FINAL REPORT

MILITARY MUNITIONS RESPONSE PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

FORMER CAMP MAXEY ARTILLERY RANGES
Paris, Texas

Contract #: W912DY-04-D-0009
Task Order #: 0010
FUDS Project No. K06TX030501

Prepared For:

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4820 University Square
Huntsville, Alabama 35816-1822

Geographical District:

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April 2014

FORMER CAMP MAXEY

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ACRONYMS

°F	Degrees Fahrenheit
%	percent
amsl	above mean sea level
ARARs	Applicable or Relevant and Appropriate Requirements
ASR	Archive Search Report
ATV	All-Terrain Vehicle
bgs	below ground surface
CEHNC	Corps of Engineers – Huntsville Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
cm^2	centimeters squared
COC	Contaminant of Concern
CSM	Conceptual Site Model
CWM	Chemical Weapons Materiel
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DMM	Discarded Military Munitions
DoD	Department of Defense
DQO	Data Quality Objective
EcoSSL	Ecological Soil Screening Level
EE/CA	Engineering Evaluation and Cost Analysis
EHE	Explosive Hazard Evaluation
EM	Engineer Manual
EM CX	Environmental and Munitions Center of Expertise
EOD	Explosives and Ordnance Disposal
EOTI/ARCADIS	Explosive Ordnance Technologies, Inc. and ARCADIS U.S., Inc.
EP	Engineer Pamphlet
ER	Engineer Regulation
ERA	Ecological Risk Assessment
ESB	Ecological Screening Benchmark
ESP	Explosives Site Plan
FCR	Field Change Request
FS	Feasibility Study

FUDS	Formerly Used Defense Site
GP	Guided Projectile
GPS	Global Positioning System
GSV	Geophysical Systems Verification
HA	Hazard Assessment
HE	High-Explosive
HEAT	High-Explosive Anti-Tank
HEI	High-Explosive Incendiary
HFA	Human Factors Applications, Inc.
HHE	Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IGD	Interim Guidance Document
IS	Incremental Sampling
IVS	Instrument Verification Strip
lbs	pounds
LANL	Los Alamos National Laboratory
LTM	Long Term Management
LUC	Land Use Control
MC	Munitions Constituents
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MIS	Management Information System
mg/kg	milligrams per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MQL	Method Quantitation Limits
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS/MSD	Matrix spike / Matrix Spike Duplicate
NA	Not Available
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ND	Non-detect
NTCRA	Non-Time Critical Removal Action
OB/OD	Open Burn/Open Detonation
OE	Ordnance and Explosives

OEW	Ordnance and Explosive Waste
PAL	Project Action Limit
PCL	Protective Concentration Limit
PES	Parsons Engineering Science, Inc.
PP	Proposed Plan
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAC	Risk Assessment Code
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROE	Right-of-Entry
SLERA	Screening Level Ecological Risk Assessment
SU	Sampling Unit
SUXOS	Senior Unexploded Ordnance Supervisor
TAC	Texas Annotated Code
TAL	Target Analyte List
TBC	To Be Considered
TCEQ	Texas Commission of Environmental Quality
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
TPP	Technical Project Planning
TPWD	Texas Parks and Wildlife Department
TRRP	Texas Risk Reduction Program
TX	Texas
UCL	Upper Confidence Limit
U.S.	United States
USACE	United States Army Corps of Engineers
USAE	USA Environmental, Inc.
USAEC	United States Army Environmental Command
USAESCH	United States Army Engineering Support Center, Huntsville
USC	United States Code
USEPA	United States Environmental Protection Agency
UXB	UXB International, Inc.
UXO	Unexploded Ordnance

UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
WMA	Wildlife Management Area

ES 1. EXECUTIVE SUMMARY

This Remedial Investigation (RI) /Feasibility Study (FS) Report has been prepared on behalf of the United States (U.S.) Army Corps of Engineers (USACE) to further remedial activities under the Military Munitions Response Program (MMRP) at the Former Camp Maxey in Paris Artillery Ranges, Texas (TX) (hereafter referred to as Former Camp Maxey). By completing the RI and FS, the USACE are in compliance with the Defense Environmental Restoration Program (DERP) statute (10 USC 2701 et seq.) which requires the MMRP activities be carried out subject to and consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended (42 USC § 9601 et seq.,), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This RI/FS Report has been prepared in accordance with the U.S. Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988) and the *Munitions Response RI/Feasibility Study (FS) Guidance* [USACE and United States Army Environmental Command (USAEC), 2009d]. All work was conducted in accordance with procedures developed in the *Final Work Plan* (EOTI, 2013), U.S. Army Engineering & Support Center (USAESCH), USACE, Department of the Army, and DoD requirements regarding personnel, equipment, and procedures.

ES 1.1 OBJECTIVE

The objective of the RI is to characterize the nature and extent of MEC and MC at the Former Camp Maxey meeting the requirements of ER 200-3-1 and the Environmental and Munitions Center of Expertise (EM CX) Interim Guidance 06-04. The purpose of the FS is to identify, develop, and evaluate remedial alternative(s) that mitigate, to acceptable levels, potential risks to human and ecological receptors for current and reasonably anticipated future land use at the Former Camp Maxey.

ES 1.2 REMEDIAL INVESTIGATION FIELD WORK SUMMARY

ES 1.2.1 A total 18 MEC items and numerous MD were identified during the RI. Of the MEC, 15 items were found on the ground surface and three were found in the subsurface at depths of no more than 12 inches. In addition, MEC and MD have historically been found during previous investigations. MEC found during the RI are listed in Table ES-1.

ES 1.2.2 Surface soil samples were collected via the incremental sampling method (see Section 3.3.1 for details). Forty-four (44) of the 47 surface soil samples, plus QC samples in the form of triplicates, were collected from sampling units (SUs) where UXO was found or were designated as medium/high MD density grids. An additional three (3) surface soil samples were collected at historical locations where prior MEC investigations and removals occurred but no MC sampling was performed. Eight surface soil background soil samples were collected. Lead and magnesium were detected at levels above Project Action Limits (PALs) in surface soil.

ES 1.2.3 Discrete subsurface soil samples were collected from SUs in which surface soil sample results exceeded the PALs established in the Work Plan. A total of 120 subsurface soil samples were collected, plus QC samples in the form of duplicates. Ten discrete subsurface soil samples were collected from the same eight SUs used for surface soil background.

Table ES-1: MEC Finds During RI

Location (Grid or Transect)	UXO Nomenclature	Depth (inches)
Eastern Range Area		
E22A3	37mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
Western Range Area		
W38A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W35A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W20A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W18A2	76mm APHE	Found on transect during geophysical operations.
W27A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W27A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W29A2	76mm APHE	Found on transect during geophysical operations.
W44A2	2.36 Rocket Motor with Fuze	Found on transect during surface clearance activities prior to geophysical operations.
W35A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W45A2	105mm Smoke Canister	Found on transect during surface clearance activities prior to geophysical operations.
W35A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W30A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W38A2	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W27A2G1	155mm HE	4

W24A2G1	76 mm APHE	12
W31A2G1	76 mm APHE	8
Grenade Training Area		
G16A	2.36 Rocket	Found on transect during surface clearance activities prior to geophysical operations.

ES 1.3 Human Health and Ecological Risk Assessment Results

The results of this baseline risk assessment demonstrate that adverse health effects from human and ecological exposure to MC in soil at the Former Camp Maxey are not expected, and no further investigation on the basis of potential human health or ecological risk is warranted. Therefore, MC remedial alternatives are not evaluated within the FS.

ES 1.4 Conceptual Site Model, Munitions Response Site Prioritization Protocol, and Munitions and Explosives of Concern Hazard Assessment Results

ES.1.4.1Based on the results of the RI fieldwork and review of existing data from previous investigations, it is recommended that 12 separate MRSs be delineated from the original Former Camp Maxey MRS. Of these 12 MRSs, eight are addressed in the FS to develop and evaluate remedial alternatives and four MRSs require additional investigation to adequately characterize the nature and extent of MEC potentially at the site. The four MRSs requiring additional investigation are not addressed further in the FS.

ES.1.4.2The following is a list of the delineated MRSs which are identified as either being addressed in the FS or needing further investigation.

1. Western Range Area A (Further Investigation)
2. Western Range Area B (Feasibility Study)
3. Western Range Area C (Feasibility Study)
4. Western Range Area D (Feasibility Study)
5. Western Range Area E (Further Investigation)
6. Eastern Range Area A (Feasibility Study)
7. Eastern Range Area B (Feasibility Study)
8. Eastern Range Area C (Feasibility Study)
9. Grenade Range Area (Feasibility Study)
10. Cave Training Area (Further Investigation)
11. Mine and Booby Trap Training Area (Feasibility Study)
12. Bivouac Area (Further Investigation)

The following areas within the Former Camp Maxey MRS were not investigated as part of the RI and are not addressed in the FS.

1. Pat Mayse Lake (Not included in project scope. Further investigation required.)
2. Texas National Guard (Not Formerly Used Defense Sites (FUDS) program eligible.)

The MEC pathway analysis for the Former Camp Maxey, shows that there are complete and potentially complete pathways for all human and ecological receptors of MEC at each of the 12 MRSs above based on the results of the RI field work, previous investigations, and existing data gaps. This includes receptors for handle/treads underfoot contact (surface), as well as work that may be conducted on the ground surface. Complete and potentially complete exposure pathways also exist in the subsurface soil for human receptors, such as outdoor site workers who may perform intrusive work and recreational visitors who may visit the site and disturb subsurface soil. The subsurface pathway is also complete for biota that may nest or burrow at the MRS. See the figures in Section 5 for details concerning specific pathways for each recommended MRS.

Based on sampling data, a HHRA and SLERA were conducted (presented in Section 6). The results of the HHRA and SLERA demonstrate that no COCs were identified for either at the site. As such, the exposure pathways are all incomplete for human receptors of MC. Figures in Section 5 illustrate the incomplete pathways to human and ecological receptors for the entire Former Camp Maxey.

Munitions Response Site Prioritization Protocols (MRSPPs) and Munitions and Explosives of Concerns Hazard Assessments (MEC HAs) were developed as applicable for the revised MRSs. MEC HA scores were only developed for sites where MEC has been found historically and/or during RI fieldwork. Results are shown below (details concerning MRSPP and MEC HA scoring are included in Section 6.1).

Table ES-2: MRSPP Scores

MRS	EHE Rating	CHE Rating	HHE Rating	MRS Priority or Alternative Rating
Western Range Area A	D	No Known or Suspected	Evaluation Pending	5
Western Range Area B	D		No Known or Suspected	5
Western Range Area C	D		No Known or Suspected	5
Western Range Area D	C		No Known or Suspected	4
Western Range Area E	C		Evaluation Pending	4
Eastern Range Area A	B		No Known or Suspected	3
Eastern Range Area B	C		No Known or Suspected	4
Eastern Range Area C	C		No Known or Suspected	4
Grenade Range Area	C		No Known or Suspected	4
Cave Training Area	F		Evaluation Pending	7
Mine and Booby Trap Training Area	E		No Known or Suspected	6
Bivouac Area	B		Evaluation Pending	3

Note: A MRSPP score of 1 indicates the highest priority and 8 the lowest.

Table ES-3: Baseline MEC HA Scores

MRS	MEC HA Score	Hazard Level
Western Range Area D	920	1
Eastern Range Area A	950	1
Eastern Range Area B	735	2
Eastern Range Area C	760	2
Grenade Range Area	920	1

Note: A MEC HA score of 1 indicates the highest potential risk and 4 indicates the lowest.

ES 1.5 FEASIBILITY STUDY

The following remedial alternatives were developed and analyzed as part of the FS to offer a range of remedial approaches as required by CERCLA guidance. Only those MRS determined to be adequately characterized following the RI were evaluated in the FS.

