI was on the surface.	Private residential and commercial. Public roadway and right-of-way bisects the site.	Residents, landowners, and general public.	Private owners have full access over their property, without restrictions. Access to public roadway and right-of-way is not restricted. Some timber harvest 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/receptor interaction remains unclear. However, because of the close proximity to MEC finds, those properties were included in area.	3 (705) / 4

Area (Acres)	Observed MEC / MD	Land Use	Potential Receptors	Potential Source/Receptor Interactions	MEC HA Hazard Level Category (Hazard Level Score) / MRSPP Score
60/81mm Mortar Area (301.3 acres)	Historical: **MEC** (60mm and 81mm mortars, M6A3, M9 and M9A1 mines, MKII grenades); **MD** (60mm and 81mm mortars, 105mm projectiles, M9 and M1 mines, 2.36" rockets) Remedial Investigation: **MEC** (60mm and 81mm mortars); **MD** (60mm and 81mm mortars, grenades, and undifferentiated fragments) Maximum depth of detection of **MEC** during the RI was 15 inches bgs.	Private residential and Croft State Park. Public roadway and right-of-way bisects the site.	Recreational users (e.g., hikers, bikers, camping, and horseback riding), residents, landowners, workers, and general public.	Private owners have full access over their property, without restrictions. Access to 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/receptor interaction remains unclear. However, because of the close proximity to MEC finds, those properties were included in area.	1 (965) / 4
Grenade Area (19.2 acres)	Historical: **MEC** (MKII grenades, 2.36" rockets, and M15 mines); **MD** (MKII grenades and M15 mines) Remedial Investigation: No MEC or MD observed; only small fraction of area was accessible.	Private residential and commercial (golf course). Portions of the site have been reworked during golf course construction.	Recreational users (e.g., golfers), residents, landowners, and workers.	Private owners have full access over their property, without restrictions. Portions of the site were not investigated because rights-of-entry were not granted by the property owners. The potential source/receptor interaction remains unclear. However, because of the close proximity to historical MEC finds, those properties were included in area.	N/A / 5

Area (Acres)	Observed MEC / MD	Land Use	Potential Receptors	Potential Source/Receptor Interactions	MEC HA Hazard Level Category (Hazard Level Score) / MRSPP Score
Grenade Maneuver Area (450.5 acres)	Historical: **MEC** (MKII grenades); **MD** (60mm and 81mm mortars and grenades) Remedial Investigation: **MEC** (60mm mortars); **MD** (60mm and 81mm mortars, projectiles, rockets, grenades, and undifferentiated fragments) Maximum depth of detection of **MEC** during the RI was six inches bgs.	Private residential and commercial and Croft State Park. Public roadway and right-of-way bisects the site. A small pond exists on private property.	Recreational users (e.g., hikers, bikers, camping, and horseback riding), residents, landowners, workers, and general public.	Private owners have full access over their property, without restrictions. Access to 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/receptor interaction remains unclear. However, because of the close proximity to MEC finds, those properties were included in area.	2 (755) / 4
Maneuver Area (1,276.5 acres)	Historical: **MEC** (60mm and 81mm mortars, 37mm and 57mm projectiles, M6A3, M9 and M9A1 mines, MKII grenades); **MD** (60mm and 81mm mortars, 37mm and 57mm projectile, M9 and M1 mines, 2.36” rockets) Remedial Investigation: **MEC** (60mm and 81mm mortars, 57mm projectiles, MKII grenades); **MD** (60mm and 81mm mortars, 57mm projectiles, grenades, and undifferentiated fragments) Maximum depth of detection of **MEC** during the RI was eight inches bgs.	Croft State Park. Much of the area is wooded, open land. Park roadways and trails throughout the site. Campgrounds and support facilities present in portion of area. Horse stable and parking area present in portion of area.	Recreational users (e.g., hikers, bikers, camping, and horseback riding), park workers, and general public.	Access to park roadways and rights-of-way is not restricted. Most site usage is focused along trails, at campground sites, at the horse facility, and along roadways and parking areas.	1 (1,000) / 3

Area (Acres)	Observed MEC / MD	Land Use	Potential Receptors	Potential Source/Receptor Interactions	MEC HA Hazard Level Category (Hazard Level Score) / MRSPP Score
Mortar/Rifle Grenade Area (22.9 acres)	Historical: **MD** (grenades and mortars) Remedial Investigation: **MD** (mortar)	Private commercial (golf course). Portions of the site have been reworked during golf course construction.	Recreational users (e.g., golfers), landowners, and workers.	Private owners have full access over their property, without restrictions. Portions of the site were not investigated because rights-of-entry were not granted by the property owners. The potential source/receptor interaction remains unclear. However, because of the close proximity to MD finds, those properties were included in area.	N/A / 4
Practice Grenade Area (6.4 acres)	Historical: **MD** (grenades, anti-tank mines) Remedial Investigation: **MD** (grenades and undifferentiated fragments)	Private residential and commercial.	Residents and landowners.	Private owners have full access over their property, without restrictions.	N/A / 4
Remaining Lands (9,093.4 acres)	Historical: **MD** (grenades, M9 and M1 mines, 2.36” rockets) Remedial Investigation: **MD** (mortars, projectiles, rockets, grenades, mines, and undifferentiated fragments)	Private residential and commercial and Croft State Park. Public roadways and rights-of-way throughout the site. Portions of the site may have been reworked during construction activities. Small ponds exist on some properties, scattered throughout the area.	Recreational users (e.g., hikers, bikers, camping, and horseback riding), residents, landowners, workers, and general public.	Private owners have full access over their property, without restrictions. Access to public roadways and rights-of-way is not restricted. Some timber harvest 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/receptor interaction remains unclear. However, because of the close proximity to MD finds, those properties were included in area.	N/A / 6
Rocket Area (93.9 acres)	Historical: **MD** (2.36” rockets, rifle grenades, and M1 and M9 mines) Remedial Investigation: **MD** (mortars, projectiles, rockets, grenades, mines, and undifferentiated fragments)	Private residential and commercial and Croft State Park. Public utility right-of-way bisects the site.	Recreational users (e.g., hikers, bikers, camping, and horseback riding), residents, landowners, and workers.	Private owners have full access over their property, without restrictions. Access to utility right-of-way is not restricted.	N/A / 4

Area (Acres)	Observed MEC / MD	Land Use	Potential Receptors	Potential Source/Receptor Interactions	MEC HA Hazard Level Category (Hazard Level Score) / MRSPP Score
Rocket/Grenade Maneuver Area (126.3 acres)	Historical: **MEC** (M6A3 rocket, M9 and/or M9A1 rifle grenades) Remedial Investigation: **MEC** (fuze); **MD** (grenades, mines, and undifferentiated fragments) Maximum depth of detection of **MEC** during the RI was four inches bgs.	Private residential and commercial. Public roadway and right-of-way bisects the site.	Residents, landowners, and general public.	Private owners have full access over their property, without restrictions. Access to public roadway and right-of-way is not restricted. Some timber harvest is conducted on private property.	2 (760) / 4
Rocket & Rifle Grenade Area (108.5 acres)	Historical: **MEC** (MKII and rifle grenades, 2.36" rockets, M6A3, M9 and M9A1 mines); **MD** (60mm and 81mm mortars, 105mm projectiles, M9 and M1 mines, 2.36" rockets) Remedial Investigation: **MEC** (MKII and rifle grenades, 2.36" rockets); **MD** (mortars, grenades, and undifferentiated fragments) Maximum depth of detection of **MEC** during the RI was 10 inches bgs.	Private residential.	Residents and landowners.	Private owners have full access over their property, without restrictions. Portions of the site were not investigated because rights-of-entry were not granted by the property owners. The potential source/receptor interaction remains unclear. However, because of the close proximity to MEC finds, those properties were included in area.	1 (905) / 3

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

3.0.1 The objective of the FS is the analysis and design of potential response actions by assessing the following factors [40 CFR 300.430(d)(2)]:

- Physical characteristics of the property;
- Characteristics/classification of soil, sediment, and surface water;
- Characteristics of the waste (e.g., quantities, concentration, toxicity, persistence, mobility, depth, nature and extent, etc.);
- The extent to which the source can be characterized;
- Actual and potential exposure pathways through environmental media;
- Actual and potential exposure routes (e.g., inhalation and ingestion); and
- Other factors such as sensitive populations that pertain to the characterization of the site or support the analysis of potential remedial action alternatives.

3.0.2 To establish the regulatory framework for the eventual remedial action (to be selected later), several goals, requirements, and objectives have to be developed; those include Preliminary Remediation Goals (PRGs), Applicable or Relevant and Appropriate Requirements (ARARs), and Remedial Action Objectives (RAOs). These factors, along with previous investigation results, were considered during the screening of General Response Actions (GRAs), or remedial technologies, and development of remedial action alternatives.

3.1 REMEDIAL GOALS, REQUIREMENTS, AND OBJECTIVES

3.1.1 Preliminary Remediation Goals

3.1.1.1 PRGs address specific goals for reducing the potential explosive safety hazards for individual MRSs to ensure protection of human health, safety, and the environment. The PRGs are intended to be as specific as possible but not so specific that the range of alternatives that can be developed is excessively limited. Due to variations among the MRSs with regard to MEC risk, site conditions, and current/future use, specific remediation goals have been developed for each MRS individually. Detailed information is provided in the following sections.

3.1.2 Current and Future Land Use

3.1.2.1 The current land use across the various sites is composed of a mixture of privately-owned residential and commercial property, State Park, and public property, as indicated in the CSMs. Current land use is anticipated to extend into the future. There are no known large-scale land-use changes anticipated for any of the areas covered under this FS.

3.1.3 Explosives Safety Hazards and Contaminants of Concern

3.1.3.1 The PRG for Munitions Response Sites (MRSs) at the former Camp Croft is to reduce potential explosive hazards by preventing residents, landowners, workers, recreational users, and the general public from contacting MEC.

3.1.3.2 Based on the MC analytical results and ecological and human health risk assessments presented in the RI, there are no contaminants of concern at any of the MRSs. MC does not present an unacceptable risk to human health or the environment, and as such, MC RAOs have not been developed.

3.1.4 Applicable or Relevant and Appropriate Requirements

3.1.4.1 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.

3.1.4.2 Refinements of ARARs are accomplished during the CERCLA process until a decision document is finalized, at which point those ARARs are incorporated into the remedial action decision. During the remedial investigation, 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.

3.1.4.3 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, no chemical-specific ARARs for remedial actions were identified in the Final Remedial Investigation report for the former Camp Croft.

3.1.4.4 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 were no location-specific ARARs identified at the former Camp Croft, as documented in the Final Remedial Investigation report.

3.1.4.5 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 (e.g., use of consolidated shots during future potential Response Actions, which would be covered under 40 CFR Part 264, Subpart X; those consolidated shots will not be permitted). No action-specific ARARs were identified for the former Camp Croft, as reported in the Final Remedial Investigation report.

3.1.5 Exposure Pathways

3.1.5.1 Exposure pathways of MEC include direct contact with MEC at the ground surface and through intrusive activities. The reduction or elimination of exposure pathways to MEC is incorporated into the RAOs.

3.1.6 Receptors and Potential Receptors

3.1.6.1 The remedial action objectives (RAOs) are based on the determination and consideration of all human and ecological receptors available for exposure. Potential receptors that may encounter MEC include:

- Residents;
- Recreational users (e.g., hikers, bikers, runners, horseback riders, etc.);
- Workers (agricultural, construction, etc. - on private and public property); and
- General public.

3.1.7 Proposed Remedial Action Objectives

3.1.7.1 To determine the feasibility of remedial actions requires the identification of RAOs. The RAOs are criteria by which aspects of a cleanup under CERCLA are measured and typically, consist of potential statutory and regulatory requirements (ARARs), guidance and advisories (to-be-considered criteria, or TBCs), and risk-based concentrations of chemicals in environmental media that have been brought forward from the human health and ecological risk assessments, if warranted.

3.1.7.2 The general PRGs for the Camp Croft MRSs are to manage MEC 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. Based on MEC discovered during the RI, penetration depths provided in Table 2-4 and below. For areas where MEC was found on the surface only or less than six inches bgs, a minimum penetration depth of six inches was used. For areas without evidence of MEC, no penetration depth is assumed. For each area RAO, penetration depths and potential receptors were evaluated; where MEC has been confirmed, a safety factor (i.e., approximately one ft) was added to the greater of those two, to determine the recommended RAO depth.

Area	Penetration Depth (bgs)^	Potential Receptor Type/Depth (bgs)*	Recommended RAO# Depth (bgs)
105mm Area	2 ft**	Residential / 2 ft	3 ft
60mm Mortar Area	6 in.	Residential / 2 ft	3 ft
60/81m Mortar Area	15 in.	Residential / 2 ft	3 ft
Grenade Area	2 ft**	Residential / 2 ft	3 ft
Grenade Maneuver Area	6 in.	Residential / 2 ft	3 ft
Maneuver Area	8 in.	Recreational / 1 ft	2 ft
Mortar/Rifle Grenade Area	-	Recreational / 1 ft	1 ft
Practice Grenade Area	-	Residential / 2 ft	2 ft
Remaining Lands	-	Residential / 2 ft	2 ft
Rocket Area	-	Residential / 2 ft	2 ft

Area	Penetration Depth (bgs)^	Potential Receptor Type/Depth (bgs)*	Recommended RAO[#] Depth (bgs)
Rocket/Grenade Maneuver Area	4 in.	Residential / 2 ft	3 ft
Rocket & Rifle Grenade Area	10 in.	Residential / 2 ft	3 ft

^ Where no MEC has been confirmed, no depth is provided
* Most conservative receptor (from Table 2-4) noted, along with estimated depth of intrusion
[#] Where MEC has been confirmed, a safety factor of one ft bgs has been added
** Based on historical data

3.1.7.3 As noted in the RI, no chemical of concern with unacceptable risks were identified for the receptors exposure pathways evaluated. The RAOs presented here are considered proposed, because final remedial goals will be established in the ROD once the remedy for the project areas are selected.

3.1.7.1 Proposed RAO for 105mm Area

3.1.7.1.1 Based on previous removal actions conducted prior to the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of two feet bgs. The RAO for the 1,399.7-acre 105mm Area is to reduce the unacceptable hazard probability for human interaction with 105mm projectiles during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and response complete (RC) can be supported.

3.1.7.2 Proposed RAO for 60mm Mortar Area

3.1.7.2.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of six inches bgs. The RAO for the 303.4-acre 60mm Mortar Area is to reduce the unacceptable hazard probability for human interaction with 60mm mortars during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and RC can be supported.

3.1.7.3 Proposed RAO for 60/81mm Mortar Area

3.1.7.3.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of 15 inches bgs. The RAO for the 301.3-acre 60/81mm Mortar Area is to reduce the unacceptable hazard probability for human interaction with 60/81mm mortars during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and RC can be supported.

3.1.7.4 Proposed RAO for Grenade Area

3.1.7.4.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths on the adjacent parcels, including the Wedgewood neighborhood. Considering historical data are general in nature and the Grenade Area is composed of a golf course where the landscape has been manipulated, we estimate MEC (if present) may be found at a maximum depth of two feet bgs. The RAO for the 19.2-acre Grenade Area is to reduce the unacceptable hazard probability for human interaction with grenades during residential activities,

which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and RC can be supported.

3.1.7.5 Proposed RAO for Grenade Maneuver Area

3.1.7.5.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of six inches bgs. The RAO for the 450.5-acre Grenade Maneuver Area is to reduce the unacceptable hazard probability for human interaction with grenades during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and RC can be supported.

3.1.7.6 Proposed RAO for Maneuver Area

3.1.7.6.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of eight inches bgs. The RAO for the 1,276.5-acre Maneuver Area is to reduce the unacceptable hazard probability for human interaction with various MEC during recreational and site work activities, which currently includes surface and subsurface use, to a depth of two feet bgs such that a low hazard determination and RC can be supported.

3.1.7.7 Proposed RAO for Mortar/Rifle Grenade Area

3.1.7.7.1 Historical information suggested the presence of MEC; no UXO was confirmed on the surface or at shallow subsurface depths during the RI. The Mortar/Rifle Grenade Area is composed of a golf course where the landscape has been manipulated, thus we estimate intrusive activities may occur to a depth of one foot bgs. The RAO for the 22.9-acre Mortar/Rifle Grenade Area is to reduce the perceived unacceptable hazard probability for human interaction with mortars/rifle grenades during recreational and site work activities, which currently includes surface and subsurface use, to a depth of one foot bgs.

3.1.7.8 Proposed RAO for Practice Grenade Area

3.1.7.8.1 Historical information suggested the presence of MEC; no UXO was confirmed on the surface or at shallow subsurface depths during the RI. The Practice Grenade Area is composed of residential properties, thus we estimate intrusive activities may occur to a depth of two feet bgs. The RAO for the 6.4-acre Practice Grenade Maneuver Area is to reduce the perceived unacceptable hazard probability for human interaction with practice grenades during residential activities, which currently includes surface and subsurface use, to a depth of two feet bgs such that a low hazard determination and RC can be supported.

3.1.7.9 Proposed RAO for Remaining Lands

3.1.7.9.1 Historical information suggested the presence of MEC; no UXO was confirmed on the surface or at shallow subsurface depths during the RI. The Remaining Lands is composed of a mixture of residential, private, and public properties, thus we estimate intrusive activities may occur to a depth of two feet bgs. The RAO for the 9,093.4-acre Remaining Lands is to reduce the perceived unacceptable hazard probability for human interaction with potential MEC during residential activities, which currently includes surface and subsurface use, to a depth of two feet bgs such that a low hazard determination and RC can be supported.

3.1.7.10 Proposed RAO for Rocket Area

3.1.7.10.1 Historical information suggested the presence of MEC; no UXO was confirmed on the surface or at shallow subsurface depths during the RI. The Rocket Area is composed of a mixture of residential, private, and public properties, thus we estimate intrusive activities may occur to a depth of two feet bgs. The RAO for the 93.9-acre Rocket Area is to reduce the perceived unacceptable hazard probability for human interaction with potential rockets during residential activities, which currently includes surface and subsurface use, to a depth of two feet bgs such that a low hazard determination and RC can be supported.

3.1.7.11 Proposed RAO for Rocket/Grenade Maneuver Area

3.1.7.11.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of six inches bgs. The RAO for the 126.3-acre Rocket/Grenade Maneuver Area is to reduce the unacceptable hazard probability for human interaction with rockets/grenades during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and RC can be supported.

3.1.7.12 Proposed RAO for Rocket & Rifle Grenade Area

3.1.7.12.1 Based on the RI findings, UXO has been confirmed on the surface and at various shallow subsurface depths; historical data are general in nature, thus we estimate a maximum penetration depth of MEC of 10 inches bgs. The RAO for the 108.5-acre Rocket & Rifle Grenade Maneuver Area is to reduce the unacceptable hazard probability for human interaction with rocket & rifle grenades during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low hazard determination and RC can be supported.

3.2 GENERAL RESPONSE ACTIONS

3.2.1 General Response Actions (GRAs) describe those actions that can potentially achieve the RAOs established in Section 3.1, above. These GRAs are broad categories that identify a set of possible response actions that may be applicable to the site, such as land use controls (LUCs), surface or subsurface removal actions, or a combination of these actions. The established performance of each technology identified from these GRAs with regard to site contaminants and conditions is considered during the identification and screening process. The screening is based on effectiveness, implementability, and relative cost. These GRAs are then used to identify specific response technologies that may be implemented at the site.

3.2.2 GRAs for the response to MEC at the former Camp Croft are presented in Table 3-1 with descriptions and listed below;

- No Action (Baseline Condition),
- Land Use Controls,
  - Signs
  - Informational Brochures and Fact Sheets
  - Zoning Restrictions
  - MEC Recognition and Safety Training
- Surface Removal,
- Subsurface Removal, and

- Long-Term Management.

3.2.1 No Action (Baseline Condition)

3.2.1.1 The No Action alternative is included to provide a baseline for comparison of other risk-reduction alternatives. No alternative technology is associated with this alternative, and no risk-reduction measure resulting in the treatment, containment, removal of, or limited exposure to potential MEC will take place. No action will be taken to address MEC potentially present at the MRSs and no restriction will be placed on access to the MRSs. This alternative is typically appropriate only for sites where 1) no MEC has been found or 2) where there is no documented evidence of military munitions usage.

3.2.2 Land Use Controls

3.2.2.1 LUCs are physical, legal, or administrative mechanisms that restrict the use of, or limit access to, real property to prevent or reduce risks to human health, safety and the environment. LUCs are considered response actions under CERCLA and, as such, must be coordinated with the current landowner(s), regulatory agencies, and appropriate local authorities. In order to assess alternatives that include LUCs, United States Army Corps of Engineers (USACE), Wilmington District (CESAW) facilitated an Institutional Analysis (IA) to determine landowner/agency acceptance and willingness towards implementing any of these (or other) options, as well the capability to execute a LUC Alternative (Appendix B).

3.2.2.2 LUCs considered potentially appropriate for the former Camp Croft MRSs include:

- Installation and maintenance of signs warning individuals of potential risk and response actions if they were to encounter a suspected MEC item;
- Informational and safety fact sheets/notices attached to construction permits;
- Issuance and enforcement of zoning laws for land use permits;
- Issuance and enforcement of land use permits; and
- MEC recognition and safety training used to educate landowners, site workers, and other community inhabitants (e.g., realtors) that have access to the MRSs.

3.2.2.3 It should be noted that within Croft State Park, LUCs in the form of informational flyers, posters, signs, and other educational materials are already in place. These instruments are implemented on a park-wide basis and are not specific to individual MRSs.

3.2.2.1 Signs

3.2.2.1.1 Signs describing former military use and MEC safety information, including appropriate actions if suspected MEC is encountered, may be installed at site access points. Signs are currently posted at some locations in Croft State Park, but not at individual MRSs or other privately-held properties.

3.2.2.2 Informational Brochures and Fact Sheets

3.2.2.2.1 Brochures and/or Fact Sheets describing former military use and MEC safety information, including appropriate actions if suspected MEC is encountered, may be distributed to any person, company, or agency planning to live or work within the former Camp Croft MRSs. In addition, the brochures will be available to anyone upon request. Croft State Park currently has some literature available for this purpose at the park headquarters. Annual informational updates to the community may be provided by mail or by public forum.

3.2.2.3 Zoning Restrictions

3.2.2.3.1 Zoning restrictions are a subset of LUCs and are primarily legal mechanisms imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. Legal mechanisms may include restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions. All of these measures will require the cooperation of, and coordination with the landowners. Although Croft State Park may likely be amenable to these restrictions, private landowners that hold property within the various MRSs may not agree with restrictions on land use. The Federal Government has no involvement with establishing, enforcing or maintaining potential zoning restrictions.

3.2.2.4 MEC Recognition and Safety Training

3.2.2.4.1 MEC recognition and safety training involves educating landowners, site workers, and other community inhabitants (e.g., realtors) that have access to the MRSs. Training may include such topics as recognition and avoidance of MEC, precautions to take if a suspected MEC item is encountered, and the proper procedures for contacting authorities if a suspected MEC item is found.

3.2.3 Surface Removal

3.2.3.1 Surface removal involves the identification, removal, and disposal of MEC and/or MD located on the ground surface or partially buried within the MRS boundaries. This response action requires teams of unexploded ordnance (UXO)-qualified personnel to use visual identification, aided by hand-held instruments, to search for MEC/MD. Potential MEC will be inspected and disposed of accordingly; MD determined to be Material Documented as Safe (MDAS) will be removed and turned in to a scrap-metal smelter. Rights-of-entry (ROEs) will be required to access impacted properties. Minimal brush clearing may be required to support a surface removal alternative.

3.2.4 Subsurface Removal

3.2.4.1 This alternative involves all activities necessary to locate, excavate, and remove potential MEC and/or MD to a depth conducive to the future land use and overall health and safety of the affected community. Detection technologies that may be used for this alternative include magnetic and/or electromagnetic geophysical sensors. Selected technologies will consider the munitions of concern, vegetation, and terrain/topography. Removal depth may be modified based on actual depths at which MEC/MD is consistently found. Potential MEC will be inspected and disposed of accordingly; MD determined to be MDAS will be removed and turned in to a scrap-metal smelter. ROEs will be required to access impacted properties. Significant brush clearing may be required to support a subsurface removal alternative.

3.2.5 Long-term Management

3.2.5.1 Long-term management includes five year reviews, which are a requirement for all alternatives not allowing for unlimited use/unrestricted exposure (UU/UE) in accordance with 40 CFR 300.430(f)(4)(ii). Five-Year Review Reports will document the information collected and evaluated, and present the findings of the evaluation of the continued protectiveness of the military munitions response actions. The report will document whether the response action that

was implemented continues to minimize explosive safety risks and is still protective of human health, safety, and the environment and/or recommend follow-up actions that may be warranted.

TABLE 3-1 GENERAL RESPONSE ACTIONS

Potential Response Actions	Response Components	Associated Systems	Implementation Methods	Process Options
No Action	None	N/A	N/A	N/A
Land Use Controls (LUCs)	Access Restrictions Deed Restrictions Educational Material Specialized Training	N/A	N/A	Signs Informational Brochures Zoning Restrictions MEC Recognition and Safety Training
Surface Removal	Data Collection Removal	Analog Geophysics Digital Geophysics	Geo-Sensors Hand Tools	Limited Removal Complete Removal
Subsurface Removal	Data Collection Excavation	Analog Geophysics Digital Geophysics	Geo-Sensors Hand Tools Mechanized Equipment	Limited Removal Complete Removal
Long-Term Management	Data Collection Evaluation Reporting	Analog Geophysics Digital Geophysics	Geo-Sensors	N/A

3.3 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

3.3.1 ZAPATA developed a list of technically-feasible technologies for risk mitigation at the former Camp Croft MRSs. These possible technologies are screened (i.e., preliminarily evaluated) using effectiveness, implementability, and relative cost. Table 3-2 presents these technologies, which provides details for each technology, including a brief description of the technology and comments about the application of the technology and the screening summary.

3.3.1 Identification and Screening of Technologies

3.3.1.1 Remedial technologies presented in this document are screened initially for effectiveness, cost, and implementability. When evaluating the remedial technologies, implementability is carefully considered, including the effectiveness of the technology/methodology, and availability of qualified personnel and materials (equipment). The controlling site conditions considered for technology effectiveness are dense vegetation, accessibility, soil type, presence of standing water, and anomaly density.

3.3.2 Evaluation and Retention of Technologies

3.3.2.1 Potential applicable technologies, and those considered ineffective for the former Camp Croft MRSs are presented in Table 3-2; technologies considered ineffective based on site conditions have been eliminated from further evaluation during the alternative development phase. Numerous technologies were retained for further consideration during the development of remedial alternatives.