Table ES-4: Remedial Alternatives Evaluated

MRS	Alternatives
Western Range Area B	1. No Action 2. LUCs 3. LUCs; 100 percent surface clearance 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 24 inches)
Western Range Area C	1. No Action 2. LUCs; Focused surface clearance for frequented public use areas (i.e. trail, dirt roads, picnic areas, camp grounds, shorelines) 3. LUCs; 100 percent surface clearance and focused 12 inch subsurface clearance for frequented public use areas (i.e. trail, dirt roads, picnic areas, camp grounds, shorelines) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 24 inches)
Western Range Area D	1. No Action 2. LUCs; 100 percent surface clearance 3. LUCs; Focused surface and 12 inch subsurface clearance for frequented public use areas (i.e. trail, dirt roads, picnic areas, camp grounds, shorelines) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 24 inches)
Eastern Range Area A	1. No Action 2. LUCs; 100 percent surface clearance 3. LUCs; Focused surface and 12 inch subsurface clearance for frequented public use areas (i.e. trails, dirt roads, picnic areas, camp grounds, beaches outside of previously cleared areas) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)
Eastern Range Area B	1. No Action 2. LUCs; Focused surface clearance for frequented public use areas (i.e. trails, dirt roads, picnic areas, camp grounds, beaches outside of previously cleared areas) 3. LUCs; 100 percent surface clearance and focused 12 inch subsurface clearance for frequented public use areas (i.e. trails, dirt roads, picnic areas, camp grounds, beaches outside of previously cleared areas) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)
Eastern Range Area C	1. No Action 2. LUCs 3. LUCs; Focused surface clearance for frequented public use areas (i.e. trails, picnic areas, shorelines) where only surface activities are expected 4. LUCS; 100 percent surface clearance 5. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)

MRS	Alternatives
Grenade Range Area	1. No Action 2. LUCs 3. LUCs; Focused surface clearance for frequented public use areas (i.e. trails, picnic areas) 4. LUCS; 100 percent surface clearance 5. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)
Mine and Booby Trap Area	1. No Action 2. LUCs 3. LUCs; 100 percent Surface and six inch subsurface clearance 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)

1 INTRODUCTION

This Remedial Investigation (RI) / Feasibility Study (FS) Report has been prepared on behalf of the United States (U.S.) Army Corps of Engineers (USACE) to further remedial activities under the Military Munitions Response Program (MMRP) at the Former Camp Maxey Artillery Ranges in Paris, Texas (TX) (hereafter referred to as Former Camp Maxey). This RI Report has been prepared in accordance with the U.S. Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988) and the *Munitions Response RI/Feasibility Study (FS) Guidance* [USACE and United States Army Environmental Command (USAEC), 2009]. All work was conducted in accordance with procedures developed in the *Final Work Plan* [Explosive Ordnance Technologies, Inc. (EOTI), 2013], U.S. Army Engineering & Support Center (USAESCH), USACE, Department of the Army, and Department of Defense (DoD) requirements regarding personnel, equipment, and procedures.

1.1 AUTHORIZATION

1.1.1 EOTI was awarded Task Order 0010 under Contract No. W912DY-04-D-0009 on 19 February 2008 to obtain government acceptance of a Decision Document following a RI/FS and all other necessary activities required to accomplish this objective.

1.1.2 The Former Camp Maxey was active from July 1942 to October 1945 during which time infantry were trained in live fire of weapons including pistols, carbines, rifles, tommy guns, automatic rifles, machine guns, mortars, bazookas, anti-tank guns, and artillery. Some of the material produced remains on the site in the form of munitions and explosives of concern (MEC), including munitions constituents (MC), and/or Munitions Debris (MD). MEC represent a potential health and safety hazard to the local populace. Thus, assessment of the Former Camp Maxey falls under the DoD Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS).

1.1.3 By completing the RI and FS, the USACE is in compliance with the DERP statute [10 United States Code (USC) 2701 et seq.] which requires the MMRP activities be carried out subject to and consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended (42 USC § 9601 et seq.), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

1.1.4 This RI/FS Report has been prepared in accordance with the U.S. Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988) and the *Munitions Response RI/Feasibility Study (FS) Guidance* [USACE and United States Army Environmental Command (USAEC), 2009d]. All work was conducted in accordance with procedures developed in the *Final Work Plan* (EOTI, 2013), U.S. Army Engineering & Support Center (USAESCH), USACE, Department of the Army, and DoD requirements regarding personnel, equipment, and procedures.

1.2 Objective

The objective of the RI is to characterize the nature and extent of MEC and MC at the Former Camp Maxey meeting the requirements of Engineer Regulation (ER) 200-3-1 and the Environmental and Munitions Center of Expertise (EM CX) Interim Guidance 06-04. The purpose of the FS is to identify, develop, and evaluate remedial alternative(s) that mitigate, to acceptable levels, potential risks to human and ecological receptors for current and reasonably anticipated future land use at the Former Camp Maxey.

1.3 Property Description

1.3.1 Location

The Former Camp Maxey is situated in Lamar County, approximately 9 miles north of Paris, TX. Highway 271 forms part of the eastern border of the site. The site consists of a single Munitions Response Site (MRS) with a total area of 16,235.44 acres. Map 1-1 shows the site and surrounding areas. Map 1-2 identifies the former installation boundary and the FUDS Management Information System (MIS) MRS boundary.

1.3.2 Topography

The Former Camp Maxey lies within the Gulf Coastal Plain which is generally a gently undulating plain characterized by uplands of low relief and broad river valleys. Elevations generally range from 450 to 1,000 feet above mean sea level (amsl). The surface elevation of Pat Mayse Lake is approximately 451 feet amsl. The topography of the Western Range Area is gently sloping down to the east, toward Pat Mayse Lake, with elevations ranging from 450 to 540 feet amsl. The topography of the Eastern Range Area is gently sloping down to the north toward Pat Mayse Lake, with elevations ranging from 450 to 540 feet amsl.

1.4 Camp Maxey Historical Information

1.4.1 From 1942 to 1947, Camp Maxey was a 41,128-acre U.S. Army post in the northeast corner of the state utilized for training infantry. Camp Maxey was activated as an infantry basic training camp on July 15, 1942, shortly after the U.S. declared war on Japan in December 1941. In October 1944, the camp was designated an infantry Advance Replacement Training Center. Infantry were trained in live fire of weapons including pistols, carbines, rifles, tommy guns, automatic rifles, machine guns, mortars, bazookas, anti-tank guns, and artillery. The camp was deactivated on October 1, 1945, after World War II had ended, and the camp was declared surplus on May 20, 1947. During 1948 and 1949, certificates of decontamination, which included restrictions on land for any purpose and for surface use only, were issued by the USACE. Land was conveyed to the State of Texas and sold to private owners. Later, some of the land was returned to the ownership of the federal government for construction of a dam on Sanders Creek. Table 1-1 and Figure 1-1 include the types and locations of ranges identified in the 1994 Archive Search Report (ASR).

1.4.2 Currently, 6,424 acres of the former camp lands are utilized by the State of Texas for a National Guard post also named Camp Maxey. In addition, approximately 6,575 acres are now occupied by Pat Mayse Lake, which formed after the USACE built a dam on Sanders Creek in 1967. A 4,283-acre portion of the lake is within the MRS as shown on Map 1-2. Over 20,000 acres surrounding the lake are occupied by a USACE flood control and recreation area and a State of Texas Wildlife Management Area. The remaining portion of the former camp lands are now privately owned and are used for residential, agricultural, and recreational purposes.

1.4.3 The National Guard property and the portions of the Pat Mayse Lake within the Munitions Response Area boundary (Map 1-2) were not investigated as part of the RI. The National Guard property is not eligible for the FUDS program and will not be investigated. Pat Mayse Lake will be investigated further under a separate task order.

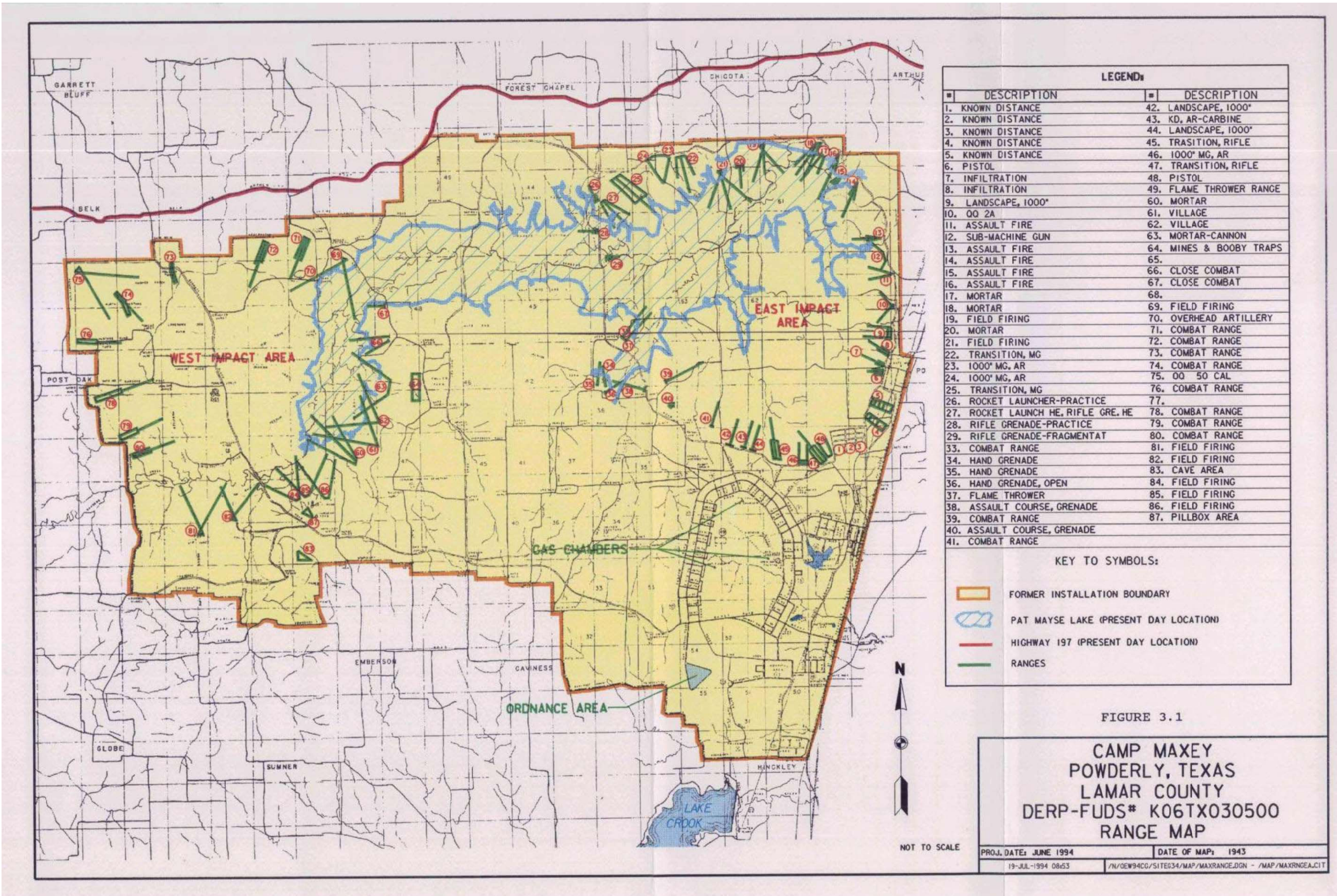
Table 1-1: Historic Ranges (Archive Search Report, 1994)

Ordnance Range or Area Type	Total Number at Camp Maxey	Range Identification Numbers
Combat Range	11	33, 39, 41, 71, 72, 73, 74, 76 78, 79, 80
Field Firing Range	8	19, 21, 69, 81, 82, 84, 85, 86
Assault Firing Range	5	11, 13, 14, 15, 16
“Known Distance” Range	5	1, 2, 3, 4, 5
Mortar Firing Range	4	17, 18, 20, 60
Hand Grenade Range	3	34, 35, 36
Landscape, 1000’	3	9, 42, 44
1000’ MG, AR Range	3	23, 24, 46
Close Combat Area	2	66, 67
Grenade Assault Course	2	38, 40
Infiltration Area	2	7, 8
Pistol Firing Range	2	6, 48
QQ 2A Range	2	10,7 5
Transition, Rifle Range	2	45, 47
Village Area	2	61, 62
Flame Thrower Area	2	37,49
Transition MG Range	2	22;25
Cave Area	1	83
KD, AR-Carbine Range	1	43
Mine and Booby Trap Area	1	64
Mortar, Cannon Range	1	63
Overhead Artillery Area	1	70
Pillbox Area	1	87

Ordnance Range or Area Type	Total Number at Camp Maxey	Range Identification Numbers
Practice Rifle Grenade Range	1	28
Fragmentation Rifle Grenade Range	1	29
Practice Rocket Launch Range	1	26
High Explosives Rocket Launch Range	1	27
Submachine Gun Range	1	12

Note: The range identification numbers refer to the corresponding range numbers in Figure 1-1.