TABLE 3-2 REMEDIAL CANDIDATE TECHNOLOGIES SCREENING

Candidate Technology	Description	Effectiveness	Implementability	Relative Cost	Retained?	Screening Comment
General Response Action: No Action						
No Action	N/A	**Low**	**High**	**Low**	Yes	Retained, per CERCLA mandate.
General Response Action: Land Use Controls (LUCs)						
Access Restrictions	Restrict access through physical barriers (e.g., signage or fencing)	**Medium** These can be effective, when the receptors agree to adhere to the restrictions.	**Medium to High** The installation of signs or fencing is fairly simple, with numerous contractors capable of providing the service.	**Low to Medium** Signage can be relatively inexpensive. Fencing (depending on the area) can be quite expense but, cheaper than significant removal action costs.	Yes	Access restrictions are a common LUC implemented at MRSs.
Deed Restrictions	Restricts access through restrictive covenants or notifications (e.g., stamps) on property deed	**High** Can limit intrusive activities and inform future land owners.	**Low** Despite beneficial effectiveness, property owners are typically resistant.	**Low** Deed stamp program is inexpensive relative to other response actions.	Yes	This is retained for evaluation by stakeholders.
Educational Material	Brochures and Fact Sheets for community and Park users	**Medium** Works well, for those that see the materials.	**High** Common response implemented at MRSs; existing material templates are widespread.	**Low** Much of these materials are generally easy to produce and supply.	Yes	Educational Material is a common LUC implemented at MRSs.
Specialized Training	Training courses (online or in-person) that provide insight into site history and potential munitions impact	**Medium** Site-specific courses provide valuable information to training participants.	**High** Coordinated annually or semi-annually for community.	**Low** Generic material is easily customized to be site-specific.	Yes	Specialized Training is a common LUC implemented at MRSs.
General Response Action: Surface / Subsurface Removal and Long-Term Management - Data Collection Detection						
Time Domain Electromagnetic Induction Metal Detectors – Advanced EMI (Representative Systems: ALLTEM, BUD, MetalMapper™, and TEMTADS)	Induces a pulsed magnetic field using a transmitter coil, which causes a secondary magnetic field to emanate from nearby objects that have conductive properties. Responses are compared to a database of responses, which increases dramatically the ability to determine whether anomalies are MEC, or not.	**High** Some may be used in production mode to detect subsurface metallic objects, and all can collect static measurements over a target location to record entire EMI response pattern. Greatest ability of all sensors for the classification of anomalies as TOI or non-TOI. Detects both ferrous and nonferrous metal objects.	**Low to Medium** MetalMapper™, TEMTADS, and ALLTEM require the use of a vehicle to tow the sensors; some sensors are man portable. Large sensors have more limited accessibility in forested or steep slopes, like portions of the former Camp Croft. Man portable systems have greater accessibility but, are less common.	**Average** Requires additional surveying and processing costs, which may be offset by decreased intrusive investigation costs.	Yes	Currently, only the MetalMapper™ is commercially available. There is reasonable industry familiarity; however, the production usage of this innovative technology at field sites is not yet widespread.

Candidate Technology	Description	Effectiveness	Implementability	Relative Cost	Retained?	Screening Comment
Time Domain Electromagnetic Induction Metal Detectors – Production EMI (Representative Systems: Geonics EM61, EM61-MKII, Schiebel AN PSS-12, Vallon VMH3)	Induces a pulsed magnetic field using a transmitter coil, which causes a secondary magnetic field to emanate from nearby objects that have conductive properties.	**High** High industry familiarity. Detects both ferrous and nonferrous metal objects.	**Medium to High** Typically uses 1 m^2 or 0.5 m by 1 m coils. Most commonly used instrument and widely available. Useful in most traversable terrains. Processing and interpretation of data are relatively straight-forward.	**Low** Average in typical terrain, like those at the former Camp Croft.	Yes	Digital signal should be co-registered with positional data for best results.
Frequency Domain Electromagnetic Induction Metal Detectors (Representative Systems: Fisher 1266X, Foerster Minex, Minelabs Explorer II, White's All-Metals)	Generates one or more defined frequencies in a continuous mode of operation. Demonstrated capability of detecting small items using a handheld unit.	**Low to Medium** Sensors have not been the primary detector in any highly-ranked MEC detection system. Experience shows capability at detecting small items and potential for improved classification. Not good for detecting deeply buried, single items. High industry familiarity. Detection of shallow ferrous and nonferrous objects.	**High** Lightweight and compact. Useful in any traversable terrain. Widely available. Classification possibilities exist for multi-channel systems.	**Low** Lower than average in most typical terrain, except for Geophex GEM3, which is average.	Yes	Analog output usually not co-registered with positional data.
Magnetometer-Electromagnetic Induction Dual Sensor Systems (Representative Systems: ERDC EM61 HH, SAIC MSEMS and STOLS/VSEMS)	Integrates magnetic and electromagnetic technologies. Detects ferrous and nonferrous metallic objects.	**High** Detects both ferrous and non-ferrous metallic objects. Medium industry familiarity. Higher potential for classification of anomalies than individual EM or magnetic sensors.	**Medium** High data processing requirements. Available from few sources.	**High** Higher than average. Lower costs using a towed array platform.	No	Based on the higher than average costs and medium implementability because systems are available from few sources, this technology was not retained.
Flux Gate Magnetometers (Representative Systems: Schonstedt 2-CX, Foerster FEREX 4.032, Vallon EL 1302DI)	Measures the vertical component of the geomagnetic field along the axis of the sensor and not the total of the geomagnetic field.	**Medium** Have been used as the primary detector in traditional mag-and-flag/dig operations. High industry familiarity. Detects ferrous objects only.	**High** Lightweight and compact. Can be used in any traversable terrain. Widely available.	**Low** Lower than average on most terrain.	Yes	Most adept at detecting smaller shallow items as opposed to relatively large, deeper items. Analog output usually not co-registered with positional data.

Candidate Technology	Description	Effectiveness	Implementability	Relative Cost	Retained?	Screening Comment
Optically Pumped Magnetometers (Representative Systems: Gem Systems GSMP-40, Geometrics G-858, Scintrex Smart Mag)	Based on the theory of optical pumping and operates at the atomic level as opposed to nuclear state.	**High** Standard detector for digital magnetic data collection for MEC detection. High industry familiarity. Detects ferrous objects only.	**Medium to High** Relatively lightweight and compact. Can be used in most traversable terrain. Widely available. Processing and interpretation require trained specialists. Classification possibilities are limited. Detection capabilities are negatively influenced by iron-bearing soils like those at the former Camp Croft.	**Medium** Average in typical terrain. Much below average when arrays of multiple detectors are used.	No	Digital signal should be co-registered with positional data for best results. Considering the iron-bearing soils common at the former Camp Croft, this technology was not retained.
Ground Penetrating Radar (Representative Systems: GSSI SIR2, SIR3, SIR8, SIR10, RAMAC Software)	Propagates electromagnetic waves into the ground via an antenna. Transmitted signals are reflected by objects and features that possess contrasts in electrical properties with the surrounding medium.	**Low** Extremely sensitive to changes in the magnetic, conductive, and dielectric properties of the subsurface. Detects both metallic and nonmetallic objects but is susceptible to many environmental / geological conditions. Low success rate as a stand-alone detector for MEC.	**Low** Large, bulky, requires trained operator, and is slow to operate. Difficult to use in any but the easiest terrain. Widely available.	**High** Higher than average. Systems are slow and require survey coverage, which is expensive.	No	Based on a combination of low effectiveness, low implementability, and high relative cost, this technology was not retained.
General Response Action: Surface / Subsurface Removal and Long-Term Management - Data Collection – Sensor Platforms						
Hand-held	Detection sensor is held or carried by the operator.	**High** Deployable in all site conditions and often the most suitable in areas with steep or uneven terrain.	**High** Lightweight and compact. Can be used in most terrains. Widely available.	**Low** Lower than average on most terrain.	Yes	
Skirt-mode	Detection sensor is suspended from the operator's shoulders.	**High** Limited by topography and vegetation, and requires reasonable operator stamina and strength to operate.	**High** Moderately manageable; can be unorthodox for inexperienced operators. Safe operation requires careful, focus usage by a trained operator.	**Low** Average in typical terrain, like those at the former Camp Croft.	Yes	

Candidate Technology	Description	Effectiveness	Implementability	Relative Cost	Retained?	Screening Comment
Cart-mounted (man-portable)	Detection sensor is mounted on a wheeled cart, which is pushed or pulled across the survey area by a person.	**High** Limited by topography and vegetation, and requires reasonable operator stamina and strength to operate.	**High** Moderately manageable; can be unorthodox for inexperienced operators. Safe operation requires careful, focus usage by a trained operator.	**Low** Average in typical terrain, like those at the former Camp Croft.	Yes	
Airborne	Detection sensor is affixed to either a helicopter or fixed-wing aircraft.	**High** Lower detection capabilities than ground-based systems for smaller, single anomalies. Limited by tree canopy.	**Low** High data collection and processing requirements. Available from few sources.	**High** Equipment is highly specialized, from limited sources.	No	Because much of the former Camp Croft is covered with a tree canopy too tall for close airborne assessment platforms, this technology was not retained.
Towed Arrays	Vehicle used to tow cart-mounted detection sensor(s).	**Medium** Limited by topography and vegetation. Most suitable for vast open areas.	**Medium** Large, bulky, requires trained operator. Difficult to use in any but the easiest open terrain.	**Medium** Much below average when arrays of multiple detectors are used in open areas.	No	Vegetation is generally too dense to allow for towed array assessment platforms; thus, this technology was not retained.
General Response Action: Surface / Subsurface Removal and Long-Term Management - Data Collection – Positioning						
Robotic Total Station (Representative Systems: Leica TRS 1100, Trimble Model 5600)	Laser-based survey station that derives its position from survey methodology and includes a servo-operated mechanism that tracks a prism mounted on the geophysical sensor.	**Medium** Is very effective in open areas for both digital mapping and reacquiring anomalies. Is effective near buildings and sparse trees. Commonly achieves accuracy to a few centimeters.	**Medium** Easy to operate. Requires existing control.	**Low** System is available for <$200/day.	Yes	Is recommended near houses or in open areas that have a high tree line.
Differential Global Positioning System (Representative Systems: Leica GPS 1200, Trimble Model 5800, Thales Ashtech Series 6500)	Worldwide positioning and navigation system using a constellation of satellites orbiting the earth. GPS uses the satellites as reference points to calculate positions on the earth's surface.	**Medium** Very effective in open area; very accurate when differentially corrected. Accuracy degrades when minimum satellites are available or in wooded areas. Advanced GPS can provide cm accuracy.	**High** Easy to operate and set up. Requires trained operators. Widely available. Better systems are typically ruggedized and durable. Some work time is lost when insufficient satellites are available.	**Low** High-end system is available for <$200/day	Yes	Is recommended in open areas.
Fiducial Method	Digital marking of a data string (data set) with an indicator of a known position. Typically, lines or markers are placed on the ground at known positions (e.g., 25 feet).	**Medium** Medium effectiveness when performed by experienced personnel; low when performed by inexperienced personnel. Generally achieves accuracy of 15-30 cm.	**Low** Is difficult to use and requires constant pace, detailed field notes, and elaborate setup.	**Low** Minimal direct costs	Yes	Requires very capable operators. Is useful if digital positioning systems are unavailable.

Candidate Technology	Description	Effectiveness	Implementability	Relative Cost	Retained?	Screening Comment
RANGER (Representative Systems: Ensco)	Radio frequency system that uses four to eight fixed radio transponders and a mobile radio integrated with the geophysical detection system.	**Medium to High** Can effectively survey open, vegetated, or cluttered areas with varying degrees of position accuracy. Can be set up over a 5-acre area.	**Medium** Technique has not been successfully demonstrated on numerous MEC projects.	**Medium to High** Purchase price is estimated to be >$15,000.	No	There is only one manufacturer and limited supply. Considering the limited availability and high cost, this technology was not retained.
Odometer	Physically measures distance traveled. Similar to fiducial method.	**Medium** Medium effectiveness when performed by experienced personnel; low when performed by inexperienced personnel. Commonly achieves accuracy of 15-30 cm.	**Low** Affected by terrain/environment. Requires detailed field notes and lengthy setup.	**Low** Very minimal costs.	No	Based on previous less than successful experiences using this method at sites similar to the former Camp Croft, this technology was not retained.
Inertial Navigation (Representative Systems: Ranger)	Measures the acceleration of an object in all three directions and calculates the location relative to the starting point. The starting point is input and periodically refreshed, typically via Differential GPS (DGPS).	**Low to Medium** Time consuming with below average accuracy. Required refreshing of baseline/starting point significantly reduces productivity.	**Low** Is difficult to operate and has limited support	**High** Is expensive to purchase or rent.	No	Considering the low effectiveness and implementability and the high costs, this technology was not retained.
Acoustic (Representative Systems: USRADS)	Uses ultrasonic techniques to determine location. Consists of a data pack, up to 15 receivers, and a master control center.	**Low to Medium** Not very efficient in open areas due to substantial calibration time. Reasonably effective in wooded areas, achieving an accuracy of 15-30 cm.	**Low** Difficult to set up, minimal technical support, affected by terrain.	**Medium** Systems are available for ~$200/day	No	Despite its apparent usefulness in wooded areas, the moderately hilly terrain around the former Camp Croft would negatively impact its success; therefore, this technology was not retained.
Laser (Representative Systems: ArcSecond “In-door GPS”)	Calculates locations by triangulating signals from stationary lasers placed on the edge of a grid.	**High** Effective in wooded areas. Can be used in open areas, though is limited due to range of transmitters. Commonly achieves accuracy to a few centimeters.	**Low** Time consuming to setup. Not ruggedized for field use.	**Medium** System is available for <$200/day	Yes	Is recommended for wooded areas.
General Response Action: Surface / Subsurface Removal – Recovery / Removal						
Manual Excavation (Representative Systems: probe, trowel, shovel, pick axe)	Excavation of individual anomalies using hand-tools.	**Medium** Is very thorough and allows for quality data on any munitions collected.	**High** Can be accomplished in most terrain and climate. Limited only by the number of qualified people available.	**Low** Locally available and easily replaced tools	Yes	Is the standard technology by which all others are measured.

Candidate Technology	Description	Effectiveness	Implementability	Relative Cost	Retained?	Screening Comment
Mechanical Excavation of Individual Anomalies (Representative Systems: tracked mini-excavator, bull dozer, loaders)	Uses backhoe or excavator to excavate anomalies.	**Medium** Used in conjunction with hand excavation when soil is too hard for hand excavation. Works well when excavating single large and/or deep anomalies.	**High** Equipment can be rented in most places and is easy to operate. Speeds excavation efforts, especially in difficult soils.	**Low** In hard soils, this method can drastically reduce costs compared to hand excavation.	Yes	Equipment is easy to rent and operate.
Mass Excavation and Sifting (Representative Systems: excavators, front-end loaders, dump trucks, trommel, shaker, rotary screen)	Uses earth moving and sifting equipment that has been armored to protect operators.	**High** Process works very well in areas of heavy concentration of MEC or DMM. Can separate several different sizes of material, allowing for large quantities of soil to be returned with minimal screening of MEC.	**Medium** Earth moving equipment is readily available. However, armoring is not as widely available. May require trained equipment operators. Not feasible for large explosively-configured munitions.	**High** Armoring earth moving equipment is expensive to rent and insure.	Yes	Equipment can be rented almost anywhere. Armoring and maintenance of armoring will be costly.
Mechanized Soil Processing (Representative Systems: wide variety for shaker and trommel systems)	Excavated soil is processed through a series of screening devised and conveyors, resulting in segregated soils of different grain sizes.	**High** Most effective in areas saturated with anomalies.	**High** Equipment and references for planning and operations are readily available.	**Medium to High** Acquisition and operation of these systems is initially expensive, though savings may be realized for large economy of scale efforts	No	Considering the few areas identified at the former Camp Croft where this technology would be able to be used, this technology was not retained.
Remotely-operated Removal Equipment	Uses earth moving equipment that has been specially modified such that it can be controlled remotely.	**Low** Remote operation can reduce the productivity and capability of equipment, especially in challenging terrain.	**Low** Robotically-controlled heavy equipment is not widely available. Requires specially-trained operators	**High** Robotically-controlled earth moving equipment is expense	No	Considering the few areas identified at the former Camp Croft where this technology would be able to be used, this technology was not retained.

Notes:
N/A – Not applicable
Effectiveness – the ability to perform as part of a comprehensive alternative that can meet RAOs under conditions and limitations that exist at the site; responses range from Low to Medium to High.
Implementability – the likelihood that the process could be implemented as part of the remedial action plan under the regulatory, technical, and schedule constraints; responses range from Low to Medium to High.
Cost – for comparative purposes only, relative to other processes/technologies that perform similar functions; responses range from Low to Medium to High.

4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 DEVELOPMENT OF ALTERNATIVES

4.1.1 Using the technologies retained following the screening process, possible remedial alternatives have been developed for the former Camp Croft; these alternatives are composed of one or more retained technologies. Below, each alternative is described, along with the rationale for creating each alternative. No preliminary screening of alternatives was conducted.

4.1.2 Per ER 200-3-1, evaluation of alternatives should consider, at a minimum, the following:

- A no-action alternative;
- An alternative that reduces or eliminates the toxicity, mobility, or volume of waste;
- An alternative that considers land use controls;
- Unrestricted Use;
- Consideration of innovative technologies;
- Consideration of monitored natural attenuation;
- Alternatives that provide various levels of protection from explosives safety hazards for projects involving MEC; and
- Consideration of Presumptive Remedies.

4.1.3 Each of the above has been incorporated into the development of the alternatives. The following section describes in greater detail the Alternatives developed for the former Camp Croft. Presumptive remedies are preferred technologies or response actions for sites with similar characteristics; those are based on patterns of historical remedy practice, data on remedy implementation, and policies. For MEC sites, presumptive remedies include those commonly used for MMRP sites (e.g., Land Use Controls or Removal/Disposal).

4.1.1 No Action Alternative

4.1.1.1 Evaluation of a no action alternative is required by the NCP to provide a baseline against which other alternatives can be compared. This alternative does not restrict site access in any way and would allow for unrestricted use of the site (pursuant to other SC DHEC regulatory requirements).

4.1.2 Land Use Controls (Limited) and Long-Term Management Alternative

4.1.2.1 Land Use Controls (LUCs) are administrative, legal, or physical measures that can be taken to control or mitigate potential or actual risk. This alternative includes limited LUC measures such as, access restrictions or physical barriers (e.g., fencing), site controls (e.g., signage), and educational materials developed to enhance the communities general understanding of site conditions. This alternative also includes a LTM component, which means that the site will be evaluated every five years to determine the protectiveness of this remedy. Results of the review will be shared with the community.

4.1.3 Land Use Controls (Enhanced) and Long-Term Management Alternative

4.1.3.1 This alternative includes the LUCs and LTM described in the LUC (Limited) and LTM Alternative above, plus provides for deed restrictions and specialized-training. Deed restrictions can vary from simple deed notifications (e.g., stamps) managed by the local zoning board to required declarations of covenants or bilateral agreements between the property owners and the

USACE. However, the USACE (or Federal Government) has no role in implementation of deed modifications/restrictions. Through the investigation process (including gathering rights-of-entry), the PDT has learned that local property owners would likely be resistant to the more forcible declaration of covenants or bilateral agreement approach. Thus, this alternative includes deed restrictions such as, "Call Before You Dig" notifications and deed/plat stamps that indicate the property lies within the boundaries of the former Camp Croft. This alternative also includes two annual one-hour training events that will communicate a general history of the former Camp Croft and safety-related avoidance and reporting information. The training events will be led by USACE personnel familiar with the site; invitees may include property owners and local real estate agents and/or home inspectors.

4.1.4 Analog Surface MEC Removal, Land Use Controls (Limited), and Long-Term Management Alternative

4.1.4.1 This alternative involves the removal of MEC that are present on the ground surface using analog geophysical instrumentation (e.g., Frequency Domain Electromagnetic Induction Metal Detectors or Flux Gate Magnetometers). Trained personnel will perform the removal action over the entire MRS. Geophysical data will not be recorded. No intrusive activities will be conducted. The location of MEC items will be recorded using GPS. Although some MD that closely resembles MEC may be removed, some MD fragments may remain in place. Along with these, this alternative includes the LUC and LTM components presented above (Section 4.1.2). This alternative reduces the risk of potential exposure to MEC where site users might encounter MEC on the ground surface and is appropriate when coupled with LUCs that dissuade intrusive activities.

4.1.5 Analog Surface MEC Removal, Land Use Controls (Enhanced), and Long-Term Management Alternative

4.1.5.1 This alternative is identical to the Analog Surface MEC Removal, LUCs (Limited), and LTM Alternative above (Section 4.1.4), with the exception that enhanced LUCs (Section 4.1.3) are used. This alternative would provide greater risk reduction than the alternative presented above (Section 4.1.4) through deed restrictions and specialized training.

4.1.6 Analog Surface and Subsurface MEC Removal, Land Use Controls (Limited), and Long-Term Management Alternative

4.1.6.1 This alternative involves the removal of MEC that are present on the ground surface and in the subsurface using analog geophysical instrumentation (e.g., Frequency Domain Electromagnetic Induction Metal Detectors or Flux Gate Magnetometers). Trained personnel will perform the removal action over the entire MRS. Geophysical data will not be recorded. The location of MEC items will be recorded using GPS. Although some MD that closely resembles MEC may be removed, some MD fragments may remain in place. Along with these, this alternative includes the LUC and LTM components presented in Section 4.1.2. This alternative reduces the risk of potential exposure to MEC where site users might encounter MEC. However, analog instruments have technical limitations that may preclude 100% MEC removal from the subsurface. Further, because the analog instruments only detect ferrous (and in some cases non-ferrous) objects with no discrimination capability, removal personnel will likely spend significant effort removing anomalies from the subsurface that are not MEC, thus wasting time and money.

4.1.7 Analog Surface and Subsurface MEC Removal, Land Use Controls (Enhanced), and Long-Term Management Alternative

4.1.7.1 This alternative is identical to the alternative above (Section 4.1.6), with the exception that enhanced LUCs (Section 4.1.3) are used, along with LTM. This alternative would provide greater risk reduction than the alternative presented in Section 4.1.4 through deed restrictions and specialized training.

4.1.8 Digital Surface and Subsurface MEC Removal, Land Use Controls (Limited), and Long-Term Management Alternative

4.1.8.1 This alternative is similar to the alternative above (Section 4.1.6), including components described in Section 4.1.2, with the exception that geophysical data would be digitally-recorded using Time Domain Electromagnetic Induction Metal Detectors (e.g., EM-61MKII). Per IGD 14-01 (EM 200-1-15), studies have shown that digital geophysical methods outperform analog geophysical methods on standardized test sites and have few false alarms. Digital data have other advantages over analog data (e.g., digital record of anomalies) but, at an increased cost. While these digital geophysical methods provide little to no true discrimination ability, they do provide an increased depth of detection, along with a gross understanding of anomaly distributions. Along with increased field efficiencies, stakeholders are able to participate in the anomaly selection process, which provides a comfort level in the overall removal process. This alternative provides a high level of risk reduction, in an efficient way, using an industry-standard approach.

4.1.9 Digital Surface and Subsurface MEC Removal, Land Use Controls (Enhanced), and Long-Term Management Alternative

4.1.9.1 This alternative is identical to the alternative above (Section 4.1.8), with the exception that enhanced LUCs (Section 4.1.3) are used, along with LTM. As noted before, this alternative would provide greater risk reduction than the similar alternative above, through deed restrictions and specialized training. Considering the significant level of likely MEC removal, LUCs may seem less useful/practical to the community.

4.1.10 Digital Advanced Classification Surface and Subsurface MEC Removal to Support Unlimited Use/Unrestricted Exposure Alternative

4.1.10.1 This alternative is similar to the alternative above (Section 4.1.8) in many ways, except that data are collected using digital geophysical instrumentation in a specialized configuration such that data can be digitally compared to an established database, and anomalies can be discriminated. These advanced classification methods are cutting-edge and allow experienced geophysicist to classify anomalies as MEC, separate from other non-MEC anomalies. These methods are currently being aggressively refined and improved by the DoD and the geophysical munitions industry and it is anticipated that future advanced classification will be more common within that industry. Typically, the advanced classification methods result in few false positives (i.e., anomalies determined to be MEC through data evaluation but are actually not MEC) and thus, are generally more efficient than more rudimentary digital data methods. The advanced nature of these methods also has requisite higher data collection and analysis costs, compared to other digital geophysical methods. However, when the method is determined to be effective onsite (e.g., where there is a large number of non MEC-related anomalies), recent studies have shown a significant cost savings (overall) by reducing the level of effort associated with follow-

on intrusive investigation. The overall implementation costs will be reduced over time, as the techniques are more commonly used, which will drive overall costs lower than less-specialized digital geophysical methods. This alternative represents the highest level of risk reduction of any preceding alternative. While no long term monitoring will be required under this alternative, the digital data collected would provide documentation of pre-clearance conditions, which stakeholders may find beneficial for any potential post-clearance analysis or future incidental findings.

4.1.10.2 In the event portions of the site are not suitable for Advanced Classification, digital data collection and processing using more traditional techniques could be employed to support the alternative. However, considering the developments underway on Advanced Classification systems, it is anticipated that much of the former Camp Croft would be suitable for Advanced Classification.

4.2 SCREENING OF INDIVIDUAL ALTERNATIVES

4.2.1 According to EPA guidance, potential remedial alternatives identified above must be screened against three broad criteria; those include short- and long-term effectiveness, implementability (including technical and administrative feasibility), and relative cost [including capital and operations & maintenance (O&M)]. The purpose of the screening evaluation is to reduce the number of alternatives chosen for a more thorough and extensive analysis, and alternatives will be evaluated more generally during the screening evaluation than during the detailed analysis (US EPA, 1988). Quantitative cost estimates are not developed during screening of alternatives. Rather, based on knowledge of relative costs, professional judgment is used to identify the relative cost-effectiveness of each alternative. Cost estimates will be developed later in this FS process as a part of the detailed analysis of alternatives that pass the screening process.

4.2.2 The 13 alternatives developed above include reasonable and likely options that are viable for the site. These alternatives represent effective options for sites like the former Camp Croft, based on professional judgment and experience. A streamlined alternative screening is present in Table 4-1, below.

4.2.3 For screening purposes, “short-term” is considered to be the remedial construction and implementation period, while “long-term” begins once the remedial action is complete and RAO has been met (US EPA, 1989). Technical feasibility includes the ability to construct, reliably operate, and meet regulations, as well as the ability to meet the O&M, replacement, and monitoring requirements after completion of the remedial action (US EPA, 1989). Administrative feasibility includes the ability to obtain approvals from other agencies; the availability of treatment, storage, and disposal services; and the availability of equipment and technical expertise (US EPA, 1989). The objective of the cost evaluation is to eliminate from further consideration those alternatives whose costs are grossly excessive for the effectiveness they provide. Cost estimates for alternatives should be sufficiently accurate to continue to support resulting decisions when their accuracy improves beyond the screening level. The cost in the streamlined screening of alternatives evaluates the capital and O&M costs on a relative basis (US EPA, 1989).

4.2.4 The majority of the alternatives were not retained following the screening process. Many of the alternatives offered similar results, with varying benefits of effectiveness, implementability and cost. Thus, four alternatives were retained for detailed analysis; these alternatives provide for

a wide spectrum of potential site outcomes. The following alternatives passed the screening and will be developed further in Section 5.0.

- **Alternative 1: No Action**
  - This alternative is retained, as mandated by CERCLA.
- **Alternative 2: Land Use Controls (LUCs; Limited) and Long-Term Management (LTM)**
  - This alternative represents the least conservative approach toward risk mitigation, is easily implementable, and relatively inexpensive. RAOs will be minimally achieved; however, if implemented successfully, the potential exposure to explosive safety hazards will be reduced.
- **Alternative 3: Analog Surface and Subsurface MEC Removal, LUCs (Limited), and LTM**
  - This alternative represents a significant effort toward risk reduction of the most immediate concern for site users. The alternative is moderately to significantly effective toward reducing the immediate risk, is moderately implementable, and moderately expensive. RAOs will be moderately achieved; potential contact with MEC will be greatly reduced however, the potential exposure to explosive hazards in the subsurface that are undetected will remain.
- **Alternative 4: Digital Advanced Classification Surface and Subsurface MEC Removal to Support Unlimited Use/Unrestricted Exposure**
  - This alternative represents the most effective effort toward risk reduction of the site hazard. The alternative is highly effective toward reducing the long-term risk, is challenging to implement, and moderately expensive. The alternative will substantially achieve RAOs.

TABLE 4-1 SCREENING OF REMEDIAL ALTERNATIVES

Alternatives	Effectiveness		Implementability		Cost*		Retained?
	Short-term	Long-term	Technical	Administrative	Capital	O & M	
No Action	No action; thus, no reduction in MEC	No action; thus, no reduction in MEC	No action; thus, not applicable	No action; thus, not applicable	No action; thus, not applicable	No action; thus, not applicable	**Yes**
Land Use Controls (LUCs; Limited) and Long-Term Management (LTM)	No reduction of MEC; Dependent upon public acceptance of LUCs	No reduction of MEC; Dependent upon public acceptance of LUCs	Signage/fencing and educational materials are readily available	Requires property-owners' agreement, which may be problematic in some cases	Minimal capital costs to establish signage and develop educational materials; Fencing costs may range from minimal to moderate ROM: $250,000	Minimal O & M to maintain fencing/signage and educational materials; Minimal O & M costs to perform and report LUC LTM ROM: $75,000	**Yes**
LUCs (Enhanced) and LTM	No reduction of MEC; Dependent upon public acceptance of LUCs	No reduction of MEC; Dependent upon public acceptance of LUCs	Signage/fencing, educational materials, and training materials are readily available; Deed modification process would have to be established	Requires property-owners' agreement, which may be problematic in some cases; Owners' willingness to agree to deed modification is doubtful	Minimal capital costs to establish signage/deed stamp and develop educational and training materials; Fencing costs may range from minimal to moderate ROM: $300,000	Minimal O & M to maintain fencing/signage and educational and training materials; Minimal O & M costs to perform and report LUC LTM ROM: $75,000	**No** Based on responses from property owners, it is unlikely enhanced LUCs would be acceptable.
Analog Surface MEC Removal, LUCs (Limited), and LTM	Moderate reduction of MEC; Potential worker exposure to MEC; Dependent upon public acceptance of LUCs	Moderate reduction of MEC; Dependent upon presence of subsurface MEC and upward migration potential; Dependent upon public acceptance of LUCs	Requires personnel with specialized MEC training; Vegetation clearance may be required; MEC removal is moderately challenging; Signage/fencing and educational materials are readily available; No geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs); LUCs require property-owners' agreement, which may be problematic in some cases	Moderate removal action costs; Minimal capital costs to establish signage and develop educational materials; Fencing costs may range from minimal to moderate ROM: $600,000	Minimal O & M to maintain fencing/signage and educational materials; Minimal O & M costs to perform and report MEC LTM ROM: $75,000	**No** Much of the MEC discovered during the RI was buried; surface removal alone will not adequately address concerns.
Analog Surface MEC Removal, LUCs (Enhanced), and LTM	Moderate reduction of MEC; Potential worker exposure to MEC; Dependent upon public acceptance of LUCs	Moderate reduction of MEC; Dependent upon presence of subsurface MEC and upward migration potential; Dependent upon public acceptance of LUCs	Requires personnel with specialized MEC training; Vegetation clearance may be required; MEC removal is moderately challenging; Signage/fencing, educational materials, and training materials are readily available; Deed modification process would have to be established; No geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs); LUCs require property-owners' agreement, which may be problematic in some cases; Owners' willingness to agree to deed modification is doubtful	Moderate removal action costs; Minimal capital costs to establish signage/deed stamp and develop educational and training materials; Fencing costs may range from minimal to moderate ROM: $650,000	Minimal O & M to maintain fencing/signage and educational and training materials; Minimal O & M costs to perform and report MEC LTM ROM: $75,000	**No** Much of the MEC discovered during the RI was buried; surface removal alone will not adequately address concerns. Also, it is anticipated enhanced LUCs would not likely be acceptable to stakeholders.
Analog Surface and Subsurface MEC Removal, LUCs (Limited), and LTM	Moderate reduction of MEC; Potential worker exposure to MEC; Dependent upon public acceptance of LUCs	Significant reduction of MEC; Dependent upon Removal Action threshold criteria; Dependent upon public acceptance of LUCs	Requires personnel with specialized MEC training; Vegetation clearance may be required; MEC removal is moderately challenging to difficult; Signage/fencing and educational materials are readily available; No geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs); LUCs require property-owners' agreement, which may be problematic in some cases	Moderate to high removal action costs; Minimal capital costs to establish signage and develop educational materials; Fencing costs may range from minimal to moderate ROM: $825,000	Minimal O & M to maintain fencing/signage and educational materials; Minimal O & M costs to perform and report MEC LTM ROM: $75,000	**Yes**

Alternatives	Effectiveness		Implementability		Cost*		Retained?
	Short-term	Long-term	Technical	Administrative	Capital	O & M	
Analog Surface and Subsurface MEC Removal, LUCs (Enhanced), and LTM	Moderate reduction of MEC; Potential worker exposure to MEC; Dependent upon public acceptance of LUCs	Significant reduction of MEC; Dependent upon Removal Action threshold criteria; Dependent upon public acceptance of LUCs	Requires personnel with specialized MEC training; Vegetation clearance may be required; MEC removal is moderately challenging to difficult; Signage/fencing, educational materials, and training materials are readily available; Deed modification process would have to be established; No geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs); LUCs require property-owners' agreement, which may be problematic in some cases; Owners' willingness to agree to deed modification is doubtful	Moderate to high removal action costs; Minimal capital costs to establish signage/deed stamp and develop educational and training materials; Fencing costs may range from minimal to moderate ROM: $875,000	Minimal O & M to maintain fencing/signage and educational and training materials; Minimal O & M costs to perform and report MEC LTM ROM: $75,000	**No** It is anticipated enhanced LUCs would not likely be acceptable to stakeholders
Digital Surface and Subsurface MEC Removal, LUCs (Limited), and LTM	Moderate reduction of MEC; Potential worker exposure to MEC; Dependent upon public acceptance of LUCs	Significant reduction of MEC; Dependent upon Removal Action threshold criteria; Dependent upon public acceptance of LUCs	Requires personnel with specialized geophysics and MEC training; Vegetation clearance likely required; MEC removal is moderately challenging to difficult; Signage/fencing and educational materials are readily available; Geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs); LUCs require property-owners' agreement, which may be problematic in some cases	Moderate to high removal action costs; Minimal capital costs to establish signage and develop educational materials; Fencing costs may range from minimal to moderate ROM: $900,000	Minimal O & M to maintain fencing/signage and educational materials; Minimal O & M costs to perform and report MEC LTM ROM: $75,000	**No** Digital data collection is more expensive than analog methods for no significant increase in benefit.
Digital Surface and Subsurface MEC Removal, LUCs (Enhanced), and LTM	Moderate reduction of MEC; Potential worker exposure to MEC; Dependent upon public acceptance of LUCs	Significant reduction of MEC; Dependent upon Removal Action threshold criteria; Dependent upon public acceptance of LUCs	Requires personnel with specialized geophysics and MEC training; Vegetation clearance likely required; MEC removal is moderately challenging to difficult; Signage/fencing, educational materials, and training materials are readily available; Deed modification process would have to be established; Geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs); LUCs require property-owners' agreement, which may be problematic in some cases; Owners' willingness to agree to deed modification is doubtful	Moderate to high removal action costs; Minimal capital costs to establish signage/deed stamp and develop educational and training materials; Fencing costs may range from minimal to moderate ROM: $950,000	Minimal O & M to maintain fencing/signage and educational and training materials; Minimal O & M costs to perform and report MEC LTM ROM: $75,000	**No** Digital data collection is more expensive than analog methods for no significant increase in benefit. Also, it is anticipated enhanced LUCs would not likely be acceptable to stakeholders.
Digital Advanced Classification Surface and Subsurface MEC Removal to Support Unlimited Use/Unrestricted Exposure	Significant reduction of MEC; Potential worker exposure to MEC	Significant reduction of MEC	Requires personnel with specialized geophysics and MEC training; Vegetation clearance likely required; MEC removal is moderately challenging to difficult; Geophysical record preserved	Removal action requires owners' rights-of-entry (ROEs)	Moderate to high removal/disposal restoration costs ROM: $650,000	None ROM: $0	**Yes**

1 * Costs are based on a rough order of magnitude (ROM) estimate using a generic 100-acre site, similar to those at the former Camp Croft which contain MEC.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

5.0.1 The purpose of this step is to evaluate and compare the alternatives remaining after the initial screening, and present a proposed plan for regulatory agencies and public review. Section 300.430 (e)(9)(iii) of the NCP describes the nine criteria for evaluating and comparing alternatives during the detailed analysis. Threshold criteria are requirements that each alternative must meet or have specifically waived to be eligible for selection. Primary balancing criteria are those that form the basis for comparison among alternatives that meet the threshold criteria. Modifying criteria are criteria considered in remedy selection. Though Section 120(b) of CERCLA indicates a preference for permanent solutions and requires assessment of permanent solutions and alternative treatment technologies or resource recovery technologies, it does not mandate selection.

5.1 INTRODUCTION

5.1.1 This section presents the detail analysis of remedial action alternatives for the MRSs at the former Camp Croft. The detailed analysis is intended to provide decision-makers with information to aid in selecting a remedial alternative that best meets the following CERCLA requirements:

- Protects human health and the environment;
- Attains ARARs (or provides grounds for invoking a waiver);
- Utilizes permanent solutions and alternative treatment technologies or resource-recovery technologies to the maximum extent practical;
- Satisfies the preference for treatment that reduces toxicity, mobility, or volume of hazardous substances as a principal element; and
- Is cost-effective.

5.1.2 The detailed analysis was performed in accordance with CERCLA Section 121 and EPA RI/FS Guidance (US EPA, 1988). The detailed analysis contains the following:

- A detailed description of each candidate remedial alternative, emphasizing the application of various component technologies; and
- An assessment of each alternative compared to the first seven of the nine evaluation criteria described in the NCP.

5.1.3 The detailed descriptions provide a conceptual design for each alternative. The description of each alternative includes a discussion of limitations, assumptions, and uncertainties for each component. Remedial alternatives are then evaluated according to the first seven of the nine NCP evaluation criteria. The nine criteria can be subdivided into three categories: threshold criteria, primary balancing criteria, and modifying criteria. The threshold criteria (overall protection of human health and the environment; compliance with ARARs) relate to statutory requirements that each alternative must satisfy in order to be eligible for selection. The primary balancing criteria (long-term effectiveness; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost) are the technical criteria upon which the detailed analysis is primarily based. The modifying criteria (state acceptance; community acceptance) are assessed formally after the public comment period. The nine NCP evaluation criteria are defined in the following paragraphs as they pertain to this FS.

5.1.1 Threshold Criteria

5.1.1.1 Overall Protection of Human Health and the Environment

5.1.1.1.1 This criterion assesses how well an alternative achieves and maintains protection of human health and the environment.

5.1.1.2 Compliance with ARARs

5.1.1.2.1 This criterion assesses how the alternatives comply with location-, chemical-, and action-specific ARARs, and whether a waiver is required or justified. For the MRSs at the former Camp Croft, there are no ARARs.

5.1.2 Balancing Criteria

5.1.2.1 Long-Term Effectiveness and Permanence

5.1.2.1.1 This criterion evaluates the effectiveness of the alternatives in protecting human health and the environment after response objectives have been met. It also considers the degree to which treatment is irreversible, and the type and quantity of residuals remaining after treatment.

5.1.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

5.1.2.2.1 This criterion addresses the preference for selecting remedial actions that employ removal action technologies that permanently and significantly reduce the toxicity, mobility, or volume of the hazardous substance. This preference is satisfied when removal actions are used to reduce principal threats through irreversible reduction of total MEC volume or mobility potential of MEC.

5.1.2.3 Short-Term Effectiveness

5.1.2.3.1 This criterion examines the effectiveness of the alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met. It also considers the protection of the community, workers, and the environment during the implementation of remedial actions. The detailed analysis of each alternative includes an estimate of the time necessary for completion of the alternative (i.e., remedial duration). The time-frame estimates are based on published construction scheduling material and professional judgment.

5.1.2.4 Implementability

5.1.2.4.1 This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. Technical feasibility considers the ability to construct and operate a technology and its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. Administrative feasibility considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

5.1.2.5 Cost

5.1.2.5.1 This criterion evaluates the capital, and operation and maintenance costs of each alternative. Present-worth costs are presented to help compare costs among alternatives.

5.1.2.5.2 Costs are presented as a present worth and as a total cost for the lifetime of the remedial alternative based on the estimated clean-up time (US EPA, 1988). Tables presenting a summary

of the costs for each alternative and identifying capital, O&M, total, and present-worth costs are included in each alternative's cost description.

5.1.2.5.3 Costs are intended to be within the target accuracy range of minus 30 percent to plus 50 percent of actual cost (US EPA, 1988). Assumptions used to develop and cost alternatives may or may not remain valid during alternative implementation. The quantities of MEC to be removed in the cost estimates were based on extrapolation of MEC/MD finds from the remedial investigation sampling results.

5.1.2.5.4 Each cost estimate includes the following items, as applicable:

- Engineering design, project and construction management (including health and safety, legal, and administrative fees), as a percentage of direct capital costs;
- A contingency to account for unforeseen project complexities such as adverse weather, the need for additional and unexpected site characterization, and increased construction standby times as a percentage of direct capital costs; and
- Operation, maintenance, and monitoring costs.

5.1.2.5.5 Details and assumptions pertaining to the cost estimate are presented in Appendix A and are discussed in each alternative's cost description.

5.1.3 Modifying Criteria

5.1.3.1 State Acceptance

5.1.3.1.1 This criterion considers the state's preferences among or concerns about the alternatives, including comments on ARARs or proposed use of waivers (not applicable at the former Camp Croft). This criterion is addressed following state inputs on the FS and Proposed Plan.

5.1.3.2 Community Acceptance

5.1.3.2.1 This criterion considers the community's preferences or concerns about the alternatives. This criterion is addressed following community input on the FS and Proposed Plan.

5.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

5.2.1 The following retained alternatives are evaluated from a general standpoint, relative to each of the MRSs at the former Camp Croft. Where specific MRS nuisances apply to specific alternatives, a clarifying note has been added.

5.2.1 Alternative #1 – No Action

5.2.1.1 Alternative Description

5.2.1.1.1 This alternative does not include remedial action components to contain or reduce MEC, nor does the alternative control potential risks from exposure to MEC by implementing land use controls or environmental monitoring. This alternative was retained as a baseline against which to compare all other alternatives, as required by the NCP.

5.2.1.2 Overall Protectiveness of Human Health and the Environment

5.2.1.2.1 This alternative does not include any actions to control perceived or potential risks or hazards posed to human or environmental receptors. As a result, Alternative 1 is not considered protective of human health and the environment.

5.2.1.3 Compliance with ARARs

5.2.1.3.1 There are no ARARs associated with the former Camp Croft.

5.2.1.4 Long-Term Effectiveness and Permanence

5.2.1.4.1 No controls for exposure and no long-term management measures will be undertaken. As a result, Alternative 1 will be ineffective.

5.2.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

5.2.1.5.1 This alternative will not provide any reduction in toxicity, mobility, or volume of MEC.

5.2.1.6 Short-Term Effectiveness

5.2.1.6.1 This alternative will not have any impacts on the community, workers, or the environment during implementation, since no remedial actions will be taken.

5.2.1.7 Implementability

5.2.1.7.1 There are no implementability concerns posed by this alternative, since no remedial actions will be taken.

5.2.1.8 Cost

5.2.1.8.1 No action will be performed under this alternative; thus, there are no costs.

5.2.2 Alternative #2 – Land Use Controls (LUCs; Limited) and Long-Term Management (LTM)

5.2.2.1 Alternative Description

5.2.2.1.1 This alternative includes limited LUC measures such as, access restrictions or physical barriers (e.g., fencing), site controls (e.g., signage), and educational materials developed to enhance the communities general understanding of site conditions. This alternative can be implemented relatively quickly, since much of the materials are readily available and easily accessible. This alternative would primarily address MEC that may exist on the surface but, will inform those conducting intrusive activities that awareness and caution are warranted. It is assumed that minimal (e.g., semi-annual) maintenance of LUCs may be required; enforcement of the maintenance will be the responsibility of the property owners. This alternative also includes a Long-Term Management (LTM) component, which means that the site will be evaluated every five years to determine the efficacy of this remedy. Results of the review will be shared with the community.

5.2.2.2 Overall Protectiveness of Human Health and the Environment

5.2.2.2.1 While this alternative would not reduce risk through MEC removal, it would support behavior modification of those that interact with the LUCs, which is an appropriate response to encountering MEC (e.g., recognize, retreat, report) and effectively reduces potential exposure risk.

5.2.2.2.2 Enforced access restrictions would be effective. Semi-permanent physical barriers, like fencing, are generally more effective than signage. However, neither physical barriers nor signage are a guaranteed solution to eliminate unauthorized site access. Educational awareness through informational brochures and fact sheets would support behavior modification for those willing to follow the advice.

5.2.2.2.3 Implementation of this alternative will support risk reduction. It will be most effective in areas where no MEC has been found, such as the Grenade Area, Mortar/Rifle Grenade Area, Practice Grenade Area, Remaining Lands, and Rocket Area.

5.2.2.3 Compliance with ARARs

5.2.2.3.1 There are no ARARs associated with the former Camp Croft.

5.2.2.4 Long-Term Effectiveness and Permanence

5.2.2.4.1 Over time, the effectiveness and permanence may diminish, unless the access restrictions and educational materials are aggressively maintained; this includes periodic checking of fencing/signs and replenishment of printed materials. At a minimum, a thorough review will be conducted every five years. However, it's likely that more frequent reviews will improve the long-term effectiveness and permanence.

5.2.2.5 Reduction of Toxicity, Mobility, or Volume through Treatment

5.2.2.5.1 This alternative will not provide any reduction in toxicity, mobility, or volume of MEC.

5.2.2.6 Short-Term Effectiveness

5.2.2.6.1 It is unlikely this alternative will have an immediate impact on reducing potential exposure risks during its implementation. Only newly installed physical barriers will capture the immediate attention of those in the community. Signage and educational material will have an immediate effective impact, as the community becomes aware of the materials.

5.2.2.7 Implementability

5.2.2.7.1 This alternative should be moderately easy to implement across any of the former Camp Croft MRSs. The materials used to restrict access and provide general site education are readily available. Access restriction components of this alternative will require property owners' approved rights-of-entry (ROE). In some cases, those will be easily obtained (e.g., Croft State Park). However, numerous property owners may be resistant to granting ROE. Assuming ROE permission is granted, this alternative can be implemented within three to six months of a government contract award for implementation. The educational component of this alternative could be implemented more quickly and should be on-going.

5.2.2.8 Cost

5.2.2.8.1 The estimated cost for Alternative 2 varies across all former Camp Croft MRSs. For this alternative, and those following, costs were calculated for a "conceptual" site, similar to those at the former Camp Croft. Using those calculations, a cost/acre was calculated and then normalized to each of the former Camp Croft MRSs; those cost calculations are provided in Appendix A and shown in Table 5-1.

5.2.3 Alternative #3 – Analog Surface and Subsurface MEC Removal, LUCs (Limited), and LTM

5.2.3.1 Alternative Description

5.2.3.1.1 This alternative includes performance of an analog instrument-aided surface and subsurface MEC removal action throughout a designated area. Using handheld geophysical equipment, operators would perform scans across the entire area. As anomalies are detected, they would be intrusively investigated. Geophysical data would not be recorded. Along with the

MEC removal action, LUCs and LTM would be implemented. The timeframe, protectiveness, and maintenance of LUCs discussed in Section 5.2.2.1 apply to this alternative, as well. Implementation of this alternative would include compulsory planning and reporting documents (e.g., Work Plan and Removal Action Report).

5.2.3.2 Overall Protectiveness of Human Health and the Environment

5.2.3.2.1 Generally, MEC surface and subsurface clearances provide a moderate to high level of overall protectiveness. This alternative assumes that 100% of the area would be surveyed by trained personnel with analog geophysical instruments and that all MEC would be removed. Inherent in that assumption is that the analog instrumentation functions properly and is capable of detecting MEC at the depths required by the RAOs. The overall protectiveness is directly related to the successful accomplishment of those tasks. Any deviation from achievement of those tasks would reduce the overall protectiveness.

5.2.3.3 Compliance with ARARs

5.2.3.3.1 There are no ARARs associated with the former Camp Croft.

5.2.3.4 Long-Term Effectiveness and Permanence

5.2.3.4.1 Removal of MEC has a high potential for moderate reduction of potential risk of exposure to MEC, if performed as designed. It is likely the moderate reduction would have a long-lasting effect, unless intrusive activities are performed where MEC was accidentally missed or that MEC migrates to the surface through various mechanisms (e.g., top soil erosion or frost heave). Further, long-term effectiveness and permanence would also depend on the community's willingness to follow the LUCs.

5.2.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

5.2.3.5.1 This alternative would have a positive impact on the reduction of MEC; all surface and subsurface MEC would be removed. However, it is possible that some subsurface MEC would remain if geophysical instrumentation fails or there are operational errors that fail to identify MEC and thus, the potential for exposure to MEC would remain.

5.2.3.6 Short-Term Effectiveness

5.2.3.6.1 Implementation of a surface and subsurface MEC removal is effective in the short-term. The removal of surface and partially buried MEC is extremely effective in mitigating immediate risk in areas identified for surface activities. There is potential for exposure of MEC to UXO workers during implementation. Risk to the public resulting from implementation is considered minimal.

5.2.3.7 Implementability

5.2.3.7.1 Surface and subsurface removal of MEC is technically feasible for an entire MRS or a smaller footprint within an MRS, based on accessibility and land use. Moderate technical effort is required for implementation. UXO-qualified personnel would survey the area, aided by handheld instruments, to detect and then intrusively remove MEC. Suspected MEC items would be inspected for explosive hazards and disposed of accordingly.

5.2.3.7.2 The LUC and LTM components of this alternative should be moderately easy to implement across any of the former Camp Croft MRSs. As noted for Alternative 2, the materials used to restrict access and provide general site education are readily available. Access restriction

components of this alternative will require property owners' approved rights-of-entry (ROE). In some cases, those will be easily obtained (e.g., Croft State Park). However, numerous property owners may be resistant to granting ROE. Assuming ROE permission is granted, this alternative can be implemented within three to six months of a government contract award for implementation. The educational component of this alternative could be implemented more quickly and should be on-going.

5.2.3.8 Cost

5.2.3.8.1 As noted with Alternative 2, the estimated cost for Alternative 3 varies across all former Camp Croft MRSs. Costs were calculated for a "conceptual" site, similar to those at the former Camp Croft. Using those calculations, a cost/acre was calculated and then normalized to each of the former Camp Croft MRSs; those cost calculations are provided Appendix A and shown in Table 5-1.

5.2.4 Alternative #4 – Digital Advanced Classification Surface and Subsurface MEC Removal to Support Unlimited Use/Unrestricted Exposure

5.2.4.1 Alternative Description

5.2.4.1.1 This alternative includes performance of an instrument-aided surface and subsurface MEC removal action throughout a designated area. Using advanced geophysical equipment, digital data would be collected and recorded across the entire area. Those data would be evaluated by skilled geophysical personnel, compared to a database of anomalies, and, in coordination with the Army and other stakeholders, anomalies determined to be MEC would be removed. The depth of MEC removal would depend upon the sensor detection capabilities, site-specific geophysical characteristics, and MRS-specific penetration depths specified in each of the PRGs. The geophysical data would be stored for comparison during follow-up site evaluations, if necessary. Considering the advanced interpretation ability associated with this alternative, it is assumed that intrusive investigation of predicted MEC anomalies would result in fewer false positive digs and thus, increased fieldwork efficiencies. Implementation of this alternative would include compulsory planning and reporting documents (e.g., Work Plan and Removal Action Report). Following discussions with the PDT, SCDHEC indicated it is hesitant to support any alternative with the goal of unlimited use / unrestricted exposure without some type of land use controls.

5.2.4.2 Overall Protectiveness of Human Health and the Environment

5.2.4.2.1 Generally, combined MEC surface and subsurface clearances provide a moderate to high level of overall protectiveness. This alternative assumes that 100% of the area would be surveyed by geophysical instruments and that all surface and subsurface MEC would be removed. These digital data collection and evaluation methods would provide real discrimination ability and would likely lead to fewer false positives and false negatives. The overall protectiveness is directly related to the successful accomplishment of those tasks. Any deviation from achievement of those tasks would reduce the overall protectiveness.

5.2.4.3 Compliance with ARARs

5.2.4.3.1 There are no ARARs associated with the former Camp Croft.

5.2.4.4 Long-Term Effectiveness and Permanence

5.2.4.4.1 Surface and subsurface removal of MEC has a high potential for significant reduction of potential risk of exposure to MEC, if performed as designed. It is likely the significant reduction would have a long-lasting effect, unless intrusive or erosional activities uncover MEC where MEC was accidentally missed from depths greater than the RAOs or the detection limits of geophysical equipment (~4 ft bgs).

5.2.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment

5.2.4.5.1 This alternative would have a positive impact on the reduction of MEC; all surface and subsurface MEC would be removed. It is possible, although unlikely, that some subsurface MEC would remain if geophysical data analysis and anomaly evaluation fail to identify MEC (i.e., a false negative) and thus, the potential for exposure to MEC would remain.

5.2.4.6 Short-Term Effectiveness

5.2.4.6.1 Implementation of a surface and subsurface MEC removal is effective in the short-term. The removal of surface and subsurface MEC is extremely effective in mitigating immediate risk in areas identified for surface and subsurface activities. There is potential for exposure of MEC to UXO workers during implementation. Risk to the public resulting from implementation is considered minimal.

5.2.4.7 Implementability

5.2.4.7.1 Surface and subsurface removal of MEC is technically feasible for an entire MRS or a smaller footprint within an MRS, based on accessibility and land use. Moderate technical effort is required for implementation. Geophysical personnel would survey the area and then process, analyze and interpret the data. UXO-qualified personnel would visually inspect, aided by handheld instruments, the MRS and use hand-held sensors to detect anomalies selected by the geophysical team for intrusive investigation/removal. Suspected MEC items would be inspected for explosive hazards and disposed of accordingly.

5.2.4.8 Cost

5.2.4.8.1 As noted with Alternatives 2 and 3, the estimated cost for Alternative 4 varies across all former Camp Croft MRSs. Costs were calculated for a "conceptual" site, similar to those at the former Camp Croft. Using those calculations, a cost/acre was calculated and then normalized to each of the former Camp Croft MRSs; those cost calculations are provided Appendix A and shown in Table 5-1.

5.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

5.3.1 In the following analysis, the alternatives are evaluated in relation to one another for each of the evaluation criteria to identify the relative advantages and disadvantages of each alternative in terms of the threshold and balancing criteria. Table 5-2 summarizes the evaluation of alternatives. Details regarding the comparative analysis are provided in the following sections.