Figure 1-1: Historic Ranges (Archive Search Report, 1994)



1.5 PREVIOUS ORDNANCE DISCOVERIES AND INVESTIGATIONS

1.5.1 Dam Construction Activities (1965-1966)

Dam construction activities began on 29 March 1965. A 2.36-inch High Explosive Anti-Tank (HEAT) rocket was found on the following day, and munitions items continued to be found. An Explosive Ordnance Disposal (EOD) Team from the Red River Arsenal was dispatched to the site on six occasions between 31 March and 4 May 1965 to remove Ordnance and Explosives (OE) items. From 17 May 1965 to 12 May 1966, a full-time two-person U.S. Army demolition team was assigned to the site to identify and remove any OE found during the construction activities. The EOD team looked over each construction area before they permitted equipment to go into the area. During that time, a total of 1,357 OE items were found. Of these, 414, or approximately 30 percent (%), were considered "dangerous" or "hazardous." The types and number of OE items identified during the dam construction activities as "dangerous" or "hazardous" are listed in Table 1-2.

Table 1-2: Items Located During Dam Construction Activities (1965-1966)

Ordnance Item	Quantity
60mm Mortar	217
2.36–inch HEAT Rocket	120
Blasting Caps	53
37mm AP Projectile	7
M-7 Rifle Grenade	6
81mm Mortar	5
37mm HE Projectile	3
.50 cal Round	2
Hand Grenade	1
Total	**414**

Source: Parsons, 2000
AP = armor piercing
cal = caliber
HE = high explosive
mm = millimeter

1.5.2 Fort Sill EOD (1987-1994)

1.5.2.1 In the 1980s and 1990s, EOD teams from Fort Sill were frequently dispatched to the Former Camp Maxey area to identify and remove or detonate Unexploded Ordnance (UXO) items. Reports of mishaps, detonation, and or discovery, though made to local authorities, are irretrievable (USACE, 1994). Some examples of reported incidents are the inadvertent excavation of mortar rounds during sand quarry operations, followed by the depositing of the excavated fill and munitions on a ballfield; the recovery of landmines by a homeowner performing yardwork; the unearthing of various types of munitions during the construction of the Beaver Creek subdivision; and the detonation of an unknown munition which resulted in injury.

1.5.2.2 The few records of these incidents which do exist are generally not detailed, and do not always note the types and locations of items found. A 13 April 1994 memorandum from the 52nd Ordnance Group at Fort Sill notes that numerous UXO items were identified and removed from the Former Camp Maxey area by the Fort Sill EOD team between 1987 and April 1994. Table 1-3 lists the number and type of items found; however, there are no records regarding the specific locations at which these items were found.

Table 1-3: UXO Removed by Fort Sill EOD Teams (1987-1994)

Ordnance Item	Quantity
81mm Practice Mortar	10
81mm HE Mortar	1
3-inch APHE Projectile	2
60mm Practice Mortar	1
60mm Illumination Mortar	2
40mm Smoke Projectile	1
20mm Practice Projectile	1
2.36-inch HEAT Rockets	4
2.36-inch Practice Rocket	1
M31 Rifle Grenade	1
Hand Grenade	1
Practice Hand Grenade	1
Hand Grenade Simulators	2
Artillery Simulator	1
Total	**29**
Source: Parsons, 2000	

1.5.3 Fort Sill and Pine Bluff EOD (1994-1996)

1.5.3.1 Records kept by the USACE Park Ranger indicate that several additional items were found after April 1994. The majority of these items were 2.36-inch rockets which were found in an area between Pat Mayse East and Pat Mayse West park areas and in the All-Terrain Vehicle (ATV) area. The number and type of UXO items found after April 1994 are provided in Table 1-4.

1.5.3.2 Although EOD teams from Fort Sill and Pine Bluff removed all of the ordnance items listed in Table 1-4, it was evident that the area between Pat Mayse East and Pat Mayse West and the ATV area contained large amounts of UXO. The risk posed by UXO in the ATV area was considered to be high due to the heavy use of the site. In addition, ruts formed by the vehicles in the sandy soil exposed buried UXO. The area between Pat Mayse East and Pat Mayse West did not receive as much traffic, but it was used for hunting. Based on this potential for exposure, a Time-Critical Removal Action (TCRA) was planned for these two areas. The results of this removal action are described in Section 1.5.5 below.

Table 1-4: UXO Removed by Fort Sill and Pine Bluff EOD Teams (1994-1996)

Ordnance Item	Bivouac Area A (Between Park Areas)	East Impact Area C (ATV Area)	Other Locations
2.36-inch Rocket	143	74	15
Rifle Grenade	1	--	--
37mm Projectile	--	--	3
57mm Projectile	--	--	2
75mm AP	--	--	1
155mm Projectile	--	--	1
Total	**144**	**74**	**22**
Source: Parsons, 2000			

1.5.4 1994 Archive Search Report

In June 1994, the USACE, St. Louis District compiled an ASR for Camp Maxey, Site No. K06TX030500, Paris, Texas (U.S. Former Camp Maxey RI/FS Work Plan Paris, Texas W912DY-04-D-0009 1-5 April 2013 Task Order 0010 Army Engineer District, 1994). Based on the results of the ASR, the Commander of the Southwestern Division Corps of Engineers determined that Camp Maxey was eligible under the DERP-FUDS program due to some areas that are "saturated with hazardous and nonhazardous Ordnance and Explosive Waste (OEW)." Camp Maxey was subsequently rated the highest "RAC 1" Risk Assessment Code in May 1995.

1.5.5 1997 Ordnance and Explosives Time Critical Removal Action

From January 27th through April 10th, 1997, Human Factors Applications, Inc. (HFA) conducted a TCRA on 381 acres in the rocket and grenade impact area (East Impact Area C and Bivouac Area A) on the north shore of Pat Mayse Lakes (Contract No. DACA87-95-D-0027, Task Order 0007). The scope of the project included a surface and subsurface MEC clearance to a depth of two feet. During this effort 2,170 2.36in rockets and 10 M-9 rifle grenades were recovered from the Eastern Range Area. The number and type of ordnance items found and their locations are provided in Table 1-5 below. Please reference the HFA Final Removal Report, dated December 5, 1997 (HFA, 1997) for further details.

Table 1-5: UXO Removed During TCRA (1997)

Ordnance Item	Bivouac Area A (Between Park Areas)	East Impact Area C (ATV Area)
2.36-inch Rocket	78	2092
M-9 Rifle Grenade	7	3
Total UXO	**85**	**2095**
Inert OE Items	507	1179
Source: HFA, 1997		

1.5.6 1998 Ordnance and Explosives Survey and Ordnance and Explosives Sampling

In 1997, Corps of Engineers – Huntsville Center (CEHNC) directed UXB International, Inc. (UXB) to conduct an OE Survey and OE Sampling. This sampling included 501 (100 feet x 100 feet) survey grids for a total of approximately 115 acres (Contract No. DACA87-97-D-0006, Delivery Order 0001). MEC items recovered during this effort are included in the table below. Please reference the UXB Final Sampling Report, dated October 9, 1998 (UXB, 1998) for further details.

Table 1-6: UXO Removed During OE Survey and OE Sampling (1998)

Ordnance Item	Quantity
2.36-inch Rockets	2
M9A1 Rifle Grenade	3
M6A2 HEAT Warhead (unfuzed)	2
37mm HE Projectile	1
37mm APHE Projectile	1
75mm APHE Projectile	4
Mk II Hand Grenade	4
Green Star Rifle Grenade	1
Total	**18**
Source: UXB, 1998	

1.5.7 2000 Engineering Evaluation (EE) and Cost Analysis (CA)

In 2000, CEHNC directed Parsons Engineering Science, Inc. (PES) to perform an Engineering Evaluation and Cost Analysis (EE/CA) of Camp Maxey based on the UXB OE Survey and OE Sampling (Section 1.5.6) under Contract DACA87-95-D-0018, Delivery Order 0015. PES prepared the EE/CA report that recommended OE removal action and a series of Institutional Controls for Camp Maxey. Please reference the PES EE/CA report, dated October 2000 (PES 2000) for further details.

1.5.8 2001 OE Removal Action

In 2000, CEHNC directed UXB to conduct an OE removal action of approximately 620 acres scattered throughout the area of the camp. According to UXB's Parcel Index Map (B-2), dated January 22, 2001, 41 parcels totaling 243.3 acres were surveyed, geophysically mapped, and cleared; 50 parcels totaling 82.3 acres were surveyed and geophysically mapped; and 13 parcels totaling 21.9 acres were surveyed (Contract No. DACA87-97-D-0006, Delivery Order 17). MEC items recovered included 19 37mm projectiles and two 75mm projectiles. All MEC was found within 12 inches of the ground surface (one inch to 12 inches) with the majority of the items located at three to four inches below ground surface (bgs). Please reference the UXB Final Removal Report, dated February 2001 (UXB 2001) for further details.

Table 1-7: UXO Removed During OE Removal Action (2001)

Ordnance Item	Quantity
37mm APHE Projectile	18
37mm HE Projectile	1
75mm APHE Projectile	2
Total	**21**
Source: UXB, 2001	

1.5.9 2002 Geophysical Prove-Out for Site Maintenance, Ordnance Investigation, and Removal

In 2002, CEHNC directed Foster Wheeler Environmental Corporation to perform a Geophysical Prove-Out to demonstrate and document the performance of the proposed data acquisition methodology and spatial sampling protocols, sensor(s) and positioning equipment, data analysis and management systems, data transfer procedures, and geophysical quality control (QC) system. The EM61 data produced fewer anomalies but smaller items were not as prominent in the data. It was recommended that the standard EM6I be used in areas where there is no evidence of 37mm or MKII grenades. The EM61 MK2 was recommended for the geophysical investigation when information regarding item size per region was not available. Given a fully operational system, the Vulcan 4T system was recommended as the primary positioning system, as it is well suited for the conditions to be encountered. A line spacing of 2.5 feet was recommended. (Contract No. DACA87-00-D-0039, Task Order 0001). Please reference the Foster Wheeler Geophysical Prove-Out Report, dated October 2002 (Foster Wheeler 2002) for further details. For details on the Geophysical Strip Verification completed for the 2013 RI see the Geophysical Systems Verification (GSV) Letter Report included as Appendix A.

1.5.10 2006 MC Sampling, Analysis, and Evaluation of FUDS

In 2006, as Delivery Order 0004, under Contract W912DY-04-D-0005, PES completed a task order to characterize the presence and concentration of MC at six FUDS, one of which was Camp Maxey. At the Former Camp Maxey, several metal constituents were detected above environmental comparison criteria in both soil and surface water media. Of these constituents, only iron was identified as a potential constituent from munitions used at the Former Camp Maxey. Other sources of metals detected in both soil and surface water media may include natural occurrence, industrial, and urban-related activities at or near Former Camp Maxey. No remedial action was taken as a result of this study.

1.5.11 2007 Site Management, Ordnance Investigation, and Removal

1.5.11.1. In 2000, as Delivery Order 0001, under Contract DACA87-00-D-0039, Tetra Tech EC, Inc. was asked to complete a Site Management, Ordnance Investigation and Removal at the Former Camp Maxey. The objective of this delivery order was to perform a removal action for OE on up to 306 acres around houses, barns, outbuildings, and other structures in active use. In 2005, thirteen properties, consisting of 101 grids, were cleared and 2 were partially cleared. Mag and Dig operations were conducted in 58 of the 101 grids and the remaining 43 grids were geophysically mapped and intrusively investigated. In 2006, four properties, consisting of 31 grids, were cleared. Mag and Dig operations were conducted in 10 of the 31 grids and the remaining 21 grids were geophysically mapped and intrusively investigated.

1.5.11.2. No UXO were encountered during the investigation and the majority of the MD found was in small, unidentifiable fragments. In 2005, two MD items were intact enough to be identified, a 57mm AP-T M70 Recoilless Rifle Projectile (found at a depth of 12.5 inches) and a MK21 Practice Grenade (depth unknown).