5.3.1 Overall Protectiveness of Human Health and the Environment

5.3.1.1 The protectiveness criterion was evaluated in terms of possible future human interaction with MEC. When considering all alternatives, Alternative 1 provides the least risk reduction as no action will be taken. Alternative 2 provides greater risk reduction than Alternative 1, although the overall risk reduction is minimal. Alternatives 3, and 4 provides significantly

greater risk reduction than Alternative 2, with Alternative 4 providing the greatest overall protectiveness.

5.3.2 Compliance with ARARs

5.3.2.1 There are no ARARs associated with the former Camp Croft.

5.3.3 Long-Term Effectiveness and Permanence

5.3.3.1 The effectiveness and permanence criterion evaluates the degree to which an alternative permanently reduces or eliminates the potential for MEC exposure hazard. Alternative 1 is least effective and permanent over the long term. Alternative 2 provides a greater level of effectiveness and permanence over Alternative 1. Alternatives 3 provides a moderate to greater level of effectiveness and permanence relative to Alternatives 1 and 2, assuming MEC is detected and removed from the surface and subsurface, as designed. Alternative 4 provides the greatest level of effectiveness and permanence, assuming data are evaluated accurately and MEC is removed as designed. Alternatives 2 and 3 require Five-Year Reviews to verify the remedies remain effective over the long term.

5.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

5.3.4.1 Alternatives 1 and 2 offer no reduction of toxicity, mobility, or volume; they provide no reduction of MEC. However, implementation of Alternative 2 is anticipated to reduce the impact of potential exposure to MEC through LUCs. Alternative 3 and 4 would provide greater reduction of toxicity, mobility, or volume of MEC relative to Alternatives 1 and 2. Alternative 3 would provide reasonably moderate reduction of toxicity, mobility, or volume by removing both MEC and some MD; some MEC may be missed by the sensors and some MD (i.e., resembling MEC) would be removed. Alternative 4 would provide the greatest reduction of toxicity, mobility, or volume, by removing MEC.

5.3.5 Short-Term Effectiveness

5.3.5.1 Alternatives 1 and 2 present no real impact on reducing potential exposure risks during their implementation and thus, have little to no short-term effectiveness. Alternatives 3 and 4 will provide an immediate impact on reducing exposure risks during the MEC removal actions. While there is exposure potential to those conducting the activities, direct removal of MEC immediately reduces the risk of human interaction potential (following the removal work) and thus has a moderate to high short-term effectiveness. Alternative 4 has the greatest short-term effectiveness, as it reduces the overall volume of MEC throughout the soil profile (to the depth of RAOs), rather than just MEC on the surface. Risk to the public resulting from implementation of Alternative 3 or 4 is considered minimal.

5.3.6 Implementability

5.3.6.1 Alternative 1 has no implementability concerns, since no remedial actions will be taken. Of the remaining alternatives, Alternative 2 is the easiest to implement; the materials used to restrict access and provide general site education are readily available. However, obtaining ROEs to implement Alternative 2 may be challenging in some instances. Alternatives 3 and 4 are much more difficult to implement; those alternatives require extensive planning and coordination in advance of challenging field implementations. Aside from a generally similar planning phase and the required technical personnel (UXO and Geophysical), Alternative 4 is only moderately more difficult to implement than Alternative 3, primarily because the work

requires more coordination with stakeholders and more advanced data interpretation. At this time, Advanced Classification (Alternative 4) is conducted using fairly large instrument arrays, which makes that alternative moderately more difficult to implement. However, it is anticipated that Advanced Classification platforms will be refined over the coming years, resulting in smaller, more manageable sensor arrays. Alternative 3 also includes Alternative 2 LUCs and LTM.

5.3.7 Cost

5.3.7.1 The cost criterion evaluates the cost to implement the alternative, and includes direct, indirect, and long-term operation and maintenance costs. Direct costs are those costs associated with the implementation of the alternative; indirect costs are those associated with administration, oversight, and contingencies. The actual costs at the time of implementation will depend on true labor rates, actual site conditions, final project scope, and numerous other variable factors. Alternative 1, which requires no action, has no incurred cost. Alternative 2 requires relatively low costs in comparison to Alternatives 3 and 4. Alternative 3 is the most costly alternative. Cost calculations are provided Appendix A and shown in Table 5-1.

5.3.8 State Acceptance

5.3.8.1 State acceptance cannot be evaluated and assessed until comments on the FS and Proposed Plan are received. Modifying criteria (i.e., state and community acceptance), however, will be considered in remedy selection.

5.3.9 Community Acceptance

5.3.9.1 Community acceptance cannot be evaluated and assessed until comments on the FS and Proposed Plan are received. Community acceptance will be considered in remedy selection.

TABLE 5-1 COST SUMMARY

MRSs*	Acres	MEC Factor†	Alt #1 No Action	Alt #2 Land Use Controls (LUCs; Limited) & Long-Term Management (LTM)	Alt #3 Analog Surface & Subsurface MEC Removal, LUCs (Limited) & LTM	Alt #4 Digital Advanced Classification Surface & Subsurface MEC Removal for Unlimited Use / Unrestricted Exposure
105mm Area	1,399.7	1	$0.00	$5,077,151	$11,549,498	$9,325,693
60mm Mortar Area	303.4	1	$0.00	$1,100,527	$2,503,478	$2,021,444
60/81mm Mortar Area	301.3	1	$0.00	$1,092,910	$2,486,150	$2,007,453
Grenade Area	19.2	0.5	$0.00	$34,822	$79,214	$63,961
Grenade Maneuver Area	450.5	1	$0.00	$1,634,105	$3,717,260	$3,001,518
Maneuver Area	1,276.5	1	$0.00	$4,630,266	$10,532,925	$8,504,856
Mortar/Rifle Grenade Area	22.9	0.5	$0.00	$41,533	$94,479	$76,287
Practice Grenade Area	6.4	0.5	$0.00	$11,607	$26,405	$21,320
Remaining Lands	9,093.4	0.5	$0.00	$16,492,307	$37,516,685	$30,293,012
Rocket Area	93.9	0.5	$0.00	$170,302	$387,404	$312,811
Rocket/Grenade Maneuver Area	126.3	1	$0.00	$458,130	$1,042,153	$841,491
Rocket & Rifle Grenade Area	108.5	1	$0.00	$393,564	$895,278	$722,896

* Bolded areas contained observed MEC.
† MEC Factor used to adjust "conceptual" cost estimate (Appendix A) to former Camp Croft Area.

TABLE 5-2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

EPA's Nine CERCLA Evaluation Criteria	**Alternative 1** **No Action (Baseline Condition)**	**Alternative 2** **Land Use Controls (LUCs; Limited) and Long-Term Management (LTM)**	**Alternative 3** **Analog Surface & Subsurface MEC Removal, LUCs (Limited), and LTM**	**Alternative 4** **Digital Advanced Classification Surface & Subsurface MEC Removal for Unlimited Use / Unrestricted Exposure**
Overall Protectiveness of Human Health and the Environment	Not protective	Protective	Protective	Protective
Compliance with ARARs	N/A	N/A	N/A	N/A
Long-Term Effectiveness and Permanence	○	○/◘	◘/●	●
Reduction of Toxicity, Mobility, or Volume through Treatment	○	○	◘	●
Short-Term Effectiveness	○	○	◘/●	●
Implementability	○	◘	◘	◘/●
Cost[‡]	N/A	$	$$/$$$	$$
State Acceptance[§]	No	Yes	Yes	Yes
Community Acceptance[§]	No	Yes	Yes	Yes

[‡] Based on overall cost (not cost per acre)
[§] State and Community Acceptance are evaluated throughout the process, until remedy selection. SCDHEC is hesitant to support any alternative with the goal of Unlimited Use / Unrestricted Exposure, without some type of land use controls.
N/A – Not Applicable
Symbols: ● – Relatively High; ◘ – Relatively Moderate; ○ – Relatively Low to none
Cost: $ – Low or minimal costs; $$ – Moderate costs; $$$ – High costs

6.0 REFERENCES

United States Army Corps of Engineers, 2004, Formerly Used Defense Sites (FUDS) Program Policy, ER 200-3-1, Department of the Army, 10 May 2004.

United States Army Corps of Engineers, 2006, Military Munitions Response Process, Engineer Pamphlet 1110-1-18, April 2006.

United States Army Military Munitions Response Program, 2009, Munitions Response Remedial Investigation/Feasibility Study Guidance, November 2009.

United States Environmental Protection Agency, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988.

United States Environmental Protection Agency, 1989, The Feasibility Study, Development and Screening of Remedial Action Alternatives, OSWER Directive 9355.3-01FS3, November 1989.

United States Environmental Protection Agency, 1990, The Feasibility Study: Detailed Analysis of Remedial Action Alternatives, OSWER Directive 9355.3-01FS4, March 1990.

Zapata Incorporated, 2011, Final Work Plans for the Remedial Investigation/Feasibility Study (RI/FS), Former Camp Croft, Spartanburg, South Carolina, 09 September 2011.

Zapata Incorporated, 2014, Final Remedial Investigation Report, Revision 1, Former Camp Croft, Spartanburg, South Carolina, October 2014.

APPENDIX A

COST ESTIMATES

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Cost Estimate Assumptions

General Assumptions

- Baseline cost estimates are based on a 100-acre area that contains MEC
- MEC Factors used to adjust cost estimates based on the presence or absence of MEC

Component 1 – Land Use Controls (Limited)

- PM will coordinate planning, execution, and reporting of LUCs
    - Planning = 40 hrs
    - Execution = 8 hrs
    - Reporting = 40 hrs
- UXO Tech III will oversee LUC installations (est. 2 weeks)
    - Prep = 8 hrs
    - Site Visit = 80 hrs
- Corporation Quality Manager will provide quality oversight
    - Planning = 4 hrs
    - Reporting = 4 hrs
- Administrative Support will coordinate and execute miscellaneous office tasks, including printing/binding/shipping deliverables
    - Planning = 24 hrs
    - Reporting = 24 hrs
- Scientist II oversees documentation of LUCs implementation
    - Planning = 40 hrs
    - Reporting = 40 hrs
- Subcontractors
    - Fencing Contractor = $25,000 (10,000 linear feet, installed)
    - Sign Manufacturers = $5,000
    - Education Materials (2,000 brochures) = $1,500
- Miscellaneous ODCs
    - Review planning/report documents will be standard bound paper deliverable
    - Planning = 10 documents (100 pgs/each) – Two Versions (Draft, Final)
    - Reporting = 10 documents (100 pgs/each) – Two Versions (Draft, Final)
    - Hard copies delivered via FedEx (overnight rate), three destinations
- Travel
    - 11.5 days of fieldwork for UXO III
    - Includes “generic” flight costs

Component 2 – Long-Term Management

- PM will coordinate planning, execution, and reporting of each five-year site review

  - Planning = 40 hrs/review
  - Execution = 8 hrs/review
  - Reporting = 40 hrs/review
- UXO Tech III and a Scientist II will conduct each five-year site review
  - Prep = 8 hrs/review/person
  - Site Visit = 16 hrs/review/person
- Corporation Quality Manager will provide quality oversight
  - Planning = 4 hrs/review
  - Reporting = 4 hrs/review
- Administrative Support will coordinate and execute miscellaneous office tasks, including printing/binding/shipping deliverables
  - Planning = 24 hrs/review
  - Reporting = 24 hrs/review
- Subcontractors
  - None
- Miscellaneous ODCs
  - Review planning/report documents will be standard bound paper deliverable
  - Planning = 10 documents (100 pgs/each) – Two Versions (Draft, Final)
  - Reporting = 10 documents (100 pgs/each) – Two Versions (Draft, Final)
  - Hard copies delivered via FedEx (overnight rate), three destinations
- Travel
  - 2.5 days of fieldwork for SUXOS and Senior Scientist
  - Includes "generic" flight costs

<u>Component 3 – Analog Surface and Subsurface MEC Removal</u>

- PM will coordinate planning, execution, and reporting
  - Planning = 40 hrs
  - Execution = 8 hrs
  - Reporting = 40 hrs
- Corporation Quality Manager will provide quality oversight
  - Planning = 8 hrs
  - Reporting = 8 hrs
- Corporate Health and Safety will provide H & S oversight
  - Planning = 40 hrs
- Scientist II oversees documentation fieldwork
  - Planning = 80 hrs
  - Reporting = 80 hrs
- Administrative Support will coordinate and execute miscellaneous office tasks, including printing/binding/shipping deliverables
  - Planning = 80 hrs

  - Reporting = 80 hrs
- UXO Tech I will conduct the removal action (assumes 20 acres/week)
  - 5 weeks of fieldwork (250 hrs/person)
  - Four persons at this rate
- UXO Tech II will conduct the removal action (assumes 20 acres/week)
  - 5 weeks of fieldwork (250 hrs/person)
  - Two persons at this rate
- SUXOS will provide removal action oversight (assumes 20 acres/week)
  - 5 weeks of fieldwork (250 hrs/person)
  - Assume 3 persons at this rate (SUXOS, UXO SO, and UXO QCS)
- Subcontractors/Vendors
  - Explosives = $10,000
  - Scrap Management = $20,000
- Miscellaneous ODCs
  - Review planning/report documents will be standard bound paper deliverable
  - Planning = 10 documents (300 pgs/each) – Two Versions (Draft, Final)
  - Reporting = 10 documents (300 pgs/each) – Two Versions (Draft, Final)
  - Hard copies delivered via FedEx (overnight rate), three destinations
- Travel
  - SUXOS (x3), UXO Tech II (x2), and UXO Tech I (x4)
  - Includes "generic" flight costs
  - 5 weeks of fieldwork

<u>Component 4 – Digital Advanced Classification Surface and Subsurface MEC Removal to Support UU/UE</u>

- PM will coordinate planning, execution, and reporting
  - Planning = 40 hrs
  - Execution = 8 hrs
  - Reporting = 40 hrs
- Corporation Quality Manager will provide quality oversight
  - Planning = 8 hrs
  - Reporting = 8 hrs
- Corporate Health and Safety will provide H & S oversight
  - Planning = 40 hrs
- Senior Geophysicist will geophysical and anomaly selection oversight
  - Planning = 40 hrs
  - Reporting = 40 hrs
- Scientist II oversees documentation fieldwork
  - Planning = 80 hrs
  - Reporting = 80 hrs

- Administrative Support will coordinate and execute miscellaneous office tasks, including printing/binding/shipping deliverables
    - Planning = 80 hrs
    - Reporting = 80 hrs
- Scientist II collects and processes digital geophysical data (assumes 2 acres/day)
    - 10 weeks of fieldwork (500 hrs/person)
    - Two persons at this rate
- Senior Geophysicists provides oversight for data collection/processing
    - Oversight = 200 hrs
- UXO Tech I will conduct the removal action (assumes 25 acres/week)
    - 4 weeks of fieldwork (200 hrs/person)
    - Four persons at this rate
- UXO Tech II will conduct the removal action (assumes 25 acres/week)
    - 4 weeks of fieldwork (200 hrs/person)
    - Two persons at this rate
- SUXOS will provide removal action oversight (assumes 25 acres/week)
    - 4 weeks of fieldwork (200 hrs/person)
    - Assume 3 persons at this rate (SUXOS, UXO SO, and UXO QCS)
- Subcontractors/Vendors
    - Explosives = $15,000
    - Scrap Management = $15,000
- Miscellaneous ODCs
    - Review planning/report documents will be standard bound paper deliverable
    - Planning = 10 documents (300 pgs/each) – Two Versions (Draft, Final)
    - Reporting = 10 documents (300 pgs/each) – Two Versions (Draft, Final)
    - Hard copies delivered via FedEx (overnight rate), three destinations
- Travel
    - SUXOS (x3), UXO Tech II (x2), and UXO Tech I (x4)
    - Includes “generic” flight costs
    - 10 weeks for geophysical; 4 weeks for removal action

Baseline (100 acres w/ MEC)

Alternative 1 $0 - No Action

Alternative 2 $362,731 - LUCs (Limited) & LTM/Five-Year Reviews

Alternative 3 $825,141 - Analog Surface and Subsurface MEC Removal, LUC (Limited), & LTM

Alternative 4 $666,264 - Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE

	Acres	MEC Factor	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
105mm Area	1,399.7	1	$0	$5,077,151	$11,549,498	$9,325,693
60mm Mortar Area	303.4	1	$0	$1,100,527	$2,503,478	$2,021,444
60/81mm Mortar Area	301.3	1	$0	$1,092,910	$2,486,150	$2,007,453
Grenade Area	19.2	0.5	$0	$34,822	$79,214	$63,961
Grenade Maneuver Area	450.5	1	$0	$1,634,105	$3,717,260	$3,001,518
Maneuver Area	1,276.5	1	$0	$4,630,266	$10,532,925	$8,504,856
Mortar/Rifle Grenade Area	22.9	0.5	$0	$41,533	$94,479	$76,287
Practice Grenade Area	6.4	0.5	$0	$11,607	$26,405	$21,320
Remaining Lands	9,093.4	0.5	$0	$16,492,307	$37,516,685	$30,293,012
Rocket Area	93.9	0.5	$0	$170,302	$387,404	$312,811
Rocket/Grenade Maneuver Area	126.3	1	$0	$458,130	$1,042,153	$841,491
Rocket & Rifle Grenade Area	108.5	1	$0	$393,564	$895,278	$722,896

Project Name: FS - Former Camp Croft
Location: Spartanburg, SC
Contract No.: W912DY-10-D-0028
Pricing Type: Firm Fixed Price (FFP)
Due Date: NA
Date: NA

Component	DESCRIPTION		Total*
1	**Land Use Controls (Limited)**		
	Contractor Cost (Labor, Supplies, and Travel)	$	76,620.54
	Government Cost (30% of Contractor Cost)	$	22,990.00
	Subtotal	$	99,610.54
	Contingency (20% of Subtotal)	$	19,930.00
	Total	**$**	**119,540.54**
2	**Long-Term Management**		
	Contractor Cost (Labor, Supplies, and Travel)	$	25,971.80
	Government Cost (30% of Contractor Cost)	$	7,800.00
	Subtotal	$	33,771.80
	Contingency (20% of Subtotal)	$	6,760.00
	Total	**$**	**40,531.80**
	6 Reviews - Present Worth	**$**	**243,190.83**
3	**Analog Surface and Subsurface MEC Removal**		
	Contractor Cost (Labor, Supplies, and Travel)	$	296,409.61
	Government Cost (30% of Contractor Cost)	$	88,930.00
	Subtotal	$	385,339.61
	Contingency (20% of Subtotal)	$	77,070.00
	Total	**$**	**462,409.61**
4	**Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE**		
	Contractor Cost (Labor, Supplies, and Travel)	**$**	**427,083.70**
	Government Cost (30% of Contractor Cost)	$	128,130.00
	Subtotal	$	555,213.70
	Contingency (20% of Subtotal)	$	111,050.00
	Total	**$**	**666,263.70**

Cost Assumptions:

* See individual cost sheets for detailed cost breakdown.

COST PROPOSAL	
Project Name:	FS - Former Camp Croft
Location:	Spartanburg, SC
Huntsville WERS 2010 - Contract No.:	W912DY-10-D-0028

1	Land Use Controls (Limited)				
LABOR	**UNIT**		**OPT YR3**	**HRS-YR3**	**COSTS**
Project Manager	Hour		$ 133.91	88	$ 11,784.08
UXO Tech III 4%	Hour		$ 63.90	88	$ 5,623.51
Corp Quality Manager	Hour		$ 142.91	8	$ 1,143.28
Administrative (Home Office)	Hour		$ 66.69	48	$ 3,201.12
Scientist II	Hour		$ 81.09	80	$ 6,487.20
Select Labor Category	Hour		$ -		$ -
Select Labor Category	Hour		$ -		$ -
Select Labor Category	Hour		$ -		$ -
Select Labor Category	Hour		$ -		$ -
Select Labor Category	Hour		$ -		$ -
Subtotal ZAPATA Labor:		*0*		*312*	*$ 28,239.19*

SUBCONTRACTOR COSTS (INCLUDING SUB PROFIT)	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Fencing Contractor	$ 25,000.00	1		$ 25,000.00
Sign Manufacturer	$ 5,000.00	1		$ 5,000.00
Education Materials	$ 1,500.00	1		$ 1,500.00
Subtotal Subcontractor Costs:				*$ 31,500.00*
G&A:			*15.96%*	*$ 5,027.40*
TOTAL SUBCONTRACTOR COSTS + G&A:				*$ 36,527.40*

	RATE	**QTY 1**	**QTY 2**	**COSTS**
Field Equipment - See Attached Worksheet	$ 296.09	1		$ 296.09
Miscellaneous	$ -			$ -
Black & White Copies	$ 0.10	4000		$ 400.00
11 x 17 Drawings Copies	$ 0.66			$ -
Color Copies	$ 1.25			$ -
Notebooks/Binders	$ 9.00	40		$ 360.00
Shipping	$ 30.00	12		$ 360.00
Subtotal Miscellaneous ODCs:				$ 1,416.09
G&A:			*15.96%*	*$ 226.01*
TOTAL MISCELLANEOUS ODCs + G&A:				$ 1,642.09

TRAVEL / PER DIEM / RENTAL CAR	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Travel Cost - See Attached Worksheet	$ 3,079.50	1		$ 3,079.50
G&A:			*15.96%*	*$ 491.49*
TOTAL TRAVEL COSTS + G&A:				*$ 3,570.99*

ZAPATA Labor Total:		$ 28,239.19
Subcontractor(s) Total:		$ 36,527.40
Miscellaneous ODCs Total:		$ 1,642.09
Profit on ZAPATA Labor, Subcontractor(s) & Miscellaneous ODCs:	10.00%	$ 6,640.87
Travel Total:		$ 3,570.99
Subtotal - Estimated Cost:		$ 76,620.54
Applicable State Taxes:	0.00%	$ -
Land Use Controls (Limited)	*1*	*Grand Total:* *$ 76,620.54*

COST PROPOSAL	
Project Name:	FS - Former Camp Croft
Location:	Spartanburg, SC
Huntsville WERS 2010 - Contract No.:	W912DY-10-D-0028

2	Long-Term Management			
LABOR	**UNIT**	**OPT YR3**	**HRS-YR3**	**COSTS**
Project Manager	Hour	$ 133.91	88	$ 11,784.08
Scientist II	Hour	$ 81.09	24	$ 1,946.16
SUXOS	Hour	$ 68.38	24	$ 1,641.03
Corp Quality Manager	Hour	$ 142.91	8	$ 1,143.28
Administrative (Home Office)	Hour	$ 66.69	48	$ 3,201.12
Select Labor Category	Hour	$ -		$ -
Select Labor Category	Hour	$ -		$ -
Select Labor Category	Hour	$ -		$ -
Select Labor Category	Hour	$ -		$ -
Select Labor Category	Hour	$ -		$ -
Subtotal ZAPATA Labor:			*192*	*$ 19,715.67*

SUBCONTRACTOR COSTS (INCLUDING SUB PROFIT)	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
				$ -
				$ -
				$ -
Subtotal Subcontractor Costs:				*$ -*
G&A:			*15.96%*	*$ -*
TOTAL SUBCONTRACTOR COSTS + G&A:				*$ -*

MISCELLANEOUS ODCs	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Field Equipment - See Attached Worksheet	$ 521.25	1		$ 521.25
Miscellaneous	$ -			$ -
Black & White Copies	$ 0.10	4000		$ 400.00
11 x 17 Drawings Copies	$ 0.66			$ -
Color Copies	$ 1.25			$ -
Notebooks/Binders	$ 9.00	40		$ 360.00
Shipping	$ 30.00	12		$ 360.00
Subtotal Miscellaneous ODCs:				$ 1,641.25
G&A:			*15.96%*	*$ 261.94*
TOTAL MISCELLANEOUS ODCs + G&A:				$ 1,903.19

TRAVEL / PER DIEM / RENTAL CAR	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Travel Cost - See Attached Worksheet	$ 1,889.50	1		$ 1,889.50
G&A:			*15.96%*	*$ 301.56*
TOTAL TRAVEL COSTS + G&A:				*$ 2,191.06*

ZAPATA Labor Total:		$ 19,715.67
Subcontractor(s) Total:		$ -
Miscellaneous ODCs Total:		$ 1,903.19
Profit on ZAPATA Labor, Subcontractor(s) & Miscellaneous ODCs:	10.00%	$ 2,161.89
Travel Total:		$ 2,191.06
Subtotal - Estimated Cost:		$ 25,971.80
Applicable State Taxes:	0.00%	$ -
Long-Term Management	*2*	*Grand Total:* *$ 25,971.80*

COST PROPOSAL	
Project Name:	FS - Former Camp Croft
Location:	Spartanburg, SC
Huntsville WERS 2010 - Contract No.:	W912DY-10-D-0028

3	Analog Surface and Subsurface MEC Removal			
LABOR	**UNIT**	**OPT YR3**	**HRS-YR3**	**COSTS**
Project Manager	Hour	$ 133.91	88	$ 11,784.08
Corp Quality Manager	Hour	$ 142.91	16	$ 2,286.56
Corp Health and Safety	Hour	$ 131.71	40	$ 5,268.40
Senior Geophysicist	Hour	$ 126.64		$ -
Scientist II	Hour	$ 81.09	160	$ 12,974.40
Administrative (Home Office)	Hour	$ 66.69	160	$ 10,670.40
UXO Tech I	Hour	$ 44.64	1000	$ 44,638.81
UXO Tech II	Hour	$ 52.60	500	$ 26,297.87
SUXOS	Hour	$ 68.38	750	$ 51,282.09
Select Labor Category	Hour	$ -		$ -
Subtotal ZAPATA Labor:			*2714*	*$ 165,202.61*

SUBCONTRACTOR COSTS (INCLUDING SUB PROFIT)	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Explosives	$ 10,000.00	1		$ 10,000.00
Scrap Management	$ 20,000.00	1		$ 20,000.00
				$ -
Subtotal Subcontractor Costs:				*$ 30,000.00*
G&A:			*15.96%*	*$ 4,788.00*
TOTAL SUBCONTRACTOR COSTS + G&A:				*$ 34,788.00*

MISCELLANEOUS ODCs	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Field Equipment - See Attached Worksheet	$ 19,610.90	1		$ 19,610.90
Miscellaneous	$ -			$ -
Black & White Copies	$ 0.10	12000		$ 1,200.00
11 x 17 Drawings Copies	$ 0.66			$ -
Color Copies	$ 1.25			$ -
Notebooks/Binders	$ 9.00	40		$ 360.00
Shipping	$ 30.00	12		$ 360.00
Subtotal Miscellaneous ODCs:				$ 21,530.90
G&A:			*15.96%*	*$ 3,436.33*
TOTAL MISCELLANEOUS ODCs + G&A:				$ 24,967.23

TRAVEL / PER DIEM / RENTAL CAR	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Travel Cost - See Attached Worksheet	$ 42,218.00	1		$ 42,218.00
G&A:			*15.96%*	*$ 6,737.99*
TOTAL TRAVEL COSTS + G&A:				*$ 48,955.99*

ZAPATA Labor Total:		$	165,202.61
Subcontractor(s) Total:		$	34,788.00
Miscellaneous ODCs Total:		$	24,967.23
Profit on ZAPATA Labor, Subcontractor(s) & Miscellaneous ODCs:	10.00%	$	22,495.78
Travel Total:		$	48,955.99
Subtotal - Estimated Cost:		$	296,409.61
Applicable State Taxes:	0.00%	$	-
Analog Surface and Subsurface MEC Removal	*3*	*Grand Total:*	*$ 296,409.61*

COST PROPOSAL	
Project Name:	FS - Former Camp Croft
Location:	Spartanburg, SC
Huntsville WERS 2010 - Contract No.:	W912DY-10-D-0028

4	Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE			
LABOR	**UNIT**	**OPT YR3**	**HRS-YR3**	**COSTS**
Project Manager	Hour	$ 133.91	88	$ 11,784.08
Corp Quality Manager	Hour	$ 142.91	16	$ 2,286.56
Corp Health and Safety	Hour	$ 131.71	40	$ 5,268.40
Senior Geophysicist	Hour	$ 126.64	280	$ 35,459.20
Scientist II	Hour	$ 81.09	1160	$ 94,064.40
Administrative (Home Office)	Hour	$ 66.69	160	$ 10,670.40
UXO Tech I	Hour	$ 44.64	800	$ 35,711.05
UXO Tech II	Hour	$ 52.60	400	$ 21,038.29
SUXOS	Hour	$ 68.38	600	$ 41,025.67
Select Labor Category	Hour	$ -		$ -
Subtotal ZAPATA Labor:			*3544*	*$ 257,308.05*

SUBCONTRACTOR COSTS (INCLUDING SUB PROFIT)	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Explosives	$ 15,000.00	1		$ 15,000.00
Scrap Management	$ 15,000.00	1		$ 15,000.00
				$ -
Subtotal Subcontractor Costs:				*$ 30,000.00*
G&A:			*15.96%*	*$ 4,788.00*
TOTAL SUBCONTRACTOR COSTS + G&A:				*$ 34,788.00*

MISCELLANEOUS ODCs	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Field Equipment - See Attached Worksheet	$ 30,082.20	1		$ 30,082.20
Miscellaneous	$ -			$ -
Black & White Copies	$ 0.10	12000		$ 1,200.00
11 x 17 Drawings Copies	$ 0.66			$ -
Color Copies	$ 1.25			$ -
Notebooks/Binders	$ 9.00	40		$ 360.00
Shipping	$ 30.00	12		$ 360.00
Subtotal Miscellaneous ODCs:				$ 32,002.20
G&A:			*15.96%*	*$ 5,107.55*
TOTAL MISCELLANEOUS ODCs + G&A:				$ 37,109.75

TRAVEL / PER DIEM / RENTAL CAR	**RATE**	**QTY 1**	**QTY 2**	**COSTS**
Travel Cost - See Attached Worksheet	$ 56,017.00	1		$ 56,017.00
G&A:			*15.96%*	*$ 8,940.31*
TOTAL TRAVEL COSTS + G&A:				*$ 64,957.31*

ZAPATA Labor Total:		$ 257,308.05
Subcontractor(s) Total:		$ 34,788.00
Miscellaneous ODCs Total:		$ 37,109.75
Profit on ZAPATA Labor, Subcontractor(s) & Miscellaneous ODCs:	10.00%	$ 32,920.58
Travel Total:		$ 64,957.31
Subtotal - Estimated Cost:		$ 427,083.70
Applicable State Taxes:	0.00%	$ -
Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE	*4*	*Grand Total:* *$ 427,083.70*

COST PROPOSAL	
Project Name:	FS - Former Camp Croft
Location:	Spartanburg, SC
Huntsville WERS 2010 - Contract No.:	W912DY-10-D-0028

GRAND TOTAL - ZAPATA WORK HOURS:	*6,762*	*0*	6,762
GRAND TOTAL - ZAPATA LABOR COST:	$ *470,465.52*		
GRAND TOTAL - SUBCONTRACTOR COST:	$ *91,500.00*		
GRAND TOTAL - MISCELLANEOUS ODCs:	$ *56,590.43*		
GRAND TOTAL - TRAVEL COST:	$ *103,204.00*	$ *103,204.00*	$ -
GRAND TOTAL - G&A:	$ *40,106.59*		
GRAND TOTAL - PROFIT:	$ *64,219.12*		
GRAND TOTAL - APPLICABLE STATE TAXES:	$ -		
GRAND TOTAL - PROJECT COST:	$ *826,085.65*	$ 826,085.65	$ -
TOTAL FROM SUMMARY PAGE:	$ -		
BALANCE:	$ *826,085.65*		

FS - Former Camp Croft
Spartanburg, SC
W912DY-10-D-0028

	MMRP EQUIPMENT			Land Use Controls (Limited)		Long-Term Management		Analog Surface and Subsurface MEC Removal		Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE	
FUNCTION	EQUIPMENT	RATE	UNIT	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Positional Equipment	EM61 MK II	$ 375.00	Week		$ -		$ -		$ -	12	$ 4,500.00
	Geometrics 856 Portable/Base Station	$ 27.00	Week		$ -		$ -		$ -		$ -
	Geometrics 856 Portable/Base Station (Mob)	$ 75.00	LS		$ -		$ -		$ -		$ -
	Geometrics G-858 Gradiometer Cesium Mag	$ 95.00	Week		$ -		$ -		$ -		$ -
	Geometrics G-858 Gradiometer Cesium Mag (Mob)	$ 95.00	LS		$ -		$ -		$ -		$ -
	GPS (Trimble XH)	$ 1,500.00	Month		$ -		$ -	3	$ 4,500.00	3	$ 4,500.00
	GPS w/RTK	$ 1,500.00	Month		$ -		$ -		$ -		$ -
	Hand Held GPS (Garmin eTrex Legend H)	$ 150.00	Each	1	$ 150.00	1	$ 150.00	4	$ 600.00	4	$ 600.00
	Magnetometer cart (Mob)	$ 40.00	LS		$ -		$ -		$ -		$ -
	Magnetometer cart (with Cable)	$ 25.00	Week		$ -		$ -		$ -		$ -
	Marine Magnetometer	$ 200.00	Week		$ -		$ -		$ -		$ -
	Shipping	$ 150.00	LS		$ -		$ -	1	$ 150.00	1	$ 150.00
	Trimble AG114 Receiver	$ 50.00	Week		$ -		$ -		$ -		$ -
	Trimble AG114 Receiver (Mob)	$ 100.00	LS		$ -		$ -		$ -		$ -
	Truck & Fuel - GPO	$ 2,250.00	Month		$ -		$ -		$ -		$ -
Other Equipment	Articulated Dump Truck	$ 12,710.00	Month		$ -		$ -		$ -		$ -
	Articulated Dump Truck Delivery/Pickup	$ 700.00	LS		$ -		$ -		$ -		$ -
	Backhoe	$ 1,550.00	Month		$ -		$ -		$ -		$ -
	Backhoe Delivery/Pickup	$ 200.00	LS		$ -		$ -		$ -		$ -
	Binary Explosives 1 lb 48 ea	$ 517.00	Case		$ -		$ -		$ -		$ -
	Blasting Caps/Detonators min 25 ea 5.90 ea	$ 174.50	Box		$ -		$ -		$ -		$ -
	Blasting Equipment Rental	$ 20.00	Month		$ -		$ -		$ -		$ -
	Blasting Equipment Rental (remote firing device)	$ 385.31	Month		$ -		$ -		$ -		$ -
	Brushcutter Truck Trailer	$ 9,341.00	Month		$ -		$ -		$ -		$ -
	Brush-hog Tractor	$ 950.00	Month		$ -		$ -	2.5	$ 2,375.00	4	$ 3,800.00
	Brush-hog Tractor Delivery/Pickup	$ 140.00	LS		$ -		$ -		$ -		$ -
	Cell phone	$ 59.99	Month	0.5	$ 30.00	0.5	$ 30.00	2.5	$ 149.98	4	$ 239.96
	Clips forCharges min 30 ea	$ 0.15	Each		$ -		$ -		$ -		$ -
	D6N Dozer	$ 6,050.54	Month		$ -		$ -		$ -		$ -
	D6N Dozer Delivery/Pickup	$ 1,125.00	LS		$ -		$ -		$ -		$ -
	Detonating Cord 500ft 80 grain	$ 895.00	Roll		$ -		$ -		$ -		$ -
	Diesel Offroad - Gallons per Week	$ 5.00	Week		$ -		$ -		$ -		$ -
	Diesel road $2.84 5 April 2010 - Gallons per Week	$ 5.00	Week		$ -		$ -		$ -		$ -
	Digital Camera	$ 129.00	LS		$ -		$ -	1	$ 129.00	1	$ 129.00
	Electrical Portable Generator 25 kw	$ 1,324.00	Month		$ -		$ -	2.5	$ 3,310.00	4	$ 5,296.00
	Electrical Service - Delivery & Pickup	$ 130.00	LS		$ -		$ -		$ -		$ -
	Electrical Services Hook-up	$ 200.00	LS		$ -		$ -		$ -		$ -
	Equipment Storage Container 20 Foot	$ 184.00	Month		$ -		$ -	2.5	$ 460.00	4	$ 736.00
	Equipment Storage Container Delivery/Pickup 20 '	$ 420.00	LS		$ -		$ -	1	$ 420.00	1	$ 420.00
	Excavator 330C/DL with Thumb Attachment	$ 10,909.00	Month		$ -		$ -		$ -		$ -
	Excavator Delivery/Pickup	$ 700.00	LS		$ -		$ -		$ -		$ -
	Explosive Charges 19.5 GM min 50 ea	$ 8.15	Each		$ -		$ -		$ -		$ -
	Explosive Charges 22GM min 50 ea	$ 8.20	Each		$ -		$ -		$ -		$ -
	Explosive Charges 24GM min 50 ea	$ 8.25	Each		$ -		$ -		$ -		$ -
	Explosive Charges 32GM min 50 ea $18.40 ea	$ 920.00	Box		$ -		$ -		$ -		$ -
	Explosive Day Box (magazine)	$ 56.87	Month		$ -		$ -		$ -		$ -
	Explosive Delivery Charge $200. hr billed 1/2	$ 200.00	HR		$ -		$ -		$ -		$ -
	Explosive Magazine Delivery	$ 520.00	LS		$ -		$ -		$ -		$ -
	Explosives Magazine Rental	$ 550.00	Month		$ -		$ -		$ -		$ -
	Fencing	$ 750.00	LS		$ -		$ -		$ -		$ -
	Field Office delivery/setup/pickup	$ 420.00	LS		$ -		$ -	1	$ 420.00	1	$ 420.00
	Field Office Rental	$ 427.00	Month		$ -		$ -	2.5	$ 1,067.50	4	$ 1,708.00
	Frontend Wheel Loader Delivery/Pickup	$ 1,125.00	LS		$ -		$ -		$ -		$ -
	Fuel Dispenser - 5 gallon with metal spout	$ 30.45	LS		$ -		$ -		$ -		$ -
	Fuel Tank 100	$ 400.00	Each		$ -		$ -		$ -		$ -
	Fuel Tank 2000	$ 850.00	Month		$ -		$ -		$ -		$ -
	Furniture for Office Trailer	$ 200.00	Month		$ -		$ -	2.5	$ 500.00	4	$ 800.00
	Internet Service	$ 50.00	Month		$ -		$ -	2.5	$ 125.00	4	$ 200.00
	Internet Service Aircard	$ 59.99	Month		$ -		$ -		$ -		$ -
	IT62H Wheel Loader with three attachments	$ 2,577.00	Week		$ -		$ -		$ -		$ -
	Laptop Computer	$ 81.00	Month		$ -		$ -	2.5	$ 202.50	4	$ 324.00
	Locks ATF	$ 18.00	Each		$ -		$ -		$ -		$ -
	Misc. Consumables-paper, tire repair,etc	$ 100.00	Week		$ -		$ -	10	$ 1,000.00	12	$ 1,200.00
	Mobilization/ Demobilization Brush cutter Truck Trailer	$ 1,500.00	LS		$ -		$ -		$ -		$ -
	Motorola Radio (5 Watt/2 Channel) w/ plug in charger	$ 21.00	Month		$ -		$ -		$ -		$ -
	Mule 4x4	$ 465.00	Month		$ -		$ -		$ -		$ -
	Portable Fuel Tank	$ 400.00	Month		$ -		$ -		$ -		$ -
	Portable Toilet	$ 125.00	Month		$ -		$ -		$ -		$ -
	Portable Toilet with Delivery/Pickup	$ 160.00	Month		$ -		$ -	2.5	$ 400.00	4	$ 640.00
	Printer/Scanner/Fax Machine	$ 100.00	Month		$ -		$ -	2.5	$ 250.00	4	$ 400.00
	Schonstedt Magnetometers	$ 40.00	Month		$ -		$ -	12	$ 480.00		$ -
	Telephone Service - Installation Fee	$ 296.50	LS		$ -		$ -		$ -		$ -
	Truck & Fuel - SUXOS & UXOSO	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Demo	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - GPO	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - MEC Clearance	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - RDD Removal	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Reacquire	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Reacquire/Intrusive	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Site Prep	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Site Prep	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Site Teardown	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Survey	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - UXOQCS	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Truck & Fuel - Vegetation Removal	$ 2,250.00	Month		$ -		$ -		$ -		$ -
	Weed Cutter	$ 295.39	LS		$ -		$ -		$ -		$ -
	Weed Cutter Face Shield with Ear Protection	$ 42.95	LS		$ -		$ -		$ -		$ -
	Weedcutter Kit	$ 3.00	Month		$ -		$ -		$ -		$ -
	Wet Bulb Thermometer (WBGT)	$ 475.00	Month		$ -		$ -		$ -		$ -
	Whites Metal Detectors	$ 40.00	Month	0.5	$ 20.00	0.5	$ 20.00	12	$ 480.00	4	$ 160.00
plies	6" Survey nails - Qty 362/Box	$ 52.50	Box		$ -		$ -		$ -		$ -
	Air Horn	$ 29.40	Each		$ -		$ -		$ -		$ -
	Air Horn refills	$ 24.00	Each		$ -		$ -		$ -		$ -
	Batteries 9 volt / AA	$ 11.50	Pk		$ -		$ -		$ -		$ -
	Burn Kits	$ 86.00	Each		$ -		$ -		$ -		$ -
	Coghlan's Ultra Fine Mesh Mosquito Head Net	$ 17.50	Each		$ -		$ -		$ -		$ -
	Drums	$ 22.00	Each		$ -		$ -	30	$ 660.00	12	$ 264.00
	Eye Protection	$ 5.95	Each		$ -		$ -		$ -		$ -
	Eyewash 32 oz bottle	$ 32.50	Each		$ -		$ -		$ -		$ -
	Eyewash Kit and Additive	$ 232.73	Each		$ -		$ -		$ -		$ -
	Fieldbooks	$ 16.95	Each		$ -	1	$ 16.95	5	$ 84.75	10	$ 169.50
	Fire Extinguisher tri class dry	$ 99.50	Each		$ -	1	$ 99.50	3	$ 298.50	3	$ 298.50
	First Aid Kits	$ 39.50	Each		$ -	1	$ 39.50	3	$ 118.50	3	$ 118.50
	Fluorescent Spray Paint	$ 4.95	Each		$ -		$ -		$ -		$ -
	Grizzly Bear Assault Deterrent (Bear Spray)	$ 65.00	Each		$ -		$ -		$ -		$ -
	Hardhats	$ 14.95	Each		$ -		$ -		$ -		$ -
	Hip Boots waders	$ 59.90	Each		$ -		$ -		$ -		$ -

MMRP EQUIPMENT				Land Use Controls (Limited)		Long-Term Management		Analog Surface and Subsurface MEC Removal		Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE	
FUNCTION	EQUIPMENT	RATE	UNIT	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Field Sup	Ice	$ 1.50	Each		$ -	10	$ 15.00	100	$ 150.00	300	$ 450.00
	Mattock	$ 15.10	Each		$ -		$ -		$ -		$ -
	Measuring Tapes	$ 81.50	Each		$ -		$ -	2	$ 163.00	4	$ 326.00
	Number tag for Wooden Stakes - Per Bundle of 1000	$ 99.00	Bundle		$ -		$ -		$ -		$ -
	Pin Flags (PVC) Bundle - Per Bundle of 100	$ 10.25	Bundle		$ -	5	$ 51.25	5	$ 51.25	4	$ 41.00
	Reflective Safety Vest	$ 34.90	Each		$ -		$ -		$ -		$ -
	Repel 40% DEET Insect Repellent	$ 8.95	Each		$ -		$ -		$ -		$ -
	Safety can fuel type 1 with funnel	$ 48.20	Each		$ -		$ -		$ -		$ -
	Shovels	$ 29.00	Each	1	$ 29.00		$ -	4	$ 116.00	8	$ 232.00
	Space Pens	$ 9.80	Each	2	$ 19.60	2	$ 19.60	2	$ 19.60	4	$ 39.20
	Spill Kit	$ 213.00	Each		$ -		$ -		$ -		$ -
	Stretchers	$ 535.00	Each		$ -		$ -		$ -		$ -
	Survey Flagging Tape	$ 1.60	Each	5	$ 8.00	10	$ 16.00	20	$ 32.00	40	$ 64.00
	Tool Chest	$ 300.00	Each		$ -		$ -		$ -		$ -
	Trauma Kit	$ 222.00	Each		$ -		$ -		$ -		$ -
	Union Pick	$ 28.40	Each		$ -		$ -		$ -		$ -
	Water	$ 5.99	Case	1	$ 5.99	5	$ 29.95	10	$ 59.90	30	$ 179.70
	Wooden Stakes - 50+ Bundle	$ 40.00	Bundle		$ -		$ -		$ -		$ -
	Work Gloves	$ 16.75	Each	2	$ 33.50	2	$ 33.50	10	$ 167.50	20	$ 335.00
Mob / Demob	Equipment Mob/Demob Costs (FedEx) - Per 100 lbs	$ 223.64	LBS		$ -		$ -	3	$ 670.92	6	$ 1,341.84
	Equipment Mob/Demob Costs (FedEx) Ground - Per 100 lbs	$ 76.76	per 100 lbs		$ -		$ -		$ -		$ -
MMRP EQUIPMENT - TOTAL COST:				**Land Use Controls (Limited)**	**$ 296.09**	**Long-Term Management**	**$ 521.25**	**Analog Surface and Subsurface**	**$ 19,610.90**	**Digital Advanced Classification Surface**	**$ 30,082.20**

ENVIRONMENTAL EQUIPMENT				Land Use Controls (Limited)		Long-Term Management		Analog Surface and Subsurface MEC Removal		Digital Advanced Classification Surface and Subsurface	
FUNCTION	EQUIPMENT	RATE	UNIT	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Soil Boring & Well Installation	TVA-1000 Calibration Kit (includes gas to purchase)	$ 220.00	LS		$ -		$ -		$ -		$ -
	TVA-1000 FID (for field screening & safety)	$ 146.00	Day		$ -		$ -		$ -		$ -
	TVA-1000 FID (for field screening & safety)	$ 436.00	Week		$ -		$ -		$ -		$ -
	TVA-1000 FID Charcoal tip	$ 11.00	Day		$ -		$ -		$ -		$ -
	TVA-1000 FID extra Hydrogen Tanks	$ 16.00	Day		$ -		$ -		$ -		$ -
	Brush Cutting Trailer/Truck	$ 9,341.00	Month		$ -		$ -		$ -		$ -
	Combustible Gas Calibration Kit (Includes gas to purchase)	$ 150.00	LS		$ -		$ -		$ -		$ -
	Combustible Gas Indicator	$ 175.00	Week		$ -		$ -		$ -		$ -
	Stainless Steel Hand Auger	$ 50.00	Week		$ -		$ -		$ -		$ -
	Stainless Steel Bowl (for homogenizing soil samples)	$ 10.00	Each		$ -		$ -		$ -		$ -
	Extra jars for headspace (shipped with sample coolers)	$ 40.00	Case		$ -		$ -		$ -		$ -
	Work Table	$ 50.00	Each		$ -		$ -		$ -		$ -
Groundwater Development and Purging	Passive Diffusion Bag Samplers	$ 6,894.00	LS		$ -		$ -		$ -		$ -
	QED Bladder Pump, 3/4 x 18" SS, Teflon Bladder	$ 50.00	Day		$ -		$ -		$ -		$ -
	QED Bladder Pump, 3/4 x 18" SS, Teflon Bladder	$ 200.00	Week		$ -		$ -		$ -		$ -
	Precision Dual Range Controller/Air Compressor	$ 85.00	Day		$ -		$ -		$ -		$ -
	Precision Dual Range Controller/Air Compressor	$ 225.00	Week		$ -		$ -		$ -		$ -
	QED Bladder Pump, 3/4 x 18" SS, Teflon Bladder	$ 50.00	Day		$ -		$ -		$ -		$ -
	QED Bladder Pump, 3/4 x 18" SS, Teflon Bladder	$ 200.00	Week		$ -		$ -		$ -		$ -
	Precision Dual Range Controller/Air Compressor	$ 85.00	Day		$ -		$ -		$ -		$ -
	Precision Dual Range Controller/Air Compressor	$ 225.00	Week		$ -		$ -		$ -		$ -
	QED Bladder Pump, 3/4 x 18" SS, Teflon Bladder	$ 50.00	Day		$ -		$ -		$ -		$ -
	QED Bladder Pump, 3/4 x 18" SS, Teflon Bladder	$ 200.00	Week		$ -		$ -		$ -		$ -
	Precision Dual Range Controller/Air Compressor	$ 85.00	Day		$ -		$ -		$ -		$ -
	Precision Dual Range Controller/Air Compressor	$ 225.00	Week		$ -		$ -		$ -		$ -
	Grundfos Redi-Flo2 Submersible Pump	$ 300.00	Week		$ -		$ -		$ -		$ -
	Generator to Power Pump	$ 45.00	Day		$ -		$ -		$ -		$ -
	Generator to Power Pump	$ 150.00	Week		$ -		$ -		$ -		$ -
	Grundfos Redi-Flo2 Submersible Pump	$ 300.00	Week		$ -		$ -		$ -		$ -
	Generator to Power Pump	$ 45.00	Day		$ -		$ -		$ -		$ -
	Generator to Power Pump	$ 150.00	Week		$ -		$ -		$ -		$ -
	Grundfos Redi-Flo2 Submersible Pump	$ 300.00	Week		$ -		$ -		$ -		$ -
	Generator to Power Pump	$ 45.00	Day		$ -		$ -		$ -		$ -
	Generator to Power Pump	$ 150.00	Week		$ -		$ -		$ -		$ -
	Electronic Water Level Indicator	$ 98.00	Week		$ -		$ -		$ -		$ -
	Electronic Water Level Indicator	$ 98.00	Week		$ -		$ -		$ -		$ -
	Interface Probe	$ 175.00	Week		$ -		$ -		$ -		$ -
	YSI-556 Flow Through Cell	$ 125.00	Day		$ -		$ -		$ -		$ -
	YSI-556 Flow Through Cell	$ 400.00	Week		$ -		$ -		$ -		$ -
	YSI-556 Field Calibration Supplies	$ 50.00	LS		$ -		$ -		$ -		$ -
	YSI-556 Flow Through Cell	$ 125.00	Day		$ -		$ -		$ -		$ -
	YSI-556 Flow Through Cell	$ 400.00	Week		$ -		$ -		$ -		$ -
	YSI-556 Field Calibration Supplies	$ 50.00	LS		$ -		$ -		$ -		$ -
	Batteries for Pumps	$ 70.00	Unit		$ -		$ -		$ -		$ -
	Battery Charger	$ 25.00	Unit		$ -		$ -		$ -		$ -
	HFS DRT-15CE Turbidity Meter (to take separate accurate measurements of turbidity)	$ 32.00	Day		$ -		$ -		$ -		$ -
	HFS DRT-15CE Turbidity Meter (to take separate accurate measurements of turbidity)	$ 98.00	Week		$ -		$ -		$ -		$ -
	HFS DRT-15CE Turbidity Meter (to take separate accurate measurements of turbidity)	$ 32.00	Day		$ -		$ -		$ -		$ -
	HFS DRT-15CE Turbidity Meter (to take separate accurate measurements of turbidity)	$ 98.00	Week		$ -		$ -		$ -		$ -
	Extra jars to photograph development water	$ 40.00	Case		$ -		$ -		$ -		$ -
	Filters for Dissolved Metals	$ 22.00	Unit		$ -		$ -		$ -		$ -
	PVC Pipe & supplies to build surge block	$ 40.00	Each		$ -		$ -		$ -		$ -
	Tubing: Polyethylene for well development (plus 5' for above ground) - Per 100' Roll	$ 25.00	Roll		$ -		$ -		$ -		$ -
	Tubing: Teflon for downhole purging & air line (see IDW table for detail)	$ 2.60	Per Foot		$ -		$ -		$ -		$ -
	Disposable Teflon Bailers (backup)	$ 20.00	Each		$ -		$ -		$ -		$ -
IDW	Drums for IDW Storage (see IDW Table for est)	$ 50.00	Each		$ -		$ -		$ -		$ -
	Drum Labels	$ 20.00	Pack		$ -		$ -		$ -		$ -
	Trash Pump (to aid in IDW staging)	$ 200.00	Week		$ -		$ -		$ -		$ -
	20 Gallon Poly Drums (for dev. & purged water transport)	$ 40.00	Each		$ -		$ -		$ -		$ -
	Buckets	$ 7.00	Each		$ -		$ -		$ -		$ -
Cooler Packing	Extra Coolers (Should be supplied by lab)	$ 20.00	Each		$ -		$ -		$ -		$ -
	Packing Tape	$ 4.00	Roll		$ -		$ -		$ -		$ -
	Ziploc Bags	$ 5.00	Box		$ -		$ -		$ -		$ -
	Trash Bags	$ 4.00	Each		$ -		$ -		$ -		$ -
	Ice	$ 2.25	Bag		$ -		$ -		$ -		$ -
Decontamination	Decon Tubs	$ 20.00	Tub		$ -		$ -		$ -		$ -
	Deionized Water for decon	$ 16.14	Gallon		$ -		$ -		$ -		$ -
	Isopropanol	$ 25.00	Container		$ -		$ -		$ -		$ -
	Alconox/Liquinox	$ 30.00			$ -		$ -		$ -		$ -
	Decon Brushes	$ 3.00	Each		$ -		$ -		$ -		$ -
	Spray Bottles for Decon	$ 30.00	Unit		$ -		$ -		$ -		$ -
	Plastic Sheeting	$ 10.00	Roll		$ -		$ -		$ -		$ -
	Towels	$ 5.00	Pack		$ -		$ -		$ -		$ -
	5 Gallon Potable Water Container	$ 10.00	Each		$ -		$ -		$ -		$ -
Safety	Nitrile Gloves	$ 15.50	Per 100		$ -		$ -		$ -		$ -
	Eye Wash Kit (will use existing kit)	$ 300.00	LS		$ -		$ -		$ -		$ -
	Eyewash Additive (will be added to our eyewash station)	$ 19.95	Each		$ -		$ -		$ -		$ -
	First Aid Kit	$ 40.00	Kit		$ -		$ -		$ -		$ -
	Fire Extinguisher	$ 25.00	Unit		$ -		$ -		$ -		$ -
	Igloo for drinking water	$ 20.00	Each		$ -		$ -		$ -		$ -
	Field Coveralls	$ 28.00	Outfit		$ -		$ -		$ -		$ -
	Tyvek Level C Protective Gear (will need for splash hazard)	$ 7.00	Suite		$ -		$ -		$ -		$ -
	Level C Boots	$ 13.95	Pair		$ -		$ -		$ -		$ -
	Work Gloves	$ 15.00	Pair		$ -		$ -		$ -		$ -
	Ear Protection	$ 36.00	Qty 200		$ -		$ -		$ -		$ -
	Eye Protection	$ 36.50	Qty 10		$ -		$ -		$ -		$ -
	Full Face Respirator	$ 175.00	Each		$ -		$ -		$ -		$ -
	HEPA/Organic Cartridges	$ 12.00	Pair		$ -		$ -		$ -		$ -
	Safety Tape	$ 16.00			$ -		$ -		$ -		$ -
	Traffic Cones	$ 5.00	Each		$ -		$ -		$ -		$ -
Aquifer Testing	Data Logger	$ 360.00	Week		$ -		$ -		$ -		$ -
	Pressure Transducers	$ 245.00	Week		$ -		$ -		$ -		$ -
	Laptop Computer	$ 100.00	Week		$ -		$ -		$ -		$ -
	Misc. Equipment needed for Aquifer Testing				$ -		$ -		$ -		$ -
	Other				$ -		$ -		$ -		$ -
n Equipment	Misc. Equipment	$ 100.00	LS		$ -		$ -		$ -		$ -
	New Locks (to replace locks to be removed)	$ 7.00	Each		$ -		$ -		$ -		$ -
	Dissolved Hydrogen Sampling Kit	$ 100.00	Kit		$ -		$ -		$ -		$ -
	Pin Flags	$ 10.00	LS		$ -		$ -		$ -		$ -
	Marking Paint	$ 5.00	Each		$ -		$ -		$ -		$ -
	Field Notebooks	$ 11.75	Each		$ -		$ -		$ -		$ -
	Digital Flowmeters (on Solutions Est)	$ 310.00	Each		$ -		$ -		$ -		$ -
	Water - 1000 Gallons	$ 2.97	Gallon		$ -		$ -		$ -		$ -
	Lights	$ 345.00	Month		$ -		$ -		$ -		$ -
	Diesel Fuel for Lights and Generator Below	$ 4.00	Gallon		$ -		$ -		$ -		$ -
	Sodium Lactate	$ 0.84	LB		$ -		$ -		$ -		$ -
	Lactate Delivery	$ 5,786.00	Each		$ -		$ -		$ -		$ -
	Frac Tank (Lactate Storage)	$ 1,260.00	Month		$ -		$ -		$ -		$ -