1.5.12 2010 Non-Time Critical Removal Action

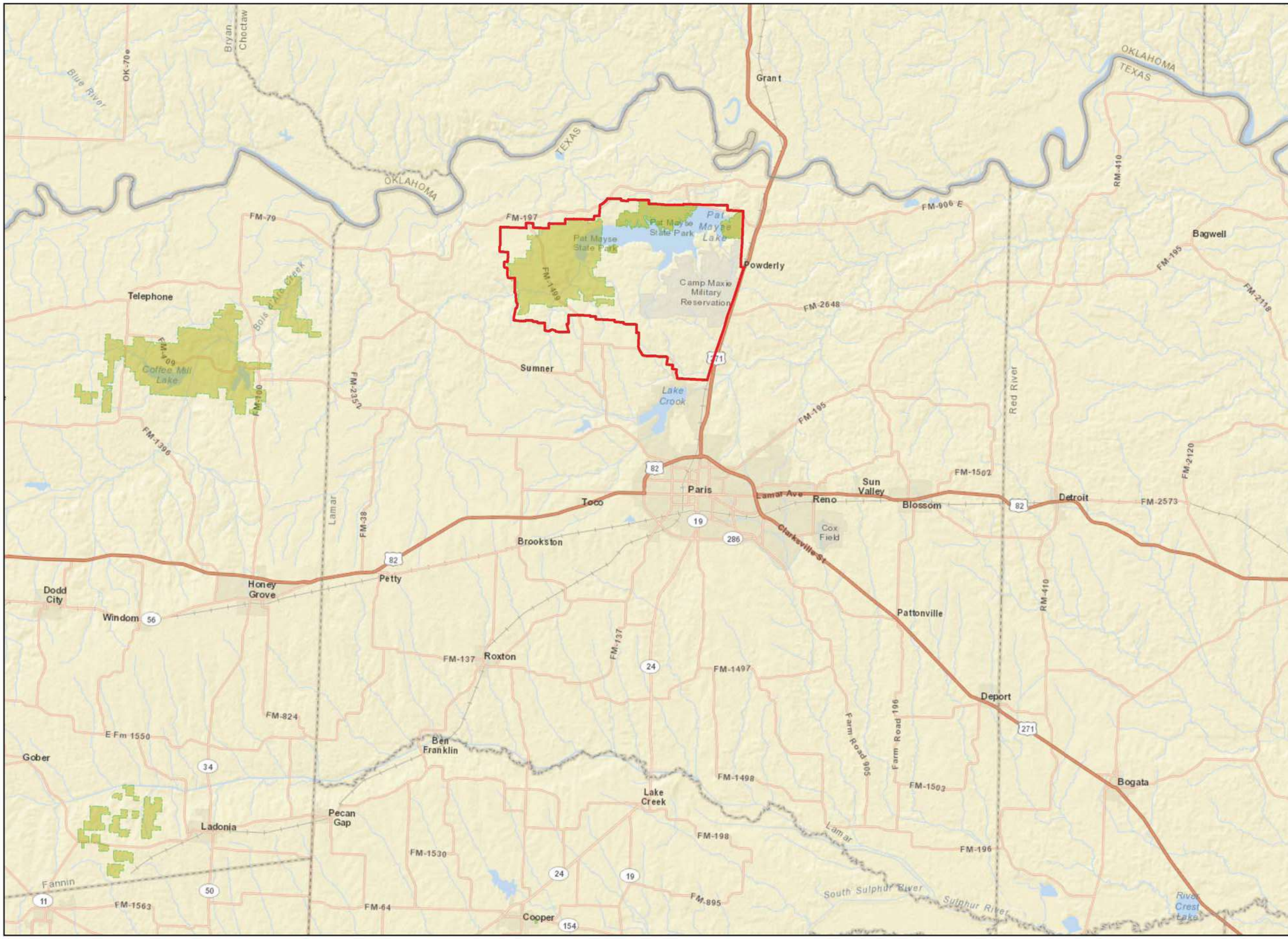
1.5.12.1 In 2006, USA Environmental, Inc. (USAE) was awarded a task order to perform a removal action to remove and dispose of all explosive hazards within selected areas at the Former Camp Maxey in accordance with the signed Action Memorandum dated November 2000. During the field operations, USAE completed surface clearance of 13 ranges consisting of 1,485 grids/341.5 acres. A total of 170 MEC items, including 2.36-inch rockets, M9 rifle grenades, and MKII hand grenades, were located and disposed of through explosive disposal operations. Depths at which MEC and MD items were located is not available. Table 1-8 and Figure 1-1 provides details related to historic ranges and items investigated and found during the Non-Time Critical Removal Action (NTCRA). Please reference the USAE Site Specific Final Report, dated July 2010 (USAE, 2010) for further details.

Table 1-8: Number of MD and MEC Removed During NTCRA (2010)

Range	Anomalies Investigated	MD	MEC
Range 9 (1000" Landscape Range)	5,312	23	--
Range 10 (Anti-Aircraft, OQ Range)	6,559	5	--
Range 11 (Assault Fire Range)	10,813	3	--
Range 12 (Submachine Gun Range)	5,134	3	--
Range 13 (Assault Fire Range)	13,948	473	5
Range 14 (Assault Fire Range)	5,134	38	--
Range 21 (Field Firing Range)	910	--	--
Range 22 (Transition Machine Gun Range)	13,421	637	6
Range 23 (1000" Machine Gun Artillery Range)	9,678	14	--
Range 24 (1000" Machine Gun Artillery Range)	11,722	77	--
Range 25 (Transition Machine Gun Range)	52,379	2,431	6
Range 26 (Rifle Grenade Anti-Tank Range)	7,252	950	--
Range 27 (Rocket Launch HE Range)	19,691	4,500	153
Total	**161,953**	**9,154**	**170**

Source: USAE, 2010
Note: UXO items encountered include 2.36-inch rockets, M9 rifle grenades, and MKII hand grenades.
Note: Range names are similar to how they are documented in Figure 1-1 from 1943. Maps from the 2010 report identify the ranges using the same range numbers but associate them with specific munitions items (e.g., 37mm, 2.36-inch rocket).

1.5.12.2 The maps on the following pages present the location, significant attributes, and historic munitions finds related to the Former Camp Maxey. Map 1-1 shows the location of the Former Camp Maxey relative to northeast Texas. Map 1-2 shows the former camp boundaries, MRS boundaries, historic range fans, and significant land use areas such as the Pat Mayse Wildlife Management Area (WMA) and State Park. Map 1-3 shows the known locations of historic MEC and MD finds of previous investigations at the Former Camp Maxey. It should be noted that geospatial data is not available for many of the items found; therefore, they are not included in Map 1-3.



Legend

- Former Camp Maxey Installation Boundary
- Texas State Parks

03°68'

UTM Zone 15 NAD 83 (Meters)
Data Provided By:
Texas Parks & Wildlife Dept.
U.S. Army Corps of Engineers
ESRI

Miles: 4.5 2.25 0 4.5
Kilometers: 7 3.5 0 7

Location Map:
Former Camp Maxey Lamar County, TX

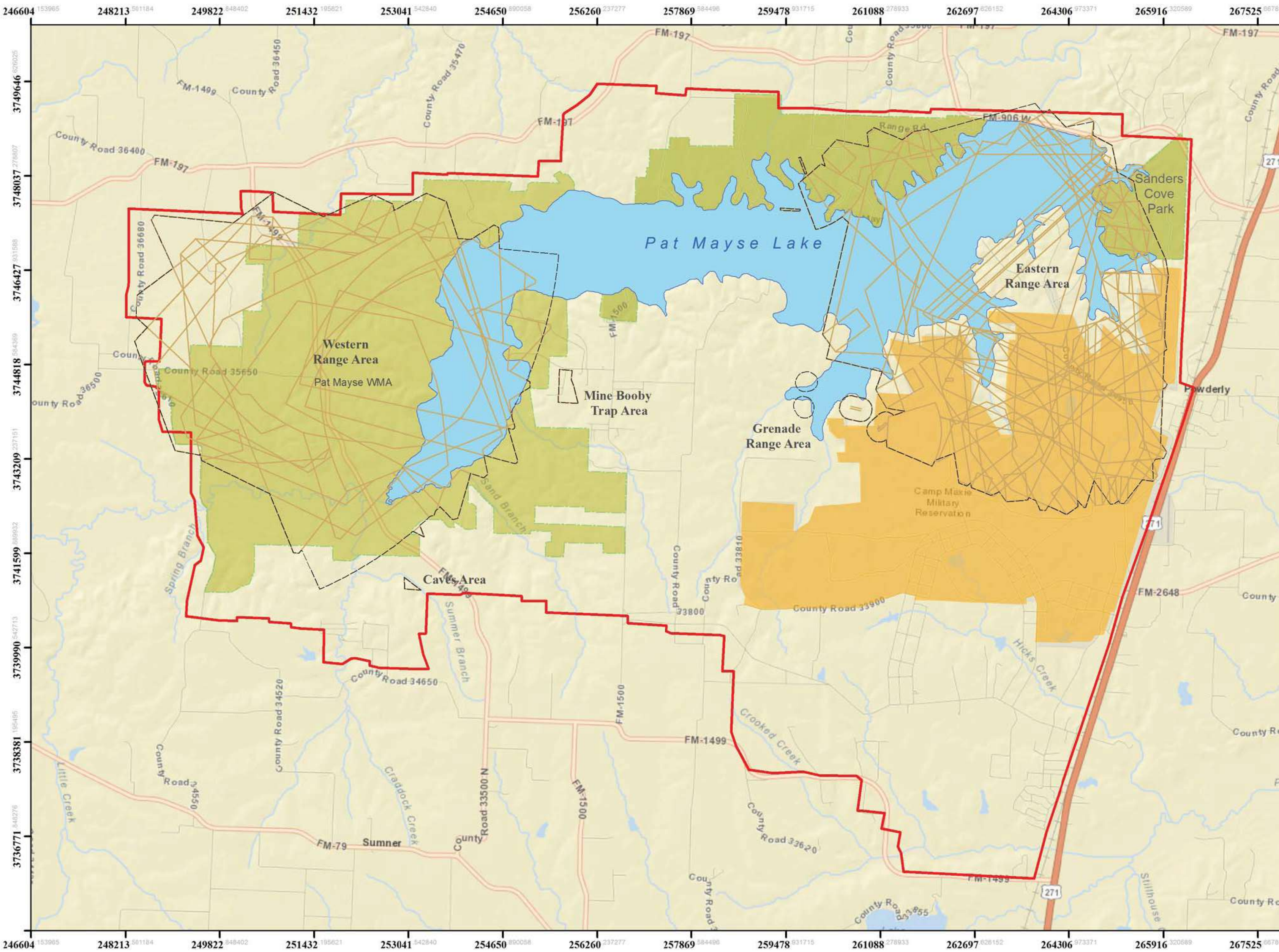
MAP 1-1
FORMER CAMP MAXEY LOCATION

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 11/19/13	FILE Former Camp Maxey Location 1-1.mxd	
PAGE # 1-1	SCALE 1 inch = 4.5 miles	



Legend

- Individual Ranges
- Camp Maxey Range Complex (MRA R01)
- National Guard Installation
- Former Camp Maxey Installation Boundary
- Pat Mayse Lake
- Pat Mayse State Park and WMA

03°68'

UTM Zone 15 NAD 83 (Meters)
Data Provided By:
Texas Parks & Wildlife Dept.
U.S. Army Corps of Engineers
ESRI

Miles: 1 0.5 0 1

Kilometers: 1.6 0.8 0 1.6

Location Map:
Former Camp Maxey Lamar County, TX

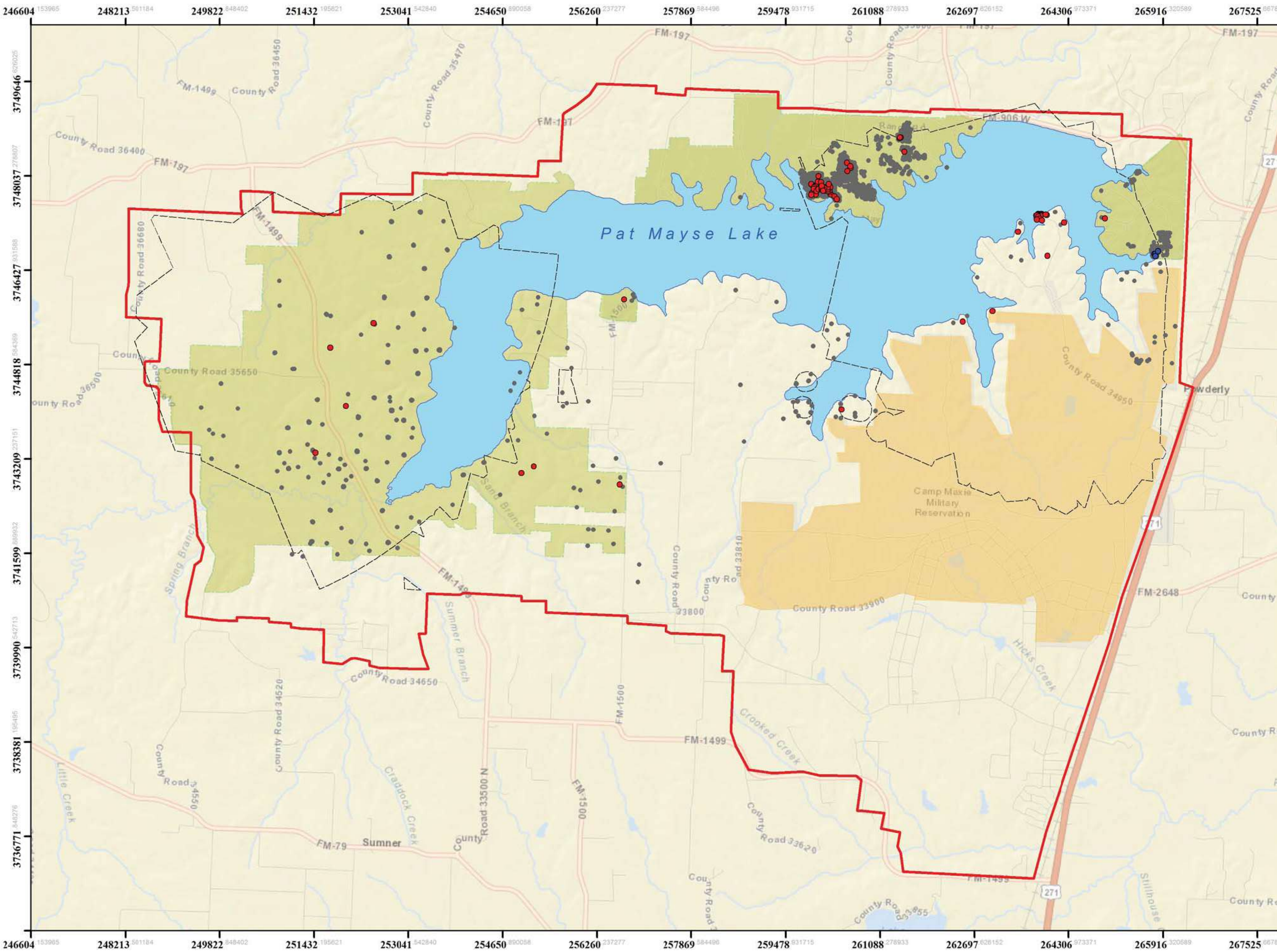
MAP 1-2
OVERVIEW

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 11/19/13	FILE Overview Map 1-2.mxd	
PAGE # 1-2	SCALE 1 inch = 5,280 feet	



MAP 1-3
PREVIOUS INVESTIGATIONS

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 12/10/13	FILE Previous Investigations 1-3.mxd	
PAGE # 1-3	SCALE 1 inch = 5,280 feet	

2 PROJECT REMEDIAL INVESTIGATION OBJECTIVES

2.1 CONCEPTUAL SITE MODEL AND PROJECT APPROACH

2.1.1 Project Approach

2.1.1.1 RI tasks were performed in accordance with the Final RI/FS Work Plan (EOTI, 2013). The Draft Final Work Plan, to include the Sampling and Analysis Plan, was reviewed during a teleconference with USACE and Texas Commission on Environmental Quality (TCEQ) on 2 April 2013. The Final Work Plan was accepted by USACE and notice to proceed was issued on 10 April 2013. The following summarizes the key elements of the RI for the Former Camp Maxey.

2.1.1.2 Explosives Site Plan – In accordance with Interim Guidance Document (IGD) 08-01, an Explosive Site Plan (ESP) for the Former Camp Maxey was submitted as a stand-alone document. The ESP provided specifics on the minimum separation distance and engineering controls that were enforced during intrusive operations. The Final ESP was approved on 21 March 2013.

2.1.1.3 Final RI/FS Work Plan – The Final RI/FS Work Plan provided the detailed approach for all MEC and MC investigation activities. The Final RI/FS Work Plan is dated 3 April 2013.

2.1.1.4 RI Fieldwork – Fieldwork to meet the objectives of the RI included the following tasks: a) GSV, b) geophysical investigation, c) intrusive investigation of subsurface anomalies, and d) MC sampling. Field work activities during the RI were limited to the investigation area determined and included:

a) GSV – A site-specific GSV consisting of an Instrument Verification Strip (IVS) and blind seeding in grids throughout the project area was completed. The IVS was conducted prior to and throughout the duration of the digital geophysical mapping (DGM) portion of the project to verify the detection sensors and positioning systems were functioning properly, and to demonstrate the geophysical data collection teams were well trained in system operation. The blind-seeding program placed industry standard objects in grids identified for geophysical survey and subsurface investigations and verified these items were detected. The Final GSV Letter Report is included as Appendix A.

b) Geophysical Investigation – The geophysical investigation process included the necessary collecting, processing, and analyzing of data to develop dig sheets and maps used to reacquire potential MEC locations identified for excavation during the intrusive investigation. Results of the geophysical survey along transects were used to identify areas with high anomaly densities that could indicate a former target area. Grids, positioned in low, medium and high density areas, were geophysically mapped and selected anomalies were investigated to determine their source.

c) Intrusive Investigation of Subsurface Anomalies – An intrusive investigation was conducted in grids within the defined investigation area. This task included the intrusive investigation of anomalies, suspected MEC/Material Potentially Presenting an Explosive Hazard (MPPEH) destruction; MEC/MPPEH accountability and anomaly count; final disposal of MPPEH, MD, and range scrap; and MPPEH inspection.

d) MC Sampling – Surface soil samples were collected using incremental sampling methodology and analyzed for explosives and select metals. Additionally, subsurface soil samples were collected from sampling units (SUs) where surface soil results exceeded the Project Action Limit (PAL) for lead.

2.1.1.5 RI Report – This report is submitted in accordance with the USEPA document *Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) (USEPA, 1988) and the MMRP Center of Expertise Technical Update as well as the *U.S. Army Munitions Response RI/FS Guidance* (USACE & USAEC, 2009).

2.1.2 Conceptual Site Model

The following presents the initial Conceptual Site Model (CSM) developed during the Technical Project Planning (TPP) process. No updates have been made to this CSM, which is considered the baseline. The revised CSM with exposure pathway analyses using results from the field work is presented in Section 4.0.

2.1.2.1 Site Profile

2.1.2.1.1 Location

Former Camp Maxey is situated in Lamar County, approximately 9 miles north of Paris, TX. Highway 271 forms part of the eastern border of the site.

2.1.2.1.2 Military History

From 1942 to 1947, Camp Maxey was a 41,128-acre U.S. Army post in the northeast corner of the state utilized for training infantry. Camp Maxey was activated as an infantry basic training camp on July 15, 1942, shortly after the United States declared war on Japan in December 1941. In October 1944, the camp was designated an infantry Advance Replacement Training Center. Infantry were trained in live fire of weapons including pistols, carbines, rifles, tommy guns, automatic rifles, machine guns, mortars, bazookas, anti-tank guns, and artillery. The camp was deactivated on 1 October 1945, after World War II had ended, and the camp was declared surplus on 20 May 1947. During 1948 and 1949, certificates of decontamination, which included restrictions on land for any purpose and for surface use only, were issued by the USACE (USACE, 1994). Subsequently, on 1 September 1949, 9,989.25 acres were conveyed to the State of Texas for use by the Texas National Guard. In 1967, approximately 6,000 acres of the land previously provided to the Texas National Guard were conveyed back to the federal government for use as a reservoir by the USACE created by the construction of a dam on Sanders Creek.

2.1.2.1.3 Boundaries and Landowners

2.1.2.1.3.1 The former camp is bounded on the east by Highway 271. Today, there are three groups of significant property owners within the Former Camp Maxey area: the federal government, the State of Texas, and private owners. The federal government owns the largest amount of the former camp, including Pat Mayse Lake and the surrounding land. A large portion of this land, 8,925 acres, has been leased to the Texas Parks and Wildlife Department (TPWD) for use as a WMA. Most of the West Impact Area is located within the WMA. The State of Texas owns 6,242 acres where the Camp Maxey Texas National Guard installation is located. Much of the East Impact Area is located within this installation.

2.1.2.1.3.2 The remaining land is privately owned. One significant owner is Paris Junior College, which owns 235 acres. Privately-owned property is generally used for residential, farming, and ranching purposes, and the majority of privately owned land is in the southern portion of the former camp in areas not used for ordnance training. The majority of the ranges were located in what is today federal or state-owned property.

2.1.2.2 Munitions/Release Profile

2.1.2.2.1 Release Mechanisms

From 1942 to 1945 the Former Camp Maxey was used for numerous types of training in live fire weapons to include the munitions items listed in Section 2.1.2.2.2. An array of weapon systems were fired into two distinct impact areas (East and West) at Camp Maxey, including small arms, mortars, bazookas, mines, rifle grenades, anti-tank guns, and artillery. Training also included hand grenades and pyrotechnics. MEC, to include UXO and MC, can exist in a number of physical states that may create risk from exposure to explosive and chemical hazards. MEC may occur at the MRSs from either being abandoned or discarded at the site or from fired munitions that failed to function as designed. MC can be released from fully intact munitions through corrosion and breaching of the casing or the development of cracks, from dissolved filler leaking through screw threads on the munitions casing, or exposed filler that resulted from incomplete detonation. MC can also be released from MD. Explosive filler residue may be scattered over the MRS or may be partially encased in the remains of the munitions casing.

2.1.2.2.2 Munitions Types/Contaminants and Media of Potential Concern

The following munitions items have been identified during investigations on land at the Former Camp Maxey. Pat Mayse Lake was purposefully excluded from the RI effort and will be evaluated separately.

- 2.36-inch HEAT Rockets
- 2.36-inch Practice Rockets
- Blasting Caps
- 37mm AP Projectiles
- M-7 Rifle Grenades
- 37mm HE Projectile
- 37mm APHE Projectiles
- 57mm Projectiles
- 75/76mm APHE Projectiles
- 155mm Projectiles
- 3-inch APHE Projectiles
- .50 cal Rounds
- Hand Grenades
- Practice Hand Grenade
- 81mm HE Mortars
- 81mm Practice Mortars
- 60mm Illumination Mortars
- 60mm Practice Mortars
- 40mm Smoke Projectiles
- 20mm Practice Projectiles
- M-7 Rifle Grenades
- M31 Rifle Grenades
- M9A1 Rifle Grenades
- MK II Hand Grenades
- Hand Grenade Simulators
- Artillery Simulators

2.1.2.2.3 Migration Routes and Mechanisms

Migration of MEC on the surface may occur naturally through soil erosion or a storm event, or by human activities such as farming, ranching, construction, or maintenance at the site. Migration of MEC in the subsurface may occur naturally through surface soil erosion or by intrusive human activities such as farming or ranching, construction, excavation, and maintenance at the site. Migration of MEC within near-shore marine environments and impounded water bodies is possible due to a storm event, potential dredging, and recreational activities. Migration of MC may occur naturally through surface soil erosion, plant or animal uptake, or by human activities such as maintenance and site work. If soil erosion and subsequent surface runoff carries MC into inland impounded water bodies, migration of MC through surface water and sediment contact, or indirect or direct ingestion can occur as well. Migration of MC may occur through groundwater.

2.1.2.3 Physical Profile

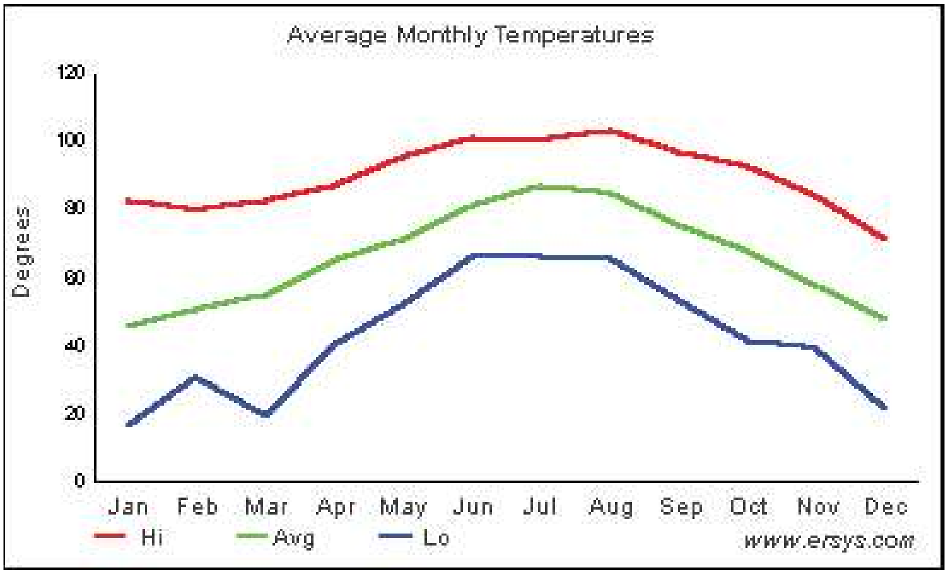
2.1.2.3.1 Climate/Meteorology

2.1.2.3.1 Lamar County is located on the edge of the Gulf Coastal Plain, which is characterized by a humid, subtropical climate, predominantly continental in winter and marine in summer. Tropical maritime air masses flow through the area in late spring, summer, and early fall, and polar air masses frequent the area in winter. Average high temperatures climb to 95 degrees in August and average lows reach 30 degrees in January.