ENVIRONMENTAL EQUIPMENT				Land Use Controls (Limited)		Long-Term Management		Analog Surface and Subsurface MEC Removal		Digital Advanced Classification Surface and Subsurface	
FUNCTION	EQUIPMENT	RATE	UNIT	QTY	COST	QTY	COST	QTY	COST	QTY	COST
Injectio	Frac Tank - Mob/Demob	$ 392.70	Each		$ -		$ -		$ -		$ -
	Portable Generator for Transfer Pump	$ 400.00	Month		$ -		$ -		$ -		$ -
	Lactate Transfer Pump	$ 985.00			$ -		$ -		$ -		$ -
	735 Gallon Poly Lactate Tank (for Trailer)	$ 2,152.00			$ -		$ -		$ -		$ -
	Backflow Preventer (Charlotte)	$ 330.00	Month		$ -		$ -		$ -		$ -
	Trailer Rental (2 needed x 8 weeks)	$ 120.00	Week		$ -		$ -		$ -		$ -
	Hydrant to Cluster SCH 40 PVC Pipe 2" (on B&V Estimate)	$ 0.65	Foot		$ -		$ -		$ -		$ -
	Cams and Adapters (on B&V Estimate)	$ 2,248.00			$ -		$ -		$ -		$ -
	Connex Box	$ 1,500.00	Month		$ -		$ -		$ -		$ -
	Wellhead Assemblies (on B&V estimate)	$ 75.00	Each		$ -		$ -		$ -		$ -
	Miscellaneous Supplies and Fittings	$ 1,000.00	Each		$ -		$ -		$ -		$ -
Shipping & Storage	Mini Storage Rental fee per month	$ 100.00	Month		$ -		$ -		$ -		$ -
	ZE Shipping Costs (QA Coolers to Govt. Contracted Lab)	$ 70.00	Overnight Item		$ -		$ -		$ -		$ -
	ZE Shipping Costs (Medium Equipment/Supply Boxes)	$ 30.00	STD Shipment		$ -		$ -		$ -		$ -
	ZE Shipping Costs (large Equipment/Supply Boxes)	$ 45.00	STD Shipment		$ -		$ -		$ -		$ -
	Enviro Equipment Shipping for Small Instruments (one way for box of tubing)	$ 51.00	Overnight Item		$ -		$ -		$ -		$ -
	Enviro Equipment Shipping for Large Instruments (pumps & controller in same box)	**$ 78.00**	Overnight Item		$ -		$ -		$ -		$ -
ENVIRONMENTAL EQUIPMENT				**Land Use Controls**	**$ -**	**Long-Term Manageme**	**$ -**	**Analog Surface**	**$ -**	**Digital Advanced**	**$ -**

TRAVEL COST

Project Name:	FS - Former Camp Croft
Location:	Spartanburg, SC
Contract No.:	W912DY-10-D-0028

1	Land Use Controls (Limited)					
DESCRIPTION (QTY: 0-TRIPS)	**QTY**	**FROM: Charlotte, NC**	**TO**	**Spartanburg, SC**	**NOTE**
Roundtrip Airfare (Each)	1.0	$ 500.00	=	$ 500.00	3 FLIGHTS/AVG
Per Diem (Days)	11.5	$ 46.00	=	$ 529.00	
Lodging (Days)	11.0	$ 83.00	=	$ 913.00	
Rental Car (Days)	12.0	$ 65.00	=	$ 780.00	
Other (Parking, Fuel, Tolls, ATM, etc.)	12.0	$ 25.00	=	$ 300.00	
Mileage (Per Mile)	100.0	$ 0.58	=	$ 57.50	
			TOTAL:	***$ 3,079.50***	**1**

2	Long-Term Management				
DESCRIPTION (QTY: 0-TRIPS)	**QTY**	**FROM: Charlotte, NC**	**TO**	**Spartanburg, SC**	**NOTE**
Roundtrip Airfare (Each)	2.0	$ 500.00	=	$ 1,000.00	3 FLIGHTS/AVG
Per Diem (Days)	5.0	$ 46.00	=	$ 230.00	
Lodging (Days)	4.0	$ 83.00	=	$ 332.00	
Rental Truck (Days)	3.0	$ 65.00	=	$ 195.00	
Fuel (Per Day)	3.0	$ 25.00	=	$ 75.00	
Mileage (Per Mile)	100.0	$ 0.58	=	$ 57.50	
			TOTAL:	***$ 1,889.50***	**2**

3	Analog Surface and Subsurface MEC Removal				
DESCRIPTION (QTY: 0-TRIPS)	**QTY**	**FROM: Charlotte, NC**	**TO**	**Spartanburg, SC**	**NOTE**
	9.0	$ 500.00	=	$ 4,500.00	3 FLIGHTS/AVG
Per Diem (Days)	238.5	$ 46.00	=	$ 10,971.00	
Lodging (Days)	234.0	$ 83.00	=	$ 19,422.00	
Rental Truck (Days)	75.0	$ 65.00	=	$ 4,875.00	
Fuel (Per Day)	75.0	$ 25.00	=	$ 1,875.00	
Mileage (Per Mile)	1000.0	$ 0.58	=	$ 575.00	
			TOTAL:	***$ 42,218.00***	**3**

4	Digital Advanced Classification Surface and Subsurface Removal to Support UU/UE				
DESCRIPTION (QTY: 0-TRIPS)	**QTY**	**FROM: Charlotte, NC**	**TO**	**Spartanburg, SC**	**NOTE**
Roundtrip Airfare (Each)	20.0	$ 500.00	=	$ 10,000.00	3 FLIGHTS/AVG
Per Diem (Days)	296.5	$ 46.00	=	$ 13,639.00	
Lodging (Days)	291.0	$ 83.00	=	$ 24,153.00	
Rental Truck (Days)	85.0	$ 65.00	=	$ 5,525.00	
Fuel (Per Day)	85.0	$ 25.00	=	$ 2,125.00	
Mileage (Per Mile)	1000.0	$ 0.58	=	$ 575.00	
			TOTAL:	***$ 56,017.00***	**4**

TOTAL TRAVEL: $ 103,204.00

APPENDIX B

INSTITUTIONAL ANALYSIS AND INSTITUTIONAL ANALYSIS REPORT

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INSTITUTIONAL ANALYSIS AND REPORT

1.0 PURPOSE OF STUDY

1.0.1 The objective of the institutional analysis is to identify government agencies having jurisdiction over Formerly Used Defense Sites (FUDS) at the former Camp Croft, and assess their appropriateness, capability, and willingness to assert this control. Information obtained during the analysis will be used for formulation of the Institutional Analysis Plan. The Technical Project Planning (TPP) process identified current land use and future land use plans. The five elements are explained in Section 11.1 of this Report were taken into consideration when assessing the ability of a local, state, or Federal agency to assist in the implementation or monitoring of a proposed institutional control program.

Institutional Control analysis questionnaire sheets were mailed out to stakeholders in early July 2014. The stakeholders' replies as of July 2015 have been compiled and placed in this report.

2.0 METHODOLOGY

2.1 RESPONSE STRATEGIES

2.1.1 There are three general categories of response strategies to MEC-related risk remaining on FUDS:

1. MEC removal (clearance);
2. Access Control; and
3. Behavior Modification.

2.1.2 The removal of the potential MEC exposure pathway is the ultimate goal, however, on certain sites this cannot be guaranteed. When the complete removal of all MEC cannot be carried out, is not necessary, or is not feasible, access control and behavior modifications become necessary. Access controls and behavior modification are also known as institutional controls. Institutional controls can be implemented as simply as placing signs around an area to warn of the possible dangers, to restricting access to the area of concern, to deed restrictions. Institutional controls must be performed with a joint effort of the property owner(s), local and/or State officials. Institutional Controls are not effective if one does not have the complete participation from all parties.

2.2 ANALYSIS METHODOLOGY

2.2.1 In order to determine the correct institutional controls (or land use controls; LUCs) for the former Camp Croft, the following issues need to be considered:

- Likelihood of MEC;
- Future land use; and
- Public access to the site.

3.0 SCOPE OF EFFORT

3.0.1 This Institutional Analysis report was prepared in accordance with guidance developed by the U.S. Army Engineering and Support Center, Huntsville (USAESCH). This analysis supports the development of strategies that will require the cooperation of private, and state, and

Federal authorities. The institutions most likely to be involved variously in implementation of institutional or land use controls include: US Army Corps of Engineers (USACE), South Carolina Department of Health and Environmental Control (SCDHEC), the South Carolina State Park Service, and Spartanburg County. The authority of these institutions varies, depending on property ownership; for example, the USACE has no authority to implement LUCs on private property. Additional agencies may become relevant for the institutional controls to work. These agencies will also be evaluated.

4.0 SELECTION CRITERIA

4.0.1 A list of agencies, individuals, and organizations were selected based on relevance to the institutional control process. A set of criteria was used in the selection of agencies. For each institution selected for review, the following information will be gathered:

- Agency name;
- Origin of institution;
- Basis of Authority;
- Sunset Provisions (refers to the periodic review of government agencies in order to continue their existence);
- Geographic jurisdiction;
- The limits of the agency's authority;
- Public safety function;
- Land use control function;
- Financial capability (in general terms only, not detailed accounting);
- Desire to participate in the institutional control program; and
- Constraints to Institutional Effectiveness.

5.0 ACCEPTANCE OF JOINT RESPONSIBILITY

5.0.1 All parties would need to accept some level of responsibility for institutional controls to remain viable.

6.0 TECHNICAL CAPABILITY

6.0.1 The South Carolina Parks Department and Spartanburg County have the ability to limit access and provide awareness to residents, visitors, and employees that work within the boundaries of the former Camp Croft. These controls require limited technical capability.

7.0 INTERGOVERNMENTAL RELATIONSHIPS

7.0.1 Intergovernmental relationships exist between SCDHEC, the South Carolina Parks Department, CESAC, and Spartanburg County.

8.0 STABILITY

8.0.1 The USACE, SCDHEC, the South Carolina Parks Department, and Spartanburg County are government entities and, hence, are expected to be the most stable type of organizations.

9.0 FUNDING SOURCES

9.0.1 The Defense Environmental Restoration Account (DERA) funds the FUDS program. The funding is programmed annually with congressional appropriations. Programming is also reviewed annually and can be modified if necessary.

10.0 RECOMMENDATIONS

10.0.1 A Feasibility Study (FS) is necessary to develop and analyze munitions response alternatives, including Institutional Controls, at the former Camp Croft. The FS will be a stand-alone document.

11.0 INSTITUTIONAL CONTROL ALTERNATIVES ANALYSIS

11.0.1 Managing risks related to MEC hazards can be accomplished through MEC removal actions, access control, public education, or a combination of these strategies. Three causative factors to avoid and understand that help prevent any MEC-related accidents:

- Presence of MEC;
- Access to MEC; and
- Behavior with MEC.

11.0.2 If there is no MEC on a site there is no possibility for a MEC-related accident, and conversely if there is MEC present and public access, there is the risk of a MEC-related accident. If site access is restricted and people are educated about the risk, the chance of a MEC-related accident can be reduced. Institutional Control Alternatives and recommendations presented in this report are based on the assumption that public access at the former Camp Croft site will be unrestricted.

11.1 INSTITUTIONAL CONTROL ALTERNATIVES

There are many ways to protect the public from MEC-related accidents. Institutional controls protect the public and other personnel with little to no impact on day-to-day activities. The following sections briefly describe actions and controls that may be considered for the former Camp Croft site.

11.1.1 Warning Signs

Warning signs are an effective way to inform personnel of the hazards in the area. They can also keep unauthorized personnel from entering a hazardous area. Warning signs should be placed on the outer boundary of the site warning the public of the possible danger if they come closer to the site, and the appropriate actions to take if a suspected munitions item is encountered.

11.1.2 Educational Programs

The use of educational programs is an effective means of reducing risk from public exposure to MEC. Education can be tailored to meet site-specific needs. Examples of educational programs include public notices and formal education sessions. Educating the local community is an important aspect of any institutional control program. Public awareness of the hazards associated with a site will encourage the public to take the necessary precautions to avoid exposure. Educational programs may be audience specific and can be performed as often as necessary to educate those with the greatest risk for exposure to MEC (e.g., construction

personnel). Educational efforts can be a stand-alone institutional control, but can also improve the effectiveness of other controls.

11.1.2.1 Public Notices

The local community can be educated through implementation of a public-notice campaign that may include mailings of informational pamphlets, installation of display cases, public service announcements, or recurrent notices in local newspapers. These educational media can serve to educate the local community and visitors to the area. The following paragraphs provide details concerning various types of public notices that can be used to educate and inform local communities.

11.1.2.2 Community Awareness Meetings

Community awareness meetings are normally held when significant site-specific documents are released to the public and provide information regarding:

- How site-specific information was evaluated in the RI and FS reports;
- MEC previously recovered at the site;
- Options available to remove MEC (if required) and enhance public safety; and
- Recommendations being made to address a particular site.

11.1.2.3 Letter Notifications, Informational Pamphlets, and Fact Sheets

Letter notifications (US certified mail) are an effective means of informing property owners of the results of the RI and FS investigations and the types of MEC that have been found. Letter notifications can be mailed to each landowner/resident within or adjacent to a MEC site to inform them of the investigation results and the proposed recommendations for the area. Informational pamphlets and fact sheets can be developed and distributed to support safety briefings and/or speaking engagements and can be effective as stand-alone educational materials. Informational pamphlets and fact sheets can warn the public of the hazards of MEC and provide information relating to the former military operations that occurred at a site. Informational pamphlets and fact sheets can be mailed to property owners/lessees in the vicinity of an MEC site and be included with seasonal hunting schedules and permits issued by the USFS. Effective pamphlets or fact sheets contain photographs and/or drawings of typical MEC items that the public might encounter and previously recovered MEC locations on a map, and the expected response/safety guidance. A telephone number for the appropriate local authority should be included in the informational pamphlet or fact sheet.

11.1.2.4 Formal Education Sessions

Formal education sessions may include community education classes. The classes can be given to a variety of audiences including public forums, local government, emergency response personnel, property owners, and construction personnel. The training sessions can be tailored to meet the specific interests/concerns of the audience, and can be an effective method to communicate the nature and extent of the hazards associated with MEC and the precautions to be taken in the event a person comes into contact with MEC. The training sessions may either be provided live by personnel knowledgeable in the site-specific conditions or through the distribution of MEC safety awareness training pamphlets or videos to local organizations and public libraries. To be effective, educational sessions need to be recurrent (e.g., every six months) so the public does not become complacent about the hazards associated with MEC.

Formal education sessions that are consistently performed are also successful in educating new homeowners and visitors to the area.

11.1.3 Zoning Restrictions

Zoning restrictions are primarily legal mechanisms imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. Legal mechanisms may include restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions. All of these measures would require the cooperation of, and coordination with the landowner.

11.1.4 Fencing and Barriers Combined with Trespass Law Enforcement

Direct intervention like fencing and other barriers combined with trespass law enforcement are the most effective way to keep unauthorized personnel from entering a hazardous area. These physical and legal mechanisms are imposed to ensure the continued effectiveness of land use restrictions imposed as part of a remedial decision. All of these measures would require the cooperation of, and coordination with the landowner.

11.2 COST

11.2.1 The cost for each of these institutional controls can vary greatly. The cost analysis of the proposed institutional controls will be provided in detail in the FS report.

12.0 RESIDUAL RISK

12.1 EDUCATIONAL CONTROLS

12.1.1 The use of educational controls is usually a good strategy to manage and reduce residual risk from public exposure to MEC. An educational program may take on many forms and be easily tailored to meet the specific needs of a site and the surrounding community. Examples of educational programs include formal education seminars and public notices (EP 1110-1-24).

12.1.2 Generally, if people are aware of and understand the hazards associated with a MEC-contaminated site, they will take the necessary precautions to avoid exposure. Educational programs can be tailored to meet the specific needs of a particular audience (e.g., local homeowners, school children, regulators, developers, etc.) and can be performed as often as necessary to educate those that are at greatest risk for exposure to MEC. Educational efforts constitute a stand-alone institutional control, but can also improve the effectiveness of other controls that are part of the overall program (EP 1110-1-24).

13.0 ROLES, RESPONSIBILITIES AND AUTHORITIES FOR INSTITUTIONAL CONTROLS

13.0.1 Several agencies and/or organizations would have a role in institutional control alternatives that might be implemented at the former Camp Croft site. Table 1 depicts the control alternative, management role, execution role, and MEC risk reduction if selected as the appropriate alternative for any of the MRS' within the former Camp Croft site. The potential roles, responsibilities, and authorities that each organization will have in implementing, maintaining, monitoring, and enforcing institutional controls are provided in Table 2. Legal,

administrative, and engineering controls are not likely to be implemented as the sole institutional control option. As part of the analysis, stakeholders were contacted to determine their willingness and capability to participate in implementation of institutional controls, if selected; Table 3a provides a summary of efforts to correspond with stakeholders through the date of the draft Remedial Investigation. This table was completed based on interviews, concurrent with finalizing the FS document. As a result, each agency's willingness and capability to implement institutional controls, based on interview responses is outlined in Table 3b.

TABLE 1 – INSTITUTIONAL CONTROLS ALTERNATIVES ANALYSIS

Control Alternative	Management Role	Execution Role	MEC Risk Reduction
Barriers/Fencing with Enforcement	USACE	TBD	Highly effective at minimizing exposure to potential MEC.
Zoning Restrictions	USACE	TBD	Moderately effective.
Installation & Maintenance of Warning Signs	USACE	TBD	Moderately effective.
Appropriate land uses by landowner	USACE	TBD	Moderately effective.
Notices attached to permits	USACE	TBD	Highly effective.
Educational Programs	USACE	TBD	Highly effective.

TABLE 2 – ROLES, RESPONSIBILITIES AND AUTHORITIES FOR IMPLEMENTATION OF INSTITUTIONAL CONTROL

Agency/ Institution	Role	Responsibility	Authority
USACE	Represents federal government in execution, oversight, and procurement of munitions response actions at former Camp Croft.	• Initiate the Decision Document • Inspect condition of signage • Report new discoveries of MEC to SCDHEC • Disseminate information and instructional pamphlets at meetings •	• Fund MEC response actions • Perform MEC investigations and munitions response actions
SCDHEC	SCDHEC represents the state government agency conducting regulatory oversight of munitions response actions at the former Camp Croft	• To protect human health and the environment. • Responds to releases, threats of releases, or discoveries of hazardous substances that present a substantial endangerment to public health or the environment. • Enforcement of environmental laws.	• Applicable South Carolina Code • Review/Comment on Decision Documents • Enforcement of environmental laws
South Carolina Parks Department	Represent issues related to site use for recreational purposes and the impacts of Institutional Controls on these uses.	• Allow installation of signage alerting recreational users and others of the MEC hazards at the site • Participate in Educational Awareness Program • Distribute information to personnel and site visitors	• Institute and enforce controls on site visitors
Spartanburg County	Represents the county government	• Distribute information to county personnel/residence • Participate in Educational Awareness Program	• None

TABLE 3a – SUMMARY OF EFFORTS TO CORRESPOND WITH STAKEHOLDERS

Stakeholder	Point-of-Contact	Willingness to Participate in the Institutional Control Program Communications (email and/or telephone)	Response Received y/n
USACE	Raymond Livermore Raymond.R.Livermore@usace.army.mil (910) 251-4702 69 Darlington Avenue Wilmington, NC 28409		
SCDHEC	Susan Byrd byrdsk@dhec.sc.gov 803-896-4188 (work) Columbia, SC	SCDHEC is supportive of the use of LUCs as a portion of the remedy at Camp Croft. We will assist as our regulations/role allows and will be available to assist with risk communication to the public.	Y
South Carolina Parks Department	John Moon jmoon@scprt.com 864-585-1283 (work) 450 Croft State Park Road Spartanburg, SC 29302		
Spartanburg County	Katherine L O'Neil (County Administrator) (864) 596-2526 koneil@spartanburgcounty.org		
Spartanburg County Sheriff Department	John Dyas (First Lieutenant) 864-503-4502 jdyas@spartanburgcounty.org		Y

TABLE 3b – WILLINGNESS AND CAPABILITY TO IMPLEMENT INSTITUTIONAL CONTROLS

Institutional Control	Willingness					Capability				
	USACE	SCDHEC	South Carolina Parks Department	Spartanburg County	Spartanburg County Sheriff Department	USACE	SCDHEC	South Carolina Parks Department	Spartanburg County	Spartanburg County Sheriff Department
Install Signs	TBD	Yes	TBD	TBD	Yes	TBD	No	TBD	TBD	No
Maintenance of Signs	TBD	Yes	TBD	TBD	Yes	TBD	No	TBD	TBD	Yes
Notify of Missing/Damaged Signs	TBD	Yes	TBD	TBD	Yes	TBD	Yes	TBD	TBD	Yes
Information Sheets attached to Construction Permits	TBD	Yes	TBD	TBD	Yes	TBD	Yes	TBD	TBD	No
Issuance of Land Use Permits	TBD	Yes	TBD	TBD	Yes	TBD	No	TBD	TBD	No
Provide Fact Sheets to workers	TBD	Yes	TBD	TBD	Yes	TBD	No	TBD	TBD	No
Installation of Fencing	TBD	Yes	TBD	TBD	Yes	TBD	No	TBD	TBD	Yes
Enforce Zoning	TBD	Yes	TBD	TBD	Yes	TBD	No	TBD	TBD	No

Note: TBD – To be determined

ATTACHMENT A
INDIVIDUAL INSTITUTIONAL ANALYSES

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Name of Agency: US Army Corps of Engineers (USACE)

Origin of Institution: The US Army Corps of Engineers (USACE) was established in 1775 under the Continental Congress for military and civil works missions.

Basis of Authority: Defense Environmental Restoration Program (DERP) [10 USC Section 2701 et seq.], Executive Order 12580 - Implementing response actions for releases of hazardous substances from each facility that is, or was, under the jurisdiction of the U.S. Department of Defense (DoD) in accordance with DERP and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

Sunset Provisions: None

Geographic Jurisdiction: CESAC area of responsibility that encompasses South Carolina with the exception of the Savannah River Watershed.

Public Safety Function: Responsible for following CERCLA in the execution of the DERP-FUDS program in its area of responsibility. Implements response actions for releases of hazardous substances from Formerly Used Defense Sites were under the jurisdiction of the DoD in accordance with DERP and CERCLA.

Land Use Control Function: Not an agency mission for private property, although they can perform real estate services for the military and civil works activities of the Army and Air Force, and for other federal agencies as requested.

Financial Capability: Defense Environmental Restoration Account (DERA) for environmental restoration activities at non-National Priorities List (NPL) sites, such as Lake Bryant BGR. DoD and State Memorandum of Agreement (DSMOA) to fund states in identifying, prioritizing, investigating, and remediating FUDS in their states.

Desire to participate:

Constraints on institutional effectiveness: USACE has minimal control relative to implementing, maintaining, monitoring, or enforcing institutional controls on privately owned property.

Name of Agency: South Carolina Department of Health and Environmental Control (SCDHEC)

Origin of Institution: State lawmakers created South Carolina's first State Board of Health in 1878, after a series of yellow fever outbreaks killed 20,000 Americans. In 1950, fish kills and streams polluted with sewage and industrial waste prompted lawmakers to add a Water Pollution Control Authority Board to the State Board of Health. When air pollution control was added in 1965, the environmental arm was renamed the Pollution Control Authority. After a short-lived organizational split in 1970, the Pollution Control Authority and the State Board of Health were reunited in 1973 to form DHEC.

Basis of Authority: Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). CFR40: "Protection of the Environment", Chapter I, Parts 1-799-Environmental Protection Agency.

Sunset Provisions: None

Geographic Jurisdiction: State of South Carolina.

Public Safety Function: SCDHEC regulates other federal agencies, state and local governments. It develops and enforces regulations to protect human health and the environment under existing environmental laws.

Land Use Control Function: N/A

Financial Capability: Defense Environmental Restoration Account (DERA) for environmental restoration activities at non-National Priorities List (NPL) sites, such as the former Camp Croft.

Desire to participate: SCDHEC is supportive of the use of LUC's as a portion of the remedy at Camp Croft. They are willing to assist as regulations/roles allow and are available to assist with risk communication to the public.

Constraints on institutional effectiveness: Has responsibility, but not local authority, for implementing, maintaining, monitoring, and enforcing institutional controls at the former Camp Croft.

Agency: South Carolina State Park Service

Origin of Institution: In 1967, the General Assembly passed legislation creating the Department of Parks, Recreation and Tourism (PRT), governed by the PRT Commission, whose primary functions were to promote tourism in the state, operate the state parks system, and assist local governments in the development of recreation facilities and programs.

Basis of Authority: South Carolina Constitution and the South Carolina Code of Laws Title 51 - Parks, Recreation and Tourism.

Sunset Provisions: None

Geographic Jurisdiction: State of South Carolina.

Public Safety Function: Law enforcement and emergency services.

Land Use Control Function: Only within the applicable regulatory framework.