2.1.2.3.2 Rainfall is fairly well distributed through the year and the average annual rainfall is 47.7 inches. From April through September, rain generally falls during thunderstorms, and fairly large amounts fall in a short time. In winter, precipitation may fall as rain, freezing rain, sleet, or snow, but thunderstorms and heavy rains may occur in any month. About 50 thunderstorms occur each year with a few of these thunderstorms accompanied by destructive wind, hail, or high intensity rain. Prevailing winds are southerly during all months of the year. In January and February, northerly winds occur from cold fronts moving through the area. Relative humidity is close to 83 percent during the early hours of the day on the average and drops to around 55 percent late in the afternoon. In Paris, the sun shines for about 75 percent of the daylight hours in the summer.

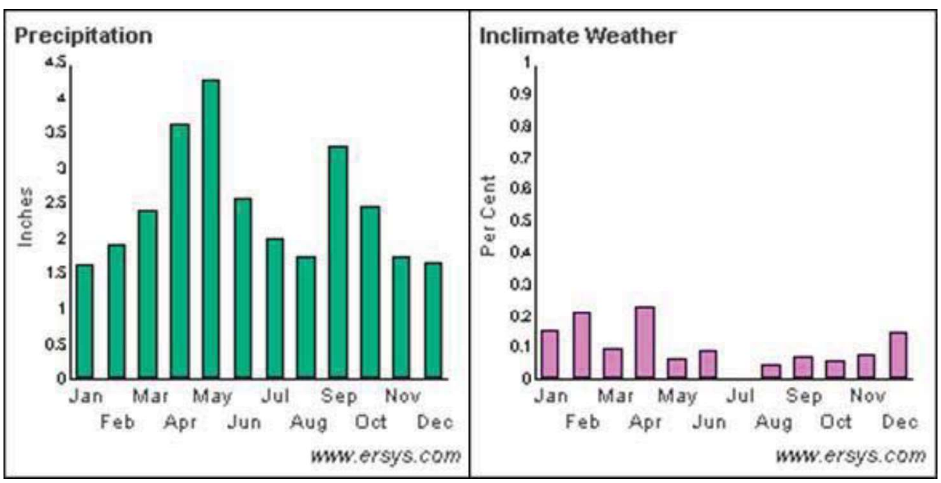
2.1.2.3.3 The following figure illustrates historical weather temperatures that are typical for each month in the Dallas area.

Figure 2-1: Average Monthly Temperatures for Dallas, Texas



2.1.2.3.4 The two charts below show information relevant to precipitation in the Dallas area. The first chart is the typical precipitation for the month indicated. The second chart shows the percentage of each month that is subject to inclement weather (i.e., rain, snow, etc.).

Figure 2-2: Average Precipitation and Inclement Weather



2.1.2.3.2 Topography

2.1.2.3.2.1 Former Camp Maxey lies within the Gulf Coastal Plains physiographic province (BEG, 1996). The Gulf Coastal Plains include three subprovinces, named the Coastal Prairies, the Interior Coastal Plains, and the Blackland Prairies. Former Camp Maxey is located in the northwest portion of the province, in the Blackland Prairies subprovince. The Gulf Coastal Plain is generally a gently undulating plain characterized by uplands of low relief and broad river valleys. The plain includes sedimentary rocks of both marine and continental origin. The rock units range in age from Late Cretaceous to Cenozoic and form the upper portion of the depositional sequence in the Gulf of Mexico Basin. Regionally, the rocks dip to the southeast.

2.1.2.3.2.2 In the Blackland Prairies subprovince, chalks and mark weather to deep, black, fertile clay soils. The blacklands have a gentle undulating surface, cleared of most natural vegetation and cultivated for crops. Elevations within the Former Camp Maxey generally range from approximately 450 to 550 feet amsl. The elevation of Pat Mayse Lake is approximately 450 feet amsl

2.1.2.3.3 Regional Geology

2.1.2.3.3.1 During most of the Paleozoic era (570 million to 245 million years ago), a sedimentary basin existed throughout much of north-central Texas. This basin received sediments of sandstone, limestone, carbonaceous shales, and other marine sediments. Sediments were deposited in this basin until late Pennsylvanian time (320 to 286 million years ago) when the Llano Uplift and Ouachita Fold Belt caused a regional tilting to the west and faulting in the immediate uplift area. The Pennsylvanian-Cretaceous unconformity shows a long period of emergence and erosion (Nordstrom, 1982).

2.1.2.3.3.2 During the first half of the Mesozoic era (245 to 144 million years ago), withdrawal of the seas from the north-central Texas area along with subsidence in the Gulf Coast embayment led to a reversal of draining direction. By the close of Jurassic time, Paleozoic rocks had been reduced to an almost flat-featureless plain, or peneplain, upon which marine sediments were deposited along an oscillating shoreline during the Cretaceous period (144 to 66 million years ago). Two major invasions of the seas during the Cretaceous period are represented by the Comanche and Gulf Series. During the late Cretaceous (Gulf Series), a general uplift occurred to the west and the seas.

2.1.2.3.3.3 Two stratigraphic units of the Gulf Series outcrop in the Former Camp Maxey area: the Eagle Ford Group and the Bonham Formation. The Eagle Ford Formation outcrops in approximately the northern two-thirds of the former camp area. The Eagle Ford Group is approximately 350 feet thick and consists of a medium to dark gray, bituminous, selenitic shale. It contains a few thin platy beds of sandstone and sandy limestone. The Bonham Formation outcrops in approximately the southern third of the former camp area. The Bonham Formation ranges from 375 to 530 feet thick, and consists of marl and clay. This greenish-gray waxy clay weathers yellowish-gray and is fossiliferous.

2.1.2.3.3.4 At the close of the Cretaceous period, sediments of Tertiary and Quaternary age were deposited. Throughout Tertiary time (66 million to 2 million years ago), the land surface was eroded and modified by streams. During Quaternary time (2 million years ago to present), the streams deposited alluvial sediments. The older sediments are represented by terrace deposits above the alluviated valleys of present streams (Nordstrom, 1982).

2.1.2.3.3.5 Quaternary age sediments outcrop in several areas within the Former Camp Maxey boundary. These sediments consist primarily of gravel, sand, and silt. Basal gravel grades upward to tan and gray sand and silt. Along the bed of Sanders Creek, alluvial deposits are found. These flood-plain deposits occur along the Red River drainage system and include low terrace deposits.

2.1.2.3.4 Soil

2.1.2.3.4.1 A soil survey conducted by the U.S. Department of Agriculture in cooperation with the Texas Agricultural Experiment Station identified six soil associations within the county. The six soil associations consist of the Houston Black-Leson-Heiden, Annona- Freestone-Woodtell, Wilson-

Normangee-Crockett, Trinity-Kaufman, Whakana-Porurn, and Severn-Caspiana-Desha (USDA, 1979). Of the six soil associations identified within Lamar County, three are common to the Former Camp Maxey area: the Annona- Freestone-Woodtell Association, the Whakana-Porum Association, and the Severn-Caspiana-Desha Association. Each of the three soil associations is described briefly in the following paragraph.

2.1.2.3.4.2 The Annona-Freestone-Woodtell Association consists of forested soils that have a loamy surface layer and a clayey subsoil. Soils of this association are nearly level to strongly sloping and are slowly permeable to very slowly permeable. This soil association occupies the southern portion of Former Camp Maxey. The Whakana-Porum Association consists of forested soils that have a loamy surface layer and clayey subsoil. Soils of this association are gently sloping to moderately steep and are moderately to very slowly permeable. It covers the majority of land surrounding Pat Mayse Lake. The Severn-Caspiana-Desha Association consists of soils on bottom lands and low stream terraces. Soils of this association are nearly level to gently sloping and are moderately rapidly to very slowly permeable north of the Pat Mayse dam.

2.1.2.3.5 Hydrogeology

2.1.2.3.5.1 Former Camp Maxey is underlain by aquifers in Cretaceous rocks. Immediately underlying the Eagle Ford Group, which outcrops in the Former Camp Maxey area, is the Woodbine Group. The Woodbine Group is the oldest member of the Gulf Series and consists of medium to coarse iron sand, sandstone, clay, and some lignite. The Woodbine Group provides water for all purposes in the Former Camp Maxey area (Nordstrom, 1982).

2.1.2.3.5.2 The group is divided into three water-bearing parts - upper, middle, and lower - which vary considerably in productivity and quality. The upper Woodbine contains water of extremely poor quality with excessive iron concentrations. The middle Woodbine generally contains water of good quality; however, high iron concentrations occur in some areas. The lower Woodbine is the most productive and contains good quality water. High yields are characteristic from the outcrop just north of the Former Camp Maxey area. The salinity of water increases with the depth of the formation.

2.1.2.3.5.3 The total thickness of the Woodbine ranges from 230 feet near the outcrop to 700 feet near the downdip limit of fresh to slightly saline water. The net sand thickness is less than 350 feet, with most of this occurring in the lower Woodbine. The average artesian coefficient of storage is 0.00015 where the Woodbine is under artesian conditions, and the specific yield is about 15 percent. Transmissivity values in downdip areas average 4,700 gallons per day per foot and permeability values average 44 gallons per day per foot.

2.1.2.3.5.4 Chemical quality deteriorates rapidly in well depths below 1,500 feet. In areas between the outcrop and this depth, quality is considered very good overall as long as groundwater with high iron concentrations from the upper Woodbine is sealed off. Water is classified as soft with most chemical analyses showing total hardness as calcium carbonate below 60 milligrams per liter.

2.1.2.3.5.5 Underlying the Gulf Series is the Comanche Series. The upper members of the series include the Washita Group and the Fredericksburg Groups, both of which consist primarily of limestone which does not produce significant quantities of groundwater. The oldest member of the Comanche Series is the Trinity Group. The Trinity Group is a large and prolific aquifer in some areas of north-central Texas; however, in the Former Camp Maxey area, water within this aquifer is generally too saline to use.

2.1.2.3.6 Hydrology

2.1.2.3.6.1 The majority of the Former Camp Maxey area lies within the Sanders Creek watershed and drainage basin. A dam built on Sanders Creek, a tributary of the Red River, forms the Pat Mayse Lake. Pat Mayse Lake is the principal surface water body on the site. The area generally drains to the northeast. About three miles downstream from Pat Mayse Lake, Sanders Creek empties into the Red River, which flows to the south and east until it meets the Mississippi River in eastern Louisiana. Shortly thereafter the Mississippi River empties into the Gulf of Mexico.

2.1.2.3.6.2 The Pat Mayse dam was built in 1967 for flood-control and municipal and industrial water supply purposes. The dam is situated at approximately the northwest boundary of the former camp. Pat Mayse Lake is a USACE project. The total drainage area for the lake is approximately 175 square miles. At the normal lake pool elevation of 451 feet mean sea level, the lake capacity is approximately 124,000 acre-feet. When the water surface is at 451 feet mean sea level, the lake covers 5,993 acres. At the flood control elevation of 460.5 feet mean sea level, the surface area of the lake is 7,680 acres.

2.1.2.4 Land Use and Exposure Profile

2.1.2.4.1 Current Land Use/Activities

2.1.2.4.1.1 The land uses within Former Camp Maxey and surrounding the former camp are predominantly ranching, farming, rural residential, and recreational. Approximately 6,000 acres of the former camp are now occupied by Pat Mayse Lake, and over 6,500 acres are occupied by the Camp Maxey National Guard Installation. Approximately 60 percent of the land within the former area (not including the lake or the National Guard installation) is used for parks and wildlife management. The Pat Mayse WMA contains 8,925 acres of land leased by TPWD from USACE. USACE maintains additional acreage surrounding the lake for flood control.

2.1.2.4.1.2 Within the land maintained by USACE are five developed park areas for public camping, picnicking, swimming, boating, fishing and other outdoor recreation. The five areas include Camp Kiwanis, Pat Mayse West, Pat Mayse East, Sanders Cove, and Lamar Point. Sanders Cove is located on the east side of the lake, Lamar Point is located on the south side, and the remaining areas are located on the north side. In addition to the developed areas, undeveloped areas are used for ATV off-road recreation and public hunting. One 10-acre area north of the lake was used frequently for ATV off-road recreation until it was closed in 1997 after numerous OE items were identified there. Intrusive activities related to recreational purposes within the MRS are generally limited to shallow hand excavations 6-12 inches deep in designated camping areas.

2.1.2.4.1.3 The remaining 40 percent of the former camp is used for ranching, farming, and residential purposes. Private homes are generally in rural areas; however, some subdivision type housing exists primarily in the southeast corner of the former camp, in the area where the cantonment was located and to the east towards Highway 271.

2.1.2.4.1.4 The largest employers in the Paris area include the Campbell Soup Company, soup and juice manufacturer; Kimberly-Clark Corporation, disposable diaper manufacturer; Merico-Earth Grains, snack cake and bread manufacturer; St. Joseph's Hospital and Health Center; and McCuistion Regional Medical Center.

2.1.2.4.1.5 As of 1993, the business establishments in Lamar County included agricultural, forestry, and fishing (2.7 percent); construction (8.5 percent); manufacturing (5.7 percent); transportation, communications, and public utilities (4.9 percent); trade (31.0 percent); finance, insurance, and real estate (7.1 percent); services (33.6 percent), and government (6.6 percent). Of the people employed in Lamar County, 30.3 percent are employed by manufacturing firms, 24.5 percent by the service industry, 19.6 percent by trade firms, 15.3 percent by the government, and the remaining 10.3 percent by other businesses.

2.1.2.4.1.6 The Former Camp Maxey area has been deeded or sold to a variety of public and private owners. Approximately 6,500 acres were deeded to the State of Texas for use by the Texas National Guard. This area, which is called Camp Maxey, is not eligible for FUDS funding, and is not a part of this report.

2.1.2.4.1.7 The primary feature on the Former Camp Maxey land is Pat Mayse Lake; however, the portions of the lake which fall inside the Former Camp Maxey MRS were not investigated and are not included in the RI/FS Report. Pat Mayse Lake was built by the USACE to provide flood control, supply water, preserve fish and wildlife, and provide recreation in the form of boating, fishing and swimming. The lake serves as a reservoir, supplying water to the City of Paris, who then supplies Lamar County and other municipalities. The city owns a two-acre site on the south side of the lake. From this point, water is pumped in two 36-inch water lines that extend southward through the existing Camp Maxey.

2.1.2.4.1.8 Pat Mayse Lake includes six access points for use by the public. These access points have been developed to include campgrounds, picnic areas, swimming areas, and boat ramps. Three of these are on the north side of the lake (The Dam Site, Pat Mayse Park East, and Pat Mayse Park West); one on the east side (Sanders Cove); and one on the south side (Lamar Point). The remainder of the land is undeveloped and open to the public for hunting. The Tulsa District of the USACE maintains an office on the north side of the Lake. The Park Ranger also utilizes this office.

2.1.2.4.1.1 Current Human Receptors

Depending on the location within the Former Camp Maxey, potential current human receptors include a wide variety of people to include residents, outdoor workers (e.g., landscapers, construction/utilities), commercial and industrial employees, recreational users (e.g., hunters, campers), visitors, and trespassers.

2.1.2.4.1.2 Potential Future Land Use/Activities

It is anticipated that the land use will remain the same and that development for similar purposes will likely continue on site.

2.1.2.4.1.3 Potential Future Human Receptors

It is anticipated that potential future human receptors will remain the same and but the numbers may increase as development will likely continue on site.

2.1.2.4.1.4 Land Use Restrictions

Various rules and regulations apply to recreational use within the Pat Mayse WMA and State Park, Pat Mayse Lake, and the surrounding USACE property. All persons accessing the Pat Mayse WMA must possess required permits, stamps or license and must check in upon entering and check out at the end of their activities at the self-registration station. Persons using the WMA may not enter restricted areas identified by boundary signs and/or marked on Pat Mayse (WMA) maps or those areas identified verbally by area personnel. Motor vehicles may not be used in areas other than on designated roads (fire guards along fences are not designated roads) and persons may not camp or build a fire anywhere other than in a designated campsite. Access to the Texas National Guard Installation is restricted by a fence and armed guards.

2.1.2.4.1.5 Archeological/Historical Resources

2.1.2.4.1.5.1 The Former Camp Maxey area has a low probability of archeological and historical significance. No known significant Native American activities occurred in the area. Military buildings and sites of historic significance from World War II have been lost through deactivation, inattention and redevelopment.

2.1.2.4.1.5.2 In a letter dated October 9, 1997, prior to the initiation of the OE characterization, the Texas Historical Commission identified the project area as having the "potential for containing archeological sites which may be eligible for inclusion in the National Register of Historic Places or for designation as State Archeological Landmarks." The letter also suggested that an archeological survey be conducted within those portions of the study area that were to be subjected to brush clearing or ground disturbance (UXB, 1998). As a result, during the 1997 field activities an archeologist from the USACE, Fort Worth District, periodically inspected grids for items of archeological or historical value. No items of cultural, historic, or archeological significance were encountered by USACE while on site in 1997. In addition, no items of apparent historical or cultural significance were encountered during the RI field work.

2.1.2.4.1.6 Demographics/Zoning

According to the U.S. Department of Commerce Bureau of the Census, Lamar County has a population of 49,811 and Paris has a population of 25,082. The population density was 54.9 persons per square mile for the county. In Lamar County, 23.8 percent of the population was under 18 years of age and 17.6 percent was over 65 years of age. Zoning information for Lamar County is not known to be available.

2.1.2.5 Environmental Profile

2.1.2.5.1 The Former Camp Maxey lies within the gently rolling landscape of the Northern Post Oak Savanna ecoregion. The majority of the vegetative cover consists of deciduous forest or woodland composed mostly of post oak (Quercus stellata), blackjack oak (Quercus marilandica), eastern redcedar (Juniperus virginiana), and black hickory (Carya texana) (Griffith et al., 2007). The understory can include yaupon (Ilex vomitoria), farkleberry (Vaccinium arboreum), winged elm (Ulmus alata), and American beautyberry (Callicarpa americana) (Griffith et al., 2007). Prairie openings contain little bluestem (Schizachyrium scoparium) and other grasses and forbs.

2.1.2.5.2 Ford and Hampton (2005) described the vegetation in the area of the Former Camp Maxey as consisting of plants of the Oak Woods and Blackland Prairie ecosystems (Farquhar et al., 1996). About 65 percent of the installation is post oak/black hickory woodland dominated by post oak, black hickory, southern red oak (Q. falcata), and blackjack oak with an understory of dogwood (Cornus florida) and farkleberry. Little bluestem indiangrass covers approximately 18 percent of the installation where prescribed burning has controlled the encroachment of trees. Shortleaf pine forest is sparse, covering only about 3 percent of the area in small scattered plots. Streamside trees are characterized by water oak (Q. nigra) and elms (Ulmus alata and U. americana).

2.1.2.5.3 Storm water runoff from the site flows into Pat Mayse Lake (TCEQ classified segment 0209) which is the dominant surface water feature in the area. A wetland inventory of the area in 1998 indicated approximately 60 hectares of regulated water bodies, including streams, ponds, lakes and small wetlands (Gravett et al., 1999).

2.1.2.5.1 Wildlife

2.1.2.5.1.1 Common wildlife species that occur within the Northern Post Oak Savanna ecoregion include white-tailed deer (Odocoileus virginianus), eastern wild turkey (Meleagris gallopavo silvestris), northern bobwhite (Colinus virginianus), eastern fox squirrel (Sciurus niger), and eastern gray squirrel (Sciurus carolinensis). Information on typical animal species for the Northern Post Oak Savanna was obtained from the TPWD.

2.1.2.5.1.2 A mammal survey was conducted at Camp Maxey (Texas Army National Guard training site) from October 2002 through June 2004. Thirty-one species were documented and include Virginia opossum (Didelphis virginiana virginiana), least shrew (Cryptotis parva parva), nine-banded armadillo (Dasypus novemcinctus mexicanus), several bat species, coyote (Canis latrans frustror), red fox (Vulpes vulpes fulva), common gray fox (Urocyon cinereoargenteus floridanus), common raccoon (Procyon lotor fuscipes), striped skunk (Mephitis mephitis mesomelas), bobcat (Lynx rufus texensis), white-tailed deer (O. virginianus texana) and several species of squirrels, mice and rats (Edwards and Johnson, 2007).

2.1.2.5.1.3 A herpetofauna biological survey was conducted in 2005 for Camp Maxey (Ford and Hampton, 2005). An estimated 5,009 animals were recorded representing 44 species, including five salamanders, 13 anurans, eight turtles, seven lizards, and 11 snakes. Amphibians comprised over 92 percent of the censused herpetofauna community. Of the anurans, northern cricket frog (Acris crepitans) was the most abundant while the eastern newt (Notopthalamus viridescens) was the most abundant salamander. Individuals of pond slider (Trachemys scripta) were the majority of the turtles censused. For the lizards, eastern fence lizard (Sceloporus undulates) and little brown skink (Scincella lateralis) comprised 65 percent of the sampled community with approximately 41 individuals each. The cottonmouth (Agkistrodon piscivorus) was the dominant snake species with 56 censused animals (Ford and Hampton, 2005). The Arkansas meadow-rue, which is listed as a species of concern, has been found in Lamar County (TPWD, 2014).

2.1.2.5.2 Protected Species

2.1.2.5.2.1 Table 2-1 lists animal species in Lamar County, Texas that are protected by the Federal or State government. The habitat requirements for most of the species listed in Table 2-1 are not present at the Former Camp Maxey. A few of the listed species have habitat requirements that may be considered comparable to the actual habitats present within the vicinity of the site. While some of the bird species listed have been found in Lamar County (i.e., Bald Eagle, American Peregrine Falcon, Arctic Peregrine Falcon, and Interior Least Tern), no protected species have been observed at the Former Camp Maxey.

2.1.2.5.2.2 The watershed is not a designated critical habitat for any of the Federal or State protected species inhabiting Lamar County, TX. The Pat Mayse WMA is located within the Western Range Area of the Former Camp Maxey (the western edge of the Pat Mayse Lake). The primary utilization of the Pat Mayse WMA is for public hunting lands. The Arkansas meadow-rue, which is listed as a plant species of concern, has been found in Lamar County (TPWD, 2014), but was not encountered or impacted during the RI field activities.

Table 2-1: Lamar County, TX - Threatened and Endangered Species

Common Name	Scientific Name	Federal Status	State Status	Habitat Potentially Present in Upland Habitat at Camp Maxey?	Habitat Requirements
BIRDS					
American Peregrine Falcon	*Falco peregrinus anatum*	DL	T	No	Year-round resident and local breeder in west Texas; nests in tall cliff eyries; migrant across state from more northern breeding areas in US and Canada; winters along coast and farther south. Occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	DL		No	Migrant throughout state from subspecies' far northern breeding range; winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.
Bachman's Sparrow	*Aimophila aestivalis*		T	Yes	Open pine woods with scattered bushes and grassy understory in Pineywoods region, brushy or overgrown grassy hillsides, overgrown fields with thickets and brambles, grassy orchards; remnant grasslands in Post Oak Savannah region; nests on ground against grass tuft or under low shrub
Bald Eagle	*Haliaeetus leucocephalus*	DL	T	Yes	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds.
Cerulean Warbler	*Dendroica cerulea*			No	Treetops of riverbank woodlands, swamps, and bottomlands; mainly insectivorous.
Eskimo Curlew	*Numenius borealis*	LE	E	No	Historic; nonbreeding: grasslands, pastures, plowed fields, and less frequently, marshes and mudflats.
Henslow's Sparrow	*Ammodramus henslowii*			No	Wintering individuals (not flocks) found in weedy fields or cut-over areas where bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking.
Interior Least Tern	*Sterna antillarum athalassos*	LE	E	No	Subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches,

Common Name	Scientific Name	Federal Status	State Status	Habitat Potentially Present in Upland Habitat at Camp Maxey?	Habitat Requirements
					wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony.
Piping Plover	*Charadrius melodus*	LT	T	No	Wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats.
Sprague's Pipit	*Anthus spragueii*	C		No	Texas migrant, strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.
Whooping Crane	*Grus americana*	LE	E	No	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.
Wood Stork	*Mycteria americana*		T	No	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.
FISHES					
Blackside darter	*Percina maculata*		T	No	Red, Sulfur and Cypress River basins; clear, gravelly streams; prefers pools with some current, or even quiet pools, to swift riffles.
Blue sucker	*Cycleptus elongatus*		T	No	Larger portions of major rivers in Texas; usually in channels and flowing pools with a moderate current; bottom type usually of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles.
Creek chubsucker	*Erimyzon oblongus*		T	No	Tributaries of the Red, Sabine, Neches, Trinity, and San Jacinto rivers; small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, and upstream creeks.
Goldeye	*Hiodon alosoides*			No	Red River basin below reservoir; spawns spring to July in shallow firm-bottomed backwaters or gravel shoals in tributaries, for the rest of the year adults remain in quiet turbid water of medium to large lowland rivers, small lakes, marshes and muddy shallows connected to them; young feed on microcrustaceans and other inverts; adult feed on surface water insects, also frogs, fishes, and small mammals.