Financial Capability: TBD

Desire to participate: TBD

Constraints on institutional effectiveness: TBD

Agency: Spartanburg County, South Carolina

Origin of Institution: "Spartan District" was created in 1785, from Ninety-Six District. In 1791, at the request of the citizens the legislature renamed the same place Spartanburg District (county) in honor of the district/county seat. In 1868, all districts including Spartanburg were renamed counties.

Basis of Authority: CODE County of SPARTANBURG, SOUTH CAROLINA Codified through Ordinance No. O-12-13, adopted April 16, 2012. (Supp. No. 18)

Sunset Provisions: None

Geographic Jurisdiction: Spartanburg County, SC.

Public Safety Function: Law enforcement and emergency services.

Land Use Control Function: Only within the applicable regulatory framework.

Financial Capability: TBD

Desire to participate: TBD

Constraints on institutional effectiveness: TBD

Agency: Spartanburg County Sheriff Department, South Carolina

Origin of Institution: "Spartan District" was created in 1785, from Ninety-Six District. June of 1785 Mr. William Young was appointed the first Sheriff of Spartanburg County. There have been forty Sheriffs in Spartanburg County since Mr. Young was appointed as the first Sheriff.

Basis of Authority: Law Enforcement for Spartanburg County, South Carolina.

Sunset Provisions: None

Geographic Jurisdiction: Spartanburg County, SC.

Public Safety Function: Law enforcement and emergency services.

Land Use Control Function: Only within the applicable regulatory framework.

Financial Capability: TBD

Desire to participate: Spartanburg County Sheriff's office is willing to maintain installed signed. They are also willing to provide fact sheets to workers, install fencing and enforce zoning.

Constraints on institutional effectiveness: TBD

REFERENCES

http://www.sac.usace.army.mil/

http://www.scdhec.gov/

http://www.spartanburgcounty.org/

http://www.southcarolinaparks.com/

http://www.scprt.com/

http://www.spartanburgsheriff.org/

USACE, 2010. Institutional Analysis and Institutional Control Plan. DID WERS-017.01. 28 April 2010.

APPENDIX C

DOCUMENT REVIEW COMMENTS

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Response to Comments Review (77882)

(history of open issues)

Title of Original Document Reviewed

Draft Final - Feasibility Study Report, ITRC Ranges, FUDS MMRP Project No. I04SC001603, Spartanburg, Spartanburg County, SC.

Reviewer / Discipline Brewer, Garry / Office of Counsel

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-GLB-1	Significant	For overall protectiveness the Alternatives are ranked from "Relatively Low to none" all the way to "Relatively High". However, as a threshold criteria protectiveness is not graded; a remedy is either protective or it is not. It cannot be determined from the Table if all or none of the Alternatives are protective. For example, Alternative 1 has a protectiveness of "Relatively low to none" which means it could be protective or might not be. Alternative 2 is rated "Relatively Moderate to "Relatively Low to none". Based on that scale, it cannot be determined if Alt 2 is protective.	Change the Table to clearly indicate if an alternative is protective or not protective.	Concur. In Table 5-2, Overall Protectiveness of Human Health and the Environment evaluation has been revised to note whether the alternative is protective or not protective.
Review Cycle: 2 UID: 77882-GLB-1	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Reviewer / Discipline Sikes, John / MEC Response

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-1	Observation	For District action: Review and update FUDSMIS Property level "Comments" tab.		Concur. The District has been closely involved with the development of the proposed MRSs and has communicated to the project PDT that updates to FUDSMIS are imminent. The Contractor will support those efforts, where necessary.

Review Cycle: 2 UID: 77882-JAS-1	Resolved	Issue Resolved	**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-2	Significant	The background paragraph discusses the impact areas as being 16,929 acres. However, under project 03 in FUDSMIS the MRS acreage is only 12,337 acres.	Correct the text, or response from district needs to indicate how the MRS acreage increased and provide supporting evidence for the increase.	Concur. Section 1.1.1 was revised to reference generalities about the former Camp Croft. However, CESAS has notified the Contractor that RI findings (e.g., delineation, and proposed MRSs) and associated updates to FUDSMIS are imminent.
Review Cycle: 2 UID: 77882-JAS-2	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-3	Significant	The key to this exhibit lists different areas by former use and also includes two named MRS's; MRS 1 and MRS 2. Going back to Dwayne Ford's comment on the RI report regarding the initiation of the delineation process (I see RTC to his comment simply said "noted"), what work has been done to date to delineate the MRA into multiple MRS's? The second significant concern here is the total acreage. The areas shown here by my calculation add up to 13250.7 acres, which is neither consistent with previous paragraphs listing acreage at 16K, nor with FUDSMIS at 12337 acres. It is critical that all the acreage be consistent and it add up to the reported MRA/property acres. This needs to be clear going forward beginning with this FS.	District needs to respond with how they intend and when they intend to begin/complete the delineation process. This preferably should be done prior to the PP, but must be done prior to drafting of the decision document(s).	Concur. The District has been closely involved with the development of the proposed MRSs and has communicated to the project PDT that updates to FUDSMIS are imminent. The Contractor will support those efforts, where necessary. Section 1.2.3 has been expanded, to incorporate more detail about the initial acreages, remedial investigation acreages, and the proposed MRS acreages at the conclusion of the Final RI report.
Review Cycle: 2 UID: 77882-JAS-3	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-4	Observation	Not clear to me in line 6 what you are referring to by "former" MRS 3; I don't see that area listed on the previous Exhibit 1.	Recommend clarifying where this area is, or correct the name here. According to FUDSMIS there is still only a single MRS.	Concur. The reference to MRS 3 in Section 1.2.1.2 was removed; it provided little value. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS. Exhibit 1-1 was moved, to follow Section 1.2.3.1.
Review Cycle: 2 UID: 77882-JAS-4	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-5	Observation	This statement needs to be consistent with the revision made to section 5.0 of the RI in response to Dwayne Ford's RI review comment. The RI revision states "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." The RI and the FS need to address the entire acreage and be clear on the data used to support decisions for each proposed MRS.	Make language consistent between RI and FS.	Concur. Section 1.2.3.2 (formerly 1.2.3.1) was revised to make limited access area language between the RI and FS more consistent.
Review Cycle: 2 UID: 77882-JAS-5	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-JAS-6	Observation	Paragraph currently discusses areas from the RI but I have seen no link between those names and the proposed MRS's listed in exhibit 1 above.	Recommend a table showing how the areas listed in the RI correlate to the proposed MRS's.	Concur. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS. Exhibit 1-1 was moved, to follow Section 1.2.3.1.
Review Cycle: 2 UID: 77882-JAS-6	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-9	Observation	The discussion of 3 MRS's is not technically correct, even though it may be terminology you used in the RI report. In 2014, a realignment action was taken to combine two areas into a single MRA/MRS of 12K+ acre MRS currently shown in FUDSMIS. The language used in these reports must be consistent with what we are reporting to Congress through FUDSMIS. At some point in this FS, you will have to clarify (best way might be a table) what the official MRS name and acreage in FUDSMIS was when you started the RI and what your proposed MRS's and acres are now. This is why Dwayne Ford commented last year that the delineation process should be initiated sooner than later. It is already getting confusing.	Clarify.	Concur. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS.
Review Cycle: 2 UID: 77882-JAS-9	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-JAS-10	Observation	Once the site is delineated, this text can be rewritten to be easily understood. Again recommend a table and a map(s) that cross-references all reported names of the different areas, concluding with what the proposed MRS name will be.	Include table and maps to show relationships of area by name.	Concur. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS. The headings in the in-line table below Section 1.2.3.3 have been revised to show pre-RI designation and acreages, along with revised (proposed) designations and acreages.
Review Cycle: 2 UID: 77882-JAS-10	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-JAS-11	Significant	Up to this point I was concerned that the single stated RAO was incomplete and too generic (paragraph 1.3), which it is. However, the discussion in this section on PRG's actually contains almost all the RAO information. See Melissa Milner comment on RAO's/PRG's. PRG's are typically applicable to HTRW projects and not standard practice for MMRP responses to MEC. The PRG discussion should be deleted and simply moved/presented as the RAO discussion. This information and the way it is written is one of the better ones I have seen, well done. The only addition to be made to complete the RAO then is define in the RAO the probability level once remediation is done and RC can be supported. Using your text: "The PRG for the 105mm Area is to reduce the potential for human interaction with UXO during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs." The question is "reduce" to what level? In order to claim success this need to be defined. The following is a generic RAO sample from guidance currently under development. “The Remedial Action Objective is to reduce the unacceptable hazard probability of [define specific munitions contributing to the explosive hazard] within [specified horizontal boundary] to a depth of [defined depth] below surface to address likelihood of exposure to [receptors] via [pathway] such that a [define reduced probability level, (low or negligible?)] hazard determination and response complete (RC) can be supported.”	Recommend the PRG(s) all be changed to RAOs and the probability level be defined, for example: "The RAO for the XX acre 105mm Area is to reduce the unacceptable hazard probability for human interaction with 105MM projectiles during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low (or negligible, unlikely-PDT define) hazard determination and response complete (RC) can be supported."	Concur. The RAOs have been revised in Section 3.1.7 (formerly 3.1.6) to include a probability level, per the recommendation from sample guidance currently under development.
Review Cycle: 2 UID: 77882-JAS-11	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-JAS-12	Observation	Is the phrase "as dictated by the depth of MEC detection…" correct or intended? Maybe I'm reading it incorrectly, but the capabilities of the instrument does not dictate the depth of the remediation. If our RAO is to protect to 4 feet for example, but instruments can only detect to 2 feet, that doesn't mean we only go to 2 feet. It means that we need to consider the limitation of the instrument, then develop a process to remediate to 4 feet.	Consider clarifying the sentence.	Concur. The first sentence of Section 3.2.4.1 has been revised, as follows: "3.2.4.1 This alternative involves all activities necessary to locate, excavate, and remove potential MEC and/or MD to a depth conducive to the future land use and overall health and safety of the affected community."
Review Cycle: 2 UID: 77882-JAS-12	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-JAS-13	Observation	Caveat: I am not a geophysicist. I like the concept and layout and believe it can be very useful. However a couple things cause me to question some of the general logic, and I believe the table could be made better. The screening comments don't seem to have a direct connection to the indiviudal ratings provided. For the first two rows, why exactly is one "difficult" and the other "easy" to implement? Is it based on industry familiarity? Row 3 for frequency domain EMI Metal Detectors. If this does not create a permanent record of geophysical data, should this technology still pass the cut? DoD and EPA have agreed in principle that geo data must be digitally recorded and georeferenced to the maximum extent practical. If the indiviudal EM or magnetic sensors is "Fair" and the dual sensor systems are "Good", why didn't the dual systems make the cut? For the Flux Gate Magnetometers, it states that it only detects ferrous objects. Are there non-ferrous targets of interest at all of these MRS's that would eliminate this instrument from passing the cut? Bottom line, seems to me that the reason for each rating should be proivded and consistent for each screening comment to allow for the reader to better understand the differences. For those that don't pass the cut line the reason it doesn't pass needs to be clear. Finally, it would benefit the table ifthe ratings were somehow linked to the RAO, and to specific MRS's physical characteristics (i.e., is a specfic MRS too wooded to use a particular instrument/configuration).	Consider if there are ways to beef up the supporting text for individual ratings relative to specific MRS's and their RAO's (previously documented as PRG's).	Table 3-2 was revised to provide more comprehensive information, which was modeled after information provided in Interim Guidance Document 14-01 (which provides EM 200-1-15) and the US Army MMRP Munitions Response Remedial Investigation / Feasibility Study Guidance dated November 2009.
Review Cycle: 2 UID: 77882-JAS-13	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-14	Observation	For all non-UU/UE alternatives, remove "Five-Year Review" from the altenrative title. 5YRs are not an alternative or part of one, they are done because the alternative cannot not achieve UU/UE. Any text needs to make that simple clarification.	Delete "Five-Year Review" from all alternative titles and clarify associated text if necessary.	Concur. The term "/Five-Year Review" has been cleaned up, throughout the document.
Review Cycle: 2 UID: 77882-JAS-14	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-16	Observation	I'm identifying this concern here, but it applies to the entire document as it is laid out to this point. Because, proposing multiple MRS's be delineated as a result of the RI, the FS needs to be organized so it is obvious that each MRS has been evaluated based on its own merits. The FS must clearly identify the RAO for each MRS (which was done through the PRG/RAO text and previous comment on this topic). Then, the rest of the alternatives development, screening and detialed evalution processes should be applied to each MRS. Currently, there is one list of 13 generic alternatives that are generically applied to all proposed MRSs.	If the project is being delineated as proposed, this document needs to address clearly each MRS relative to its site conditions, land use, receptors, alternatives development and screening, etc.	Estimated costs were derived using a "generic" site, similar to those found at the former Camp Croft. For alternatives that were retained, those generic costs were extrapolated to each of the proposed MRSs to determine a rough cost estimate that is more in line with each individual proposed MRS. The FS cost estimates were calculated to be within -30 to +50% which is in accordance with EPA guidance.
Review Cycle: 2 UID: 77882-JAS-16	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-JAS-17	Significant	This paragraph and Table 4-1 need additional information in order to adequately support why some pass the screening process and why some don't. Two things; there is no current text that explains specifically why an alternative was screened out, and there is no cost shown. There must be a rough order of magnitude cost number provided for each alternative being screened. In this paragraph or in the table (preferred) add some explanation in the last column or add a new column to include specific reasons why an alternative was kept or not, and add rough order cost estimate for each alternative being screened. If the analog surface and subsurface alternative made it, I'm wondering why the DGM surface and subsurface alternative did not.	Add discussion to the text or table as suggested in the comment.	Concur. Table 4-1 has been revised to provide additional cost information (a rough order of magnitude) and justification for alternatives not retained.
Review Cycle: 2 UID: 77882-JAS-17	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review Cycle: 1 UID: 77666-JAS-18	Observation	Delete the last sentence which currently states: "However, it will have some overall protectiveness at all of the MRSs." Add a clear statement that the alternative is protective. IN general, the text for the entire evaluation fo the LUC alternative is very vague and seems to caveat everything……it would "generally modify behavior" , access restrictions "may" be effective, education might work ir people are willing to follow the advice, this alternative will support risk reduction in a "general sense". All this language makes me question why it passed the screening process or that passes the threshhold criterion of protectiveness. It almost reads like we are trying to convince the decision maker not to choose this alternative. The text should be stronger leading to a direct statement that this alternative is proetective (not "some overall protectiveness"). I will defer to our regulatory specialist and Office of Counsel on this concern.	Recommend stronger language that describes how this alternative is protective.	Concur. §5.2.2.2.3 has been revised to emphasize protectiveness of the alternative.
Review Cycle: 2 UID: 77882-JAS-18	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Reviewer / Discipline Milner, Melissa L. / Compliance

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-MLK-1	Significant	There is a distinct difference between RAOs and PRGs which needs to be called out. The information presented in this document appears to have the two terms confused. PRGs are general in nature. They are developed to eliminate technologies, and prior to looking at any remedies. PRGs are based upon baseline risk assessment and ARARs, and current/future site conditions and land use. PRGs are combined together to develop RAOs. For example, a PRG would be: Clean up groundwater to MCLs. Or: Reduce potentail explosive hazards by preventing residents, landowners, workers,.....from contacting MEC. RAOs-The text states that "RAOs are intended to be as specific as possible but not so specific that the range of alternatives that can be developed is excessively limited." TAOs are much more specific and detailed than PRGs. RAOs are in essence what the remedy has to accomplish to protect human health and environment and reduce risk in each media. Further, RAOs should: identify contaminants of concern, identify exposure routes and receptors, and identify acceptable contaminant levels. The RAO is USACE's exit strategy for that site. An example RAO is, "Prevent human ingestion of groundwater with benzene concentrations exceeding 5 ppb." Potential RAO for UXO-Prevent human dermal contact with UXO in residential areas to a depth of three feet bgs at 60 mm Mortar area, 105mm Area, etc.	Revise the RAO to be more specific. Likely the "PRGs" in this document are actually RAOs.	Concur. The usage of those terms has been revised, per this and others' comments. Additionally, RAOs have been revised to add more specificity.
Review Cycle: 2 UID: 77882-MLK-1	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review

Review Cycle: 1 UID: 77666-MLK-2	Significant	Document states that the FS does not select an alternative….that selection will be made by stakeholders following a review of the FS. This is incongruent with DoD policy, because following the detailed analysis of alternatives in an FS a final remedy is recommended. Further, at DoD sites, DoD recommends the final remedy; since this FUDS site is likely not an NPL site, DoD does not even require EPA or State concurrence on the remedy.	Revise this section	EMCX - No Response Found/Required
Review Cycle: 2 UID: 77882-MLK-2	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

Review - Comment ID	Type/Status	EMCX Review Comment	EMCX Review Recomendation	Response to EMCX Review
Review Cycle: 1 UID: 77666-MLK-3	Significant	ARARs-In essence there are not ARARs listed for this site. Was there a table in this document where potential ARARs were evaluated, but then ruled out? This reviewer couldn't find such a table. Has the State been afforded the opportunity to submit ARARs in accordance with public participation responsibilities (40 CFR 300.515(g)(2))? Has the RCRA Military Muntions Rule (40 CFR 266, Subpart M) that applies to FUDS for most purposes as an ARAR been considered? How was this rule determined to not be an ARAR. What about RCRA Subpart X? Text states, "Further refinement of ARARs will be accomplished through the CERCLA process, if necessary." Ensure that ALL ARARs are included during the FS; that list is refined; but the Final list of Key ARARs is presented in the DD, and ARARs are frozen at that point. Key to this: no NEW ARARs are added at the DD stage….they should have been considered and listed during the FS.	Include a table that explains potential ARARs and how they are not applicable. Rework the last sentence in lines 16-17	In coordination with the PDT (including South Carolina DHEC) and under advisement from CX Office of Counsel, ARARs were eliminated during the finalization of the Remedial Investigation report. Section 3.1.4 (formerly Section 3.1.3) has been revised to reference the ARAR evaluation process conducted during the RI phase. The Contractor has been advised by the CX Office of Counsel that RCRA Military Rule (40 CFR 266, Subpart M) provides a definition of solid waste but, is not considered an ARAR. Section 3.1.4.5 (formerly Section 3.1.3.5) has been revised to strengthen the intend to avoid use of consolidated shots during future site removal actions, thus negating RCRA Subpart X as an ARAR. Section 3.1.4.2 (formerly Section 3.1.3.2) has been revised to more clearly explain the how and when ARARs are identified and refined during the CERCLA process.
Review Cycle: 2 UID: 77882-MLK-3	Resolved	Issue Resolved		**RESOLVED issues do not require a response.**

77666 : Draft Final - Feasibility Study Report, ITRC Ranges, FUDS MMRP Project No. I04SC001603, Spartanburg, Spartanburg County, SC.

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-MLK-1	Significant	No	3.1.2 and 3.1.6			Milner, Melissa L.	Compliance

Comment: There is a distinct difference between RAOs and PRGs which needs to be called out. The information presented in this document appears to have the two terms confused.

PRGs are general in nature. They are developed to eliminate technologies, and prior to looking at any remedies. PRGs are based upon baseline risk assessment and ARARs, and current/future site conditions and land use. PRGs are combined together to develop RAOs. For example, a PRG would be: Clean up groundwater to MCLs. Or: Reduce potentail explosive hazards by preventing residents, landowners, workers,…..from contacting MEC.

RAOs-The text states that "RAOs are intended to be as specific as possible but not so specific that the range of alternatives that can be developed is excessively limited." TAOs are much more specific and detailed than PRGs. RAOs are in essence what the remedy has to accomplish to protect human health and environment and reduce risk in each media. Further, RAOs should: identify contaminants of concern, identify exposure routes and receptors, and identify acceptable contaminant levels. The RAO is USACE's exit strategy for that site. An example RAO is, "Prevent human ingestion of groundwater with benzene concentrations exceeding 5 ppb."

Potential RAO for UXO-Prevent human dermal contact with UXO in residential areas to a depth of three feet bgs at 60 mm Mortar area, 105mm Area, etc.

Recommendation: Revise the RAO to be more specific. Likely the "PRGs" in this document are actually RAOs.

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-MLK-3	Significant	No	3.1.3			Milner, Melissa L.	Compliance

Comment: ARARs-In essence there are not ARARs listed for this site. Was there a table in this document where potential ARARs were evaluated, but then ruled out? This reviewer couldn't find such a table. Has the State been afforded the opportunity to submit ARARs in accordance with public participation responsibilities (40 CFR 300.515(g)(2))? Has the RCRA Military Muntions Rule (40 CFR 266, Subpart M) that applies to FUDS for most purposes as an ARAR been considered? How was this rule determined to not be an ARAR. What about RCRA Subpart X?

Text states, "Further refinement of ARARs will be accomplished through the CERCLA process, if necessary." Ensure that ALL ARARs are included during the FS; that list is refined; but the Final list of Key ARARs is presented in the DD, and ARARs are frozen at that point. Key to this: no NEW ARARs are added at the DD stage….they should have been considered and listed during the FS.

Recommendation: Include a table that explains potential ARARs and how they are not applicable. Rework the last sentence in lines 16-17

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-2	Significant	No	1.1	1-1		Sikes, John	MEC Response

Comment: The background paragraph discusses the impact areas as being 16,929 acres. However, under project 03 in FUDSMIS the MRS acreage is only 12,337 acres.

Recommendation: Correct the text, or response from district needs to indicate how the MRS acreage increased and provide supporting evidence for the increase.

Citation:

Ref. Docs:

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-3	Significant	No	Exhibit 1-1	1-2		Sikes, John	MEC Response

Comment: The key to this exhibit lists different areas by former use and also includes two named MRS's; MRS 1 and MRS 2. Going back to Dwayne Ford's comment on the RI report regarding the initiation of the delineation process (I see RTC to his comment simply said "noted"), what work has been done to date to delineate the MRA into multiple MRS's?

The second significant concern here is the total acreage. The areas shown here by my calculation add up to 13250.7 acres, which is neither consistent with previous paragraphs listing acreage at 16K, nor with FUDSMIS at 12337 acres. It is critical that all the acreage be consistent and it add up to the reported MRA/property acres. This needs to be clear going forward beginning with this FS.

Recommendation: District needs to respond with how they intend and when they intend to begin/complete the delineation process. This preferably should be done prior to the PP, but must be done prior to drafting of the decision document(s).

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-11	Significant	No	3.1.6	3-3		Sikes, John	MEC Response

Comment: Up to this point I was concerned that the single stated RAO was incomplete and too generic (paragraph 1.3), which it is. However, the discussion in this section on PRG's actually contains almost all the RAO information.

See Melissa Milner comment on RAO's/PRG's. PRG's are typically applicable to HTRW projects and not standard practice for MMRP responses to MEC. The PRG discussion should be deleted and simply moved/presented as the RAO discussion. This information and the way it is written is one of the better ones I have seen, well done. The only addition to be made to complete the RAO then is define in the RAO the probability level once remediation is done and RC can be supported. Using your text:

"The PRG for the 105mm Area is to reduce the potential for human interaction with UXO during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs."
The question is "reduce" to what level? In order to claim success this need to be defined.

The following is a generic RAO sample from guidance currently under development.
"The Remedial Action Objective is to reduce the unacceptable hazard probability of [define specific munitions contributing to the explosive hazard] within [specified horizontal boundary] to a depth of [defined depth] below surface to address likelihood of exposure to [receptors] via [pathway] such that a [define reduced probability level, (low or negligible?)] hazard determination and response complete (RC) can be supported."

Recommendation: Recommend the PRG(s) all be changed to RAOs and the probability level be defined, for example:

"The RAO for the XX acre 105mm Area is to reduce the unacceptable hazard probability for human interaction with 105MM projectiles during residential activities, which currently includes surface and subsurface use, to a depth of three feet bgs such that a low (or negligible, unlikely-PDT define) hazard determination and response complete (RC) can be supported."

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"
Friday, August 07, 2015

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-17	Significant	No	4.2.4	4-5		Sikes, John	MEC Response

Comment: This paragraph and Table 4-1 need additional information in order to adequately support why some pass the screening process and why some don't. Two things; there is no current text that explains specifically why an alternative was screened out, and there is no cost shown. There must be a rough order of magnitude cost number provided for each alternative being screened.

In this paragraph or in the table (preferred) add some explanation in the last column or add a new column to include specific reasons why an alternative was kept or not, and add rough order cost estimate for each alternative being screened.

If the analog surface and subsurface alternative made it, I'm wondering why the DGM surface and subsurface alternative did not.

Recommendation: Add discussion to the text or table as suggested in the comment.

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-GLB-1	Significant	No	Table 5-2	5-12		Brewer, Garry	Office of Counsel

Comment: For overall protectiveness the Alternatives are ranked from "Relatively Low to none" all the way to "Relatively High". However, as a threshold criteria protectiveness is not graded; a remedy is either protective or it is not. It cannot be determined from the Table if all or none of the Alternatives are protective. For example, Alternative 1 has a protectiveness of "Relatively low to none" which means it could be protective or might not be. Alternative 2 is rated "Relatively Moderate to "Relatively Low to none". Based on that scale, it cannot be determined if Alt 2 is protective.

Recommendation: Change the Table to clearly indicate if an alternative is protective or not protective.

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-1	Observation	No	FUDSMIS			Sikes, John	MEC Response

Comment: For District action: Review and update FUDSMIS Property level "Comments" tab.

Recommendation:

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-4	Observation	No	1.2.1.2	1-3		Sikes, John	MEC Response

Comment: Not clear to me in line 6 what you are referring to by "former" MRS 3; I don't see that area listed on the previous Exhibit 1.

Recommendation: Recommend clarifying where this area is, or correct the name here. According to FUDSMIS there is still only a single MRS.

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-5	Observation	No	1.2.3	1-3	32	Sikes, John	MEC Response

Comment: This statement needs to be consistent with the revision made to section 5.0 of the RI in response to Dwayne Ford's RI review comment. The RI revision states "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."

The RI and the FS need to address the entire acreage and be clear on the data used to support decisions for each proposed MRS.

Recommendation: Make language consistent between RI and FS.

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-6	Observation	No	1.2.3	1-3		Sikes, John	MEC Response

Comment: Paragraph currently discusses areas from the RI but I have seen no link between those names and the proposed MRS's listed in exhibit 1 above.

Recommendation: Recommend a table showing how the areas listed in the RI correlate to the proposed MRS's.

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-9	Observation	No	2.2.1	2-2		Sikes, John	MEC Response

Comment: The discussion of 3 MRS's is not technically correct, even though it may be terminology you used in the RI report. In 2014, a realignment action was taken to combine two areas into a single MRA/MRS of 12K+ acre MRS currently shown in FUDSMIS. The language used in these reports must be consistent with what we are reporting to Congress through FUDSMIS. At some point in this FS, you will have to clarify (best way might be a table) what the official MRS name and acreage in FUDSMIS was when you started the RI and what your proposed MRS's and acres are now. This is why Dwayne Ford commented last year that the delineation process should be initiated sooner than later. It is already getting confusing.

Recommendation: Clarify.

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-10	Observation	No	2.2.5	2-4		Sikes, John	MEC Response

Comment: Once the site is delineated, this text can be rewritten to be easily understood. Again recommend a table and a map(s) that cross-references all reported names of the different areas, concluding with what the proposed MRS name will be.

Recommendation: Include table and maps to show relationships of area by name.

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-12	Observation	No	3.2.4	3-8	4	Sikes, John	MEC Response

Comment: Is the phrase "as dictated by the depth of MEC detection…" correct or intended? Maybe I'm reading it incorrectly, but the capabilities of the instrument does not dictate the depth of the remediation. If our RAO is to protect to 4 feet for example, but instruments can only detect to 2 feet, that doesn't mean we only go to 2 feet. It means that we need to consider the limitation of the instrument, then develop a process to remediate to 4 feet.

Recommendation: Consider clarifying the sentence.

Citation:

Ref. Docs:

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-13	Observation	No	Table 3-2	3-11		Sikes, John	MEC Response

Comment: Caveat: I am not a geophysicist. I like the concept and layout and believe it can be very useful. However a couple things cause me to question some of the general logic, and I believe the table could be made better.

The screening comments don't seem to have a direct connection to the indiviudal ratings provided. For the first two rows, why exactly is one "difficult" and the other "easy" to implement? Is it based on industry familiarity?

Row 3 for frequency domain EMI Metal Detectors. If this does not create a permanent record of geophysical data, should this technology still pass the cut? DoD and EPA have agreed in principle that geo data must be digitally recorded and georeferenced to the maximum extent practical.

If the indiviudal EM or magnetic sensors is "Fair" and the dual sensor systems are "Good", why didn't the dual systems make the cut?

For the Flux Gate Magnetometers, it states that it only detects ferrous objects. Are there non-ferrous targets of interest at all of these MRS's that would eliminate this instrument from passing the cut?

Bottom line, seems to me that the reason for each rating should be proivded and consistent for each screening comment to allow for the reader to better understand the differences. For those that don't pass the cut line the reason it doesn't pass needs to be clear. Finally, it would benefit the table ifthe ratings were somehow linked to the RAO, and to specific MRS's physical characteristics (i.e., is a specfic MRS too wooded to use a particular instrument/configuration).

Recommendation: Consider if there are ways to beef up the supporting text for individual ratings relative to specific MRS's and their RAO's (previously documented as PRG's).

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-14	Observation	No	4.1.2	4-1		Sikes, John	MEC Response

Comment: For all non-UU/UE alternatives, remove "Five-Year Review" from the altenrative title. 5YRs are not an alternative or part of one, they are done because the alternative cannot not achieve UU/UE. Any text needs to make that simple clarification.

Recommendation: Delete "Five-Year Review" from all alternative titles and clarify associated text if necessary.

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-16	Observation	No	4.2			Sikes, John	MEC Response

Comment: I'm identifying this concern here, but it applies to the entire document as it is laid out to this point. Because, proposing multiple MRS's be delineated as a result of the RI, the FS needs to be organized so it is obvious that each MRS has been evaluated based on its own merits. The FS must clearly identify the RAO for each MRS (which was done through the PRG/RAO text and previous comment on this topic). Then, the rest of the alternatives development, screening and detialed evalution processes should be applied to each MRS. Currently, there is one list of 13 generic alternatives that are generically applied to all proposed MRSs.

Recommendation: If the project is being delineated as proposed, this document needs to address clearly each MRS relative to its site conditions, land use, receptors, alternatives development and screening, etc.

Citation:

Ref. Docs:

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-18	Observation	No	5.2.2.2.3			Sikes, John	MEC Response

Comment: Delete the last sentence which currently states: "However, it will have some overall protectiveness at all of the MRSs." Add a clear statement that the alternative is protective.

IN general, the text for the entire evaluation fo the LUC alternative is very vague and seems to caveat everything……it would "generally modify behavior" , access restrictions "may" be effective, education might work ir people are willing to follow the advice, this alternative will support risk reduction in a "general sense". All this language makes me question why it passed the screening process or that passes the threshhold criterion of protectiveness. It almost reads like we are trying to convince the decision maker not to choose this alternative. The text should be stronger leading to a direct statement that this alternative is proetective (not "some overall protectiveness"). I will defer to our regulatory specialist and Office of Counsel on this concern.

Recommendation: Recommend stronger language that describes how this alternative is protective.

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-7	Editorial	No	Table 1-1	1-4		Sikes, John	MEC Response

Comment: Correct footnote to state "no MEC Hazard Assessment" was performed.

Recommendation:

Citation:

Ref. Docs:

-- Always include the "Unique ID" when referencing specific comments

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-8	Editorial	No	1.4.2	1-5	2	Sikes, John	MEC Response

Comment: What is meant by "MEC-impacts MRSs"?

Recommendation:

Citation:

Ref. Docs:

Unique ID	Type	Global	Section	Page	Line	Reviewer	Discipline
77666-JAS-15	Editorial	No	4.1.3.1	4-2	9-10	Sikes, John	MEC Response

Comment: I think there is a typo, sentence currently states: "……the PDT has learned that local property owners would like be resistant to the more…." Should "like" be "likely"?

Recommendation:

Citation:

Ref. Docs:

Note: comments are grouped by type and in the order of "Significant", "Observation" and "Editorial"

Title For Review 77666 : Draft Final - Feasibility Study Report, ITRC Ranges, FUDS MMRP Project
No. I04SC001603, Spartanburg, Spartanburg County, SC.

Please enter a response to each comment in the "Responses" column using plain text =====>>

Please enter your responses below -- the text boxes will automatically expand to hold your input.

UniqueID	Comment_Type	Global_Comment	Section	Page	Line	Reviewer	Discipline	Comment	Recommendation	Citation	Ref_Docs	Response
77666-MLK-1	Significant	No	3.1.2 and 3.1.6			Milner, Melissa L.	Compliance	There is a distinct difference between RAOs and PRGs which needs to be called out. The information presented in this document appears to have the two terms confused.	Revise the RAO to be more specific. Likely the "PRGs" in this document are actually RAOs.			Concur. The usage of those terms has been revised, per this and others' comments. Additionally, RAOs have been revised to add more specificity.
77666-MLK-3	Significant	No	3.1.3			Milner, Melissa L.	Compliance	ARARs-In essence there are not ARARs listed for this site. Was there a table in this document where potential ARARs were evaluated, but then ruled out? This reviewer couldn't find such a table. Has the State been afforded the opportunity to submit ARARs in accordance with public participation	Include a table that explains potential ARARs and how they are not applicable. Rework the last sentence in lines 16-17			In coordination with the PDT (including South Carolina DHEC) and under advisement from CX Office of Counsel, ARARs were eliminated during the finalization of the Remedial Investigation report. Section 3.1.4 (formerly Section 3.1.3) has been revised to reference the ARAR evaluation process
77666-JAS-2	Significant	No	1.1	1-1		Sikes, John	MEC Response	The background paragraph discusses the impact areas as being 16,929 acres. However, under project 03 in FUDSMIS the MRS acreage is only 12,337 acres.	Correct the text, or response from district needs to indicate how the MRS acreage increased and provide supporting evidence for the increase.			Concur. Section 1.1.1 was revised to reference generalities about the former Camp Croft. However, CESAS has notified the Contractor that RI findings (e.g., delineation, and proposed MRSs) and associated updates to FUDSMIS are imminent.
77666-JAS-3	Significant	No	Exhibit 1-1	1-2		Sikes, John	MEC Response	The key to this exhibit lists different areas by former use and also includes two named MRS's; MRS 1 and MRS 2. Going back to Dwayne Ford's comment on the RI report regarding the initiation of the delineation process (I see RTC to his comment simply said "noted"), what work has been done	District needs to respond with how they intend and when they intend to begin/complete the delineation process. This preferably should be done prior to the PP, but must be done prior to drafting of the decision			Concur. The District has been closely involved with the development of the proposed MRSs and has communicated to the project PDT that updates to FUDSMIS are imminent. The Contractor will support those efforts, where necessary.
77666-JAS-11	Significant	No	3.1.6	3-3		Sikes, John	MEC Response	Up to this point I was concerned that the single stated RAO was incomplete and too generic (paragraph 1.3), which it is. However, the discussion in this section on PRG's actually contains almost all the RAO information.	Recommend the PRG(s) all be changed to RAOs and the probability level be defined, for example: "The RAO for the XX acre 105mm Area is to reduce the			Concur. The RAOs have been revised in Section 3.1.7 (formerly 3.1.6) to include a probability level, per the recommendation from sample guidance currently under development.
77666-JAS-17	Significant	No	4.2.4	4-5		Sikes, John	MEC Response	This paragraph and Table 4-1 need additional information in order to adequately support why some pass the screening process and why some don't. Two things; there is no current text that explains specifically why an alternative was screened out, and there is no cost shown. There must be a rough order of magnitude cost number provided for each alternative being screened. In this paragraph or in the table (preferred) add some explanation in the last column or add a new column to include specific reasons why an alternative was kept or not, and add rough order cost estimate for each alternative	Add discussion to the text or table as suggested in the comment.			Concur. Table 4-1 has been revised to provide additional cost information (a rough order of magnitude) and justification for alternatives not retained.
77666-GLB-1	Significant	No	Table 5-2	5-12		Brewer, Garry	Office of Counsel	For overall protectiveness the Alternatives are ranked from "Relatively Low to none" all the way to "Relatively High". However, as a threshold criteria protectiveness is not graded; a remedy is either protective or it is not. It cannot be determined from the Table if all or none of the Alternatives are	Change the Table to clearly indicate if an alternative is protective or not protective.			Concur. In Table 5-2, Overall Protectiveness of Human Health and the Environment evaluation has been revised to note whether the alternative is protective or not protective.
77666-JAS-1	Observation	No	FUDSMIS			Sikes, John	MEC Response	For District action: Review and update FUDSMIS Property level "Comments" tab.				Concur. The District has been closely involved with the development of the proposed MRSs and has communicated to the project PDT that updates to FUDSMIS are imminent. The Contractor will support those efforts, where necessary.
77666-JAS-4	Observation	No	1.2.1.2	1-3		Sikes, John	MEC Response	Not clear to me in line 6 what you are referring to by "former" MRS 3; I don't see that area listed on the previous Exhibit 1.	Recommend clarifying where this area is, or correct the name here. According to FUDSMIS there is still only a single MRS.			Concur. The reference to MRS 3 in Section 1.2.1.2 was removed; it provided little value. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in
77666-JAS-5	Observation	No	1.2.3	1-3	32	Sikes, John	MEC Response	This statement needs to be consistent with the revision made to section 5.0 of the RI in response to Dwayne Ford's RI review comment. The RI revision states "The nature and extent of MEC and MC cannot be directly determined on property that was not investigated; however, in some	Make language consistent between RI and FS.			Concur. Section 1.2.3.2 (formerly 1.2.3.1) was revised to make limited access area language between the RI and FS more consistent.
77666-JAS-6	Observation	No	1.2.3	1-3		Sikes, John	MEC Response	Paragraph currently discusses areas from the RI but I have seen no link between those names and the proposed MRS's listed in exhibit 1 above.	Recommend a table showing how the areas listed in the RI correlate to the proposed MRS's.			Concur. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS. Exhibit 1-1 was moved, to follow
77666-JAS-9	Observation	No	2.2.1	2-2		Sikes, John	MEC Response	The discussion of 3 MRS's is not technically correct, even though it may be terminology you used in the RI report. In 2014, a realignment action was taken to combine two areas into a single MRA/MRS of 12K+ acre MRS currently shown in FUDSMIS. The language used in these reports must be	Clarify.			Concur. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS.
77666-JAS-10	Observation	No	2.2.5	2-4		Sikes, John	MEC Response	Once the site is delineated, this text can be rewritten to be easily understood. Again recommend a table and a map(s) that cross-references all reported names of the different areas, concluding with what the proposed MRS name will be.	Include table and maps to show relationships of area by name.			Concur. Section 1.2.3.1 was greatly expanded, to explain how the single MRA identified in FUDSMIS was investigated during the RI and subsequently delineated into smaller proposed MRSs, which are being updated in FUDSMIS and referenced in the FS. The headings in the in-line table below
77666-JAS-12	Observation	No	3.2.4	3-8	4	Sikes, John	MEC Response	Is the phrase "as dictated by the depth of MEC detection…" correct or intended? Maybe I'm reading it incorrectly, but the capabilities of the instrument does not dictate the depth of the remediation. If our RAO is to protect to 4 feet for example, but instruments can only detect to 2 feet,	Consider clarifying the sentence.			Concur. The first sentence of Section 3.2.4.1 has been revised, as follows: "3.2.4.1 This alternative involves all activities necessary to locate, excavate, and remove potential MEC and/or MD to a depth conducive to the future
77666-JAS-13	Observation	No	Table 3-2	3-11		Sikes, John	MEC Response	Caveat: I am not a geophysicist. I like the concept and layout and believe it can be very useful. However a couple things cause me to question some of the general logic, and I believe the table could be made better.	Consider if there are ways to beef up the supporting text for individual ratings relative to specific MRS's and their RAO's (previously documented as PRG's).			Table 3-2 was revised to provide more comprehensive information, which was modeled after information provided in Interim Guidance Document 14-01 (which provides EM 200-1-15) and the US Army MMRP Munitions Response Remedial Investigation / Feasibility Study Guidance dated
77666-JAS-14	Observation	No	4.1.2	4-1		Sikes, John	MEC Response	For all non-UU/UE alternatives, remove "Five-Year Review" from the altenrative title. 5YRs are not an alternative or part of one, they are done because the alternative cannot not achieve UU/UE. Any text needs to make that simple clarification.	Delete "Five-Year Review" from all alternative titles and clarify associated text if necessary.			Concur. The term "/Five-Year Review" has been cleaned up, throughout the document.
77666-JAS-16	Observation	No	4.2			Sikes, John	MEC Response	I'm identifying this concern here, but it applies to the entire document as it is laid out to this point. Because, proposing multiple MRS's be delineated as a result of the RI, the FS needs to be organized so it is obvious that each MRS has been evaluated based on its own merits. The FS must clearly	If the project is being delineated as proposed, this document needs to address clearly each MRS relative to its site conditions, land use, receptors, alternatives development and screening, etc.			Estimated costs were derived using a "generic" site, similar to those found at the former Camp Croft. For alternatives that were retained, those generic costs were extrapolated to each of the proposed MRSs to determine a rough cost estimate that is more in line with each individual proposed
77666-JAS-18	Observation	No	5.2.2.2.3			Sikes, John	MEC Response	Delete the last sentence which currently states: "However, it will have some overall protectiveness at all of the MRSs." Add a clear statement that the alternative is protective.	Recommend stronger language that describes how this alternative is protective.			Concur. §5.2.2.2.3 has been revised to emphasize protectiveness of the alternative.
77666-JAS-7	Editorial	No	Table 1-1	1-4		Sikes, John	MEC Response	Correct footnote to state "no MEC Hazard Assessment" was performed.				Concur. The footnote for Table 1-1 "…no MEC Hazard Analysis was…" has been revised to "…no MEC Hazard Assessment was…".

77666-JAS-8	Editorial	No	1.4.2	1-5	2	Sikes, John	MEC Response	What is meant by "MEC-impacts MRSs"?	The typo "MEC-impacts" in Section 1.4.2 has been revised to "MEC-impacted".
77666-JAS-15	Editorial	No	4.1.3.1	4-2	9-10	Sikes, John	MEC Response	I think there is a typo, sentence currently states: "……the PDT has learned that local property owners would like be resistant to the more…." Should "like" be "likely"?	Concur. The word "like" in Section 4.1.3.1 has been revised to "likely".

Note: You can resize columns and rows as needed.

D H E C
PROMOTE PROTECT PROSPER

Catherine E. Heigel, Director
Promoting and protecting the health of the public and the environment

September 14, 2015

Mr. Raymond Livermore
U.S. Army Corps of Engineers (USACE) Wilmington District
69 Darlington Ave
Wilmington, NC 28403

Re: Draft Final Feasibility Study Report
Former Camp Croft
Spartanburg, South Carolina
Dated July 2015

Dear Mr. Livermore:

The Department has reviewed the above referenced document and has the following comments:

1. As discussed in the Remedial Investigation (RI) report, the "Proposed Remaining Lands" is the area of MRS 3 not included in other proposed area realignments. Please provide a brief explanation of the other remaining land within the former Camp Croft boundary (areas not shared within the boundary in Exhibit 1-1) and how these areas have been addressed or why they are excluded.

2. The Department is hesitant to support any alternative with the goal of unrestrictive use/unrestrictive exposure as we believe some type of land use controls (LUCs) will be necessary. Our opinion of necessary LUCs may vary for different areas of the former Camp Croft based on the former land use, coverage of the investigations, work complete, and accessibility of area for investigation based on right-of-entry.

3. Although the various proposed MRS realignment areas are shown in the report as Exhibits 2-1 thru 2-12, the Department believes it would also be beneficial to include a map showing the results of the entire Camp Croft site. This will assist in demonstrating the overall investigation results for the entire site as well as serve as a beneficial resource during any 5-year reviews or future right-of-entry discussions. The Department suggests the figure shown during the December 2014 RAB meeting titled "Proposed Boundary Realignment, Exhibit 8-11."

Further, it appears that the Final RI report, dated October 2014, was never official approved by the Department. Concurrence to the Draft Final RI Report was written on October 7, 2014 (Byrd to Livermore) and a final version was submitted on October 31, 2014. During the review of the FS, the final RI was reviewed concurrently to ensure the administrative record is complete. Please note that the Executive Summary section mistakenly recommends MRS 1 to proceed to the FS stage. The Department recognizes this as being inconsistent with the RI's S*ection 8.3 - Conclusions and Recommendations* as well as the summary included in the Draft FS. No change or revision to the RI is necessary and the Final RI is approved.

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
2600 Bull Street • Columbia, SC 29201 • Phone: (803) 898-3432 • www.scdhec.gov

Thank you for allowing the Department to be involved in the investigation process. If you need any additional information or have questions, feel free to contact me at (803) 898-0255.

Sincerely,

Kent Krieg
FUDS Project Manager
Bureau of Land and Waste Management

File #56839

Responses to SCDHEC Comments

1. As discussed in the Remedial Investigation (RI) report, the "Proposed Remaining Lands" is the area of MRS 3 not included in other proposed area realignments. Please provide a brief explanation of the other remaining land within the former Camp Croft boundary (areas not shared within the boundary in Exhibit 1-1) and how these areas have been addressed or why they are excluded.

USACE Response: §1.1.1 has been revised to explain that areas within the FUDS boundary but beyond the interpreted munitions-use areas are not part of the remedial investigation.

2. The Department is hesitant to support any alternative with the goal of unrestrictive use/unrestrictive exposure as we believe some type of land use controls (LUCs) will be necessary. Our opinion of necessary LUCs may vary for different areas of the former Camp Croft based on the former land use, coverage of the investigations, work complete, and accessibility of area for investigation based on right-of-entry.

USACE Response: Noted. Response actions will be selected and refined during the Proposed Plan and Decision Document phases; the USACE will rely on SCDHEC input regarding LUCs during that time.

3. Although the various proposed MRS realignment areas are shown in the report as Exhibits 2-1 thru 2-12, the Department believes it would also be beneficial to include a map showing the results of the entire Camp Croft site. This will assist in demonstrating the overall investigation results for the entire site as well as serve as a beneficial resource during any 5-year reviews or future right-of-entry discussions. The Department suggests the figure shown during the December 2014 RAB meeting titled "Proposed Boundary Realignment, Exhibit 8-11."

USACE Response: Concur. An exhibit similar to that described will be provided as Appendix D to the FS Report.

D H E C
PROMOTE PROTECT PROSPER

Catherine E. Heigel, Director
Promoting and protecting the health of the public and the environment

November 30, 2015

Mr. Raymond Livermore
U.S. Army Corps of Engineers (USACE) Wilmington District
69 Darlington Ave
Wilmington, NC 28403

Dear Mr. Livermore:

Re: Final Feasibility Study Report
Former Camp Croft
Spartanburg, South Carolina
Dated October 2015

Dear Mr. Livermore:

The Department has reviewed the above referenced document it does not appear that my comment #1 was understood as intended. For the administrative record, I want to ensure that all of the land within the former Camp Croft boundary will have been addressed by the USACE. This will be important for future discussions as the remaining work is selected and completed at the various investigation areas.

In an attempt to restate my initial concern, please provide the justification or rationale for why the "remaining lands" area boundary does not extend to the Camp Croft boundary leaving undesignated areas of the former Camp Croft that appear that they have not been addressed (i.e. Figure D-1: the unshaded, white area between the area boundary and Camp Croft boundary along the southern section or the large portion of the N/NW portion within the Camp Croft boundary). Another way to ask this may be why is this undesignated portions of land excluded from the "remaining lands" investigation?

Similarly, why is there un-designated areas surrounded by proposed area boundaries near the "Proposed 60/81mm Mortar Area "Proposed Grenade Maneuver Area, and Remaining Lands Area?"

I hope that this response can be addressed through an additional response to comments and that only Appendix C and cover pages will need to be updated.

Thank you for allowing the Department to be involved in the investigation process. If you have any questions regard the intent of my comment, feel free to contact me at (803) 898-0255.

Sincerely,

Kent Krieg
FUDS Project Manager
Bureau of Land and Waste Management

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
File #56839 2600 Bull Street • Columbia, SC 29201 • Phone: (803) 898-3432 • www.scdhec.gov

Responses to SCDHEC Comments

1. As discussed in the Remedial Investigation (RI) report, the "Proposed Remaining Lands" is the area of MRS 3 not included in other proposed area realignments. Please provide a brief explanation of the other remaining land within the former Camp Croft boundary (areas not shared within the boundary in Exhibit 1-1) and how these areas have been addressed or why they are excluded.

USACE Response: §1.1.1 has been revised to explain that areas within the FUDS boundary but beyond the interpreted munitions-use areas are not part of the remedial investigation.

SC DHEC Clarification (30 November 2015): In an attempt to restate my initial concern, please provide the justification or rationale for why the "remaining lands" area boundary does not extend to the Camp Croft boundary leaving undesignated areas of the former Camp Croft that appear that they have not been addressed (i.e., Figure D-1: the unshaded, white area between the area boundary and Camp Croft boundary along the southern section or the large portion of the N/NW portion within the Camp Croft boundary). Another way to ask this may be why is this undesignated portion of land excluded from the "remaining lands" investigation?

Similarly, why is there un-designated areas surrounded by proposed area boundaries near the "Proposed 60/81mm Mortar Area "Proposed Grenade Maneuver Area, and Remaining Lands Area?"

USACE Response: As the Project Delivery Team (PDT; USACE, SC DHEC, SC Parks and Recreation, and ZAPATA) discussed during the project planning phase and documented in the Final Work Plans (09 September 2011), an Archives Search Report (ASR) was completed by the USACE, Rock Island District in September 1993. The ASR documents previous site investigations; those include a Site Survey of Camp Croft conducted in 1984, a Site Screening Investigation performed in 1990, and a Preliminary Assessment completed in 1991. An ASR Supplement was completed by the USACE, Rock Island District in November 2004. The ASR Supplement documented the type, size, configuration, location, munitions used, and preliminary risk (among other details) at numerous ranges at Camp Croft.

Fifteen Military Munitions Response (MMR) areas were identified in the Archive Search Report (ASR; USACE, 1993) and ASR Supplement (USACE, 2004). The PDT discussed results presented in all previous investigation and removal action documents and compared findings in those documents with the information provided in the ASR and ASR Supplement and by the community's Restoration Advisory Board. The PDT agreed to a Conceptual Site Model constructed to better understand the historical range usage, and to focus the areas of remedial investigation on any area with suspected historical ordnance use. This process allowed the PDT to eliminate portions of the former Camp Croft (i.e., the cantonment area in the N/NW portion of

the FUDS, areas south of the range fans, and other miscellaneous areas) from the investigation. Following the data collection and analysis performed during the remedial investigation, areas boundaries were established (or refined) based on field evidence. For areas not included in the FS, like those referenced in SC DHEC's comment, the Department of the Army may initiate an investigation or response action, should additional information indicate a need for such, at any time in the future, subject to funding availability.

2. The Department is hesitant to support any alternative with the goal of unrestrictive use/unrestrictive exposure as we believe some type of land use controls (LUCs) will be necessary. Our opinion of necessary LUCs may vary for different areas of the former Camp Croft based on the former land use, coverage of the investigations, work complete, and accessibility of area for investigation based on right-of-entry.

USACE Response: Noted. Response actions will be selected and refined during the Proposed Plan and Decision Document phases; the USACE will rely on SCDHEC input regarding LUCs during that time.

3. Although the various proposed MRS realignment areas are shown in the report as Exhibits 2-1 thru 2-12, the Department believes it would also be beneficial to include a map showing the results of the entire Camp Croft site. This will assist in demonstrating the overall investigation results for the entire site as well as serve as a beneficial resource during any 5-year reviews or future right-of-entry discussions. The Department suggests the figure shown during the December 2014 RAB meeting titled "Proposed Boundary Realignment, Exhibit 8-11."

USACE Response: Concur. An exhibit similar to that described will be provided as Appendix D to the FS Report.

APPENDIX D

COMPREHENSIVE MUNITIONS-RELATED FINDINGS

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MRS 1 (23.79 ac.)

Proposed Mortar/Rifle Grenade Area (22.93 ac.)

MRS 2 (24.89 ac.)

Proposed Grenade Area (19.22 ac.)

Proposed Practice Grenade Area (6.39 ac.)

AoPI 9G (6.59 ac.)

Proposed Rocket & Rifle Grenade Area (134.69 ac.)

AoPI 5 (5.48 ac.)

AoPI 9E (7.64 ac.)

Proposed Rocket Area (93.93 ac.)

AoPI 8 (22.93 ac.)

Proposed 60/81mm Mortar Area (236.71 ac.)

Proposed Grenade Maneuver Area (257.67 ac.)

Proposed 105mm Area (980.72 ac.)

Proposed Maneuver Area (1,252.62 ac.)

Proposed Remaining Lands (9,626.91 ac.)

Proposed 60mm Mortar Area (182.35 ac.)

Proposed Rocket/Grenade Maneuver Area (126.34 ac.)

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

Project Number	Date	Exhibit
R20012	SEPTEMBER 2015	D-1

KEY

- 2.36 in Rocket from TCRA
- Hand Grenade from TCRA
- Rifle Grenade from TCRA
- DMM, Grenade
- UXO, 2.36 in Rocket
- UXO, 57 mm
- UXO, 60 mm
- UXO, 81 mm
- UXO, Fuze
- UXO, Grenade
- Frag / Undifferentiated MD
- Grenade MD
- Grenade / Rocket MD
- Mine MD
- Mortar MD
- Projectile MD
- Rocket MD
- Rocket / 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)
- 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)
- 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)
- UXO (Historical Find from Other Source)
- MD (Historical Find from Other Source)
- Small Arms Concentrations
- Area Boundary
- 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
- Parcel Boundary
- Inaccessible Area
- 105mm Area (1,399.7 ac.)
- 60/81mm Mortar Area (301.3 ac.)
- 60mm Mortar Area (303.4 ac.)
- Grenade Area (19.2 ac.)
- Grenade Maneuver Area (450.5 ac.)
- MRS 1 (23.8 ac.)
- MRS 2 (24.9 ac.)
- Maneuver Area (1,276.5 ac.)
- Mortar/Rifle Grenade Area (22.9 ac.)
- Practice Grenade Area (6.4 ac.)
- Remaining Lands (9,093.4 ac.)
- Rocket & Rifle Grenade Area (108.5 ac.)
- Rocket Area (93.9 ac.)
- Rocket/Grenade Maneuver Area (126.3 ac.)

N
W E
S

0 550 1,100 Feet

Source(s)
USAESCH, ZAPATA, Esri

Projection
NAD 1983 UTM Zone 17N
Note: Main Data Frame Rotated to True North

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

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

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

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