Common Name	Scientific Name	Federal Status	State Status	Habitat Potentially Present in Upland Habitat at Camp Maxey?	Habitat Requirements
Orangebelly darter	*Etheostoma radiosum*			No	Red through Angelina River basins; headwaters ranging from high gradient streams to more sluggish lowland streams, gravel and rubble riffles preferred; eggs buried in gravel and riffle raceways, post-larvae live in quiet water, move into progressively faster water as they mature; young feed mostly on copepods and cladocerans, adults feed on mayfly and fly larvae; spawn late February through mid-April in eastern Texas.
Paddlefish	*Polyodon spathula*		T	No	Prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars.
Shovelnose sturgeon	*Scaphirhynchus platorynchus*		T	No	Open, flowing channels with bottoms of sand or gravel; spawns over gravel or rocks in an area with a fast current; Red River below reservoir and rare occurrence in Rio Grande.
Taillight shiner	*Notropis maculatus*			No	Sulfur River and Big Cypress Bayou; mostly headwaters, typically large sluggish, mud-bottomed small to large streams and lakes, usually with some aquatic vegetation; spawns March-October in backwaters and pools; feeds mainly on insect larva and cladocerans, also algae.
Western sand darter	*Ammocrypta clara*			No	Red and Sabine River basins; clear to slightly turbid water of medium to large rivers that have moderate to swift currents, primarily over extensive areas of sandy substrate.
INSECTS					
American burying beetle	*Nicrophorus americanus*	LE		Yes	Varies widely from oak-hickory and coniferous forest ridges tops or hillsides to riparian corridors and valley floor pastures; extremely xeric, saturated, or loose sandy soils unsuitable; adults primarily above ground, eggs in soil adjacent to buried carcass, teneral adults overwinter in soil.
MAMMALS					
Black bear	*Ursus americanus*	T/SA;NL	T	Yes	Bottomland hardwoods and large tracts of inaccessible forested areas; due to field characteristics similar to Louisiana Black Bear (LT, T), treat all east Texas black bears as federal and state listed Threatened.
Plains spotted skunk	*Spilogale putorius interrupta*			Yes	Catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie.
Red wolf	*Canis rufus*	LE	E	No	Extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies.

Common Name	Scientific Name	Federal Status	State Status	Habitat Potentially Present in Upland Habitat at Camp Maxey?	Habitat Requirements
MOLLUSKS					
Common pimpleback	*Quadrula pustulosa*			No	Small streams to larger rivers, and associated with nearly every bottom type except deep shifting sands; Red River downstream of Lake Texoma and possibly Big Cypress Bayou and lower Sulphur river basins.
Fawnsfoot	*Truncilla donaciformis*			No	Small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.
Ouachita rock pocketbook	*Arkansia wheeleri*	LE		No	Large, dense, diverse beds of other unionids; stable mud, sand, and gravel substrates of medium-sized rivers, backwater or slackwater areas adjacent to the main channel; also reported from cobble-gravel bottoms in pools of small, slow-flowing rivers; Red River Basin.
Wartyback	*Quadrula nodulata*			No	Gravel and sand-gravel bottoms in medium to large rivers; Red, Sabine, and Neches River basins.
White heelsplitter	*Lasmigona complanata*			No	Typically large rivers and streams with sluggish, turbid waters, on mud or mud-gravel bottoms; also smaller streams and reservoirs usually deep in soft mud or occasionally among rocks; quiet areas of otherwise swift streams; Red River with unsuccessful introductions into the upper Trinity River System.
REPTILES					
Alligator snapping turtle	*Macrochelys temminckii*		T	No	perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October
Texas horned lizard	*Phrynosoma cornutum*		T	No	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September.
Timber/Canebrake rattlesnake	*Crotalus horridus*		T	Yes	Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover (i.e. grapevines or palmetto).
PLANTS					
Arkansas meadow-rue	*Thalictrum arkansanum*			Yes	Mostly deciduous forests on alluvial terraces and upper drainages of hardwood slope forests at contacts

Common Name	Scientific Name	Federal Status	State Status	Habitat Potentially Present in Upland Habitat at Camp Maxey?	Habitat Requirements
					with calcareous prairies; flowering March-April.

[a] This table includes all state and federally listed threatened and endangered species known to occur in Lamar County, Texas and have critical habitat in the county. No species have been observed at Camp Maxey.

[b] TPWD 2013.

Status Key:
LE, LT -Federally Listed Endangered/Threatened
PE, PT -Federally Proposed Endangered/Threatened
SAE, SAT -Federally Listed Endangered/Threatened by Similarity of Appearance
C -Federal Candidate for Listing; formerly Category 1 Candidate
DL, PDL -Federally Delisted/Proposed for Delisting
NL -Not Federally Listed
E, T -State Listed Endangered/Threatened
NT -Not tracked or no longer tracked by the State
“blank” -Rare, but with no regulatory listing status

2.2 PRELIMINARY REMEDIATION GOALS AND REMEDIAL ACTION OBJECTIVES

2.2.1 MEC and MC

2.2.1.1 The primary goal of the RI/FS MEC investigation at the Former Camp Maxey is to characterize the nature and extent of MEC and MC. MEC has previously been recovered from several areas on the former military property and may remain on the site as a result of activities conducted by the DoD during operation of Camp Maxey and may pose a threat to human health. An intrusive geophysical investigation and MEC sampling was conducted to determine the presence and characteristics of MEC. Following the MEC investigation, soil samples were collected, using incremental sampling for surface soil and discrete sampling for subsurface soil, from various locations to obtain data to delineate the nature and extent of potential MC. Data from these investigations was combined with previous MEC investigation and removal data to complete an RI and FS for the Former Camp Maxey and to perform Munitions response Site Prioritization Protocol (MRSPP) scoring of the MRSs defined in the final CSM.

2.2.1.2 The primary goals of the Former Camp Maxey RI and FS are:

- Evaluate the CSM
- Complete geophysical surveys and intrusive investigations of potential MEC
- Collect soil samples to assess presence of MC at the MRS
- Determine nature and extent of MEC and MC at the site
- If necessary, further delineate the site into separate MRSs
- Evaluate human health and ecological risk to include the development of MEC Hazard Assessments (MEC HAs)
- Perform MRSPP scoring of defined MRSs
- Determine if a remedial action may be warranted
- Identify, develop, and evaluate potential remedial alternatives

2.3 PRELIMINARY IDENTIFICATION OF POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND "TO BE CONSIDERED" INFORMATION

2.3.1 Definition of Applicable or Relevant and Appropriate Requirements

2.3.1.1 According to 40 Code of Federal Regulations (CFR) 300.5, applicable requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not ''applicable'' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

2.3.1.2 Response actions under FUDS must identify and attain or formally waive applicable or relevant and appropriate requirements (ARARs) under Federal and State laws (ER 200-3-1). Although the RI is not considered a response action, preliminary identification of chemical-specific and location-specific ARARs is conducted during RI site characterization. ARARs are used as a "starting point" to determining the protectiveness of a site remedy. When ARARs do not exist for a particular chemical or remedial activity, other criteria, advisories, and guidance referred to as To Be Considered (TBC) are useful in designing and selecting a remedial alternative.

2.3.1.3 As the RI/FS process continues, the list of ARARs and TBCs will be updated, particularly as guidance is issued by state and federal agencies. ARARs and TBCs will be used as a guide to establish the appropriate extent of site cleanup; to aid in scoping, formulating, and selecting proposed treatment technologies; and to govern the implementation and operation of the selected remedial alternative. As part of the FS, primary consideration should be given to remedial alternatives that attain or exceed the requirements of the identified ARARs and TBCs. Throughout the RI/FS phase, ARARs and TBCs are identified and used by taking into account the following:

- Contaminants suspected or identified to be at the site;
- Chemical analysis performed, or scheduled to be performed;
- Types of media (air, soil, ground water, surface water, and sediment);
- Geology and other site characteristics;
- Use of site resources and media;
- Potential contaminant transport mechanisms;
- Purpose and application of potential ARARs and TBCs; and
- Remedial alternatives considered for site cleanup.

2.3.1.4 Chemical-Specific - Chemical-specific requirements define acceptable exposure levels for specific hazardous substances and, therefore, may be used as a basis for establishing preliminary remediation goals and cleanup levels for chemicals of concern in the designated media. Chemical-specific ARARs and TBCs are also used to determine treatment and disposal requirements for remedial actions. In the event a chemical has more than one requirement, the more stringent of the two requirements will be used.

2.3.1.5 Location-Specific - Location-specific requirements set restrictions on the types of remedial actions that can be performed based on site-specific characteristics or location. Alternative remedial actions may be restricted or precluded based on federal and state laws for hazardous waste facilities or proximity to wetlands, floodplains or man-made features, such as existing landfills, disposal areas, and local historic landmarks or buildings.

2.3.1.6 Action-Specific - Action-specific requirements set controls or restrictions on the design, implementation, and performance of remedial actions. They are triggered by the particular types of treatment or remedial actions that are selected to accomplish the cleanup. After remedial alternatives are developed, action-specific ARARs and TBCs that specify remedial action performance levels, as well as specific contaminant levels for discharge of media or residual chemical levels for media left in place, are used as a basis for assessing the feasibility and effectiveness of the remedial action.

Table 2-2: Potential ARARs and TBC Criteria

Activity	ARAR/TBC	Reference/Citation	Applicability or Relevance
Chemical-Specific			
No applicable chemical-specific ARARS or TBC Criteria.			
Location-Specific			
No applicable location-specific ARARS or TBC Criteria.			
Action-Specific			
Consolidated Shots (munitions destruction)	Resource Conservation and Recovery Act (RCRA) Subpart X (Miscellaneous Units)	40 CFR Part 264, Subpart X	RCRA miscellaneous units are a unique category of hazardous waste management units. Subpart X is applicable if munitions are consolidated for treatment, storage, or disposal.
To Be Considered (TBC) Criteria			
No additional and applicable TBC Criteria.			

2.4 Institutional Analysis

2.4.1 Institutional analyses are prepared to support the development of institutional control strategies and munitions response alternatives. These strategies rely on existing powers and authorities of government agencies to protect the public at large from MEC and MC risks.

2.4.2 A review of government institutions and private entities that exercise jurisdiction and ownership indicates that the property encompassing the Former Camp Maxey is under the jurisdiction of both government agencies and private landowners including the USACE and the State of Texas. On properties the federal or state government owns or controls, remedial actions, to include land use controls (LUCs), can be more easily implemented, maintained, or enforced. Before any alternative containing a LUC component can be selected, there needs to be documented commitment from the current landowners that they will implement, maintain, and enforce the LUCs. See the Institutional Analysis Report in Appendix M for details.

2.5 Data Needs and Data Quality Objectives

2.5.1 Data Needs

2.5.1.1 Data needs support the primary goal to characterize the nature and extent of MEC and MC at the Former Camp Maxey. The data collected was used to perform and complete the RI, human health and ecological risk assessments, FS, MEC hazard assessments, and MRSPP scoring.

2.5.1.2 Historical data were considered when determining data needs. Five data collection areas were identified for the RI; Western Range Area, Eastern Range Area, Grenade Range Area, Cave Training Area, and Mine and Booby Trap Training Area. The Western and Eastern Range areas make up the largest data collection areas. Portions of the Eastern Range Area were excluded from the study area, since there is sufficient data available from previous investigations and removal actions.

2.5.1.3 Historical data, as well as previous investigation data, concerning the presence of MEC was incorporated into the RI Report as both site history and RI data. The large overall size of Former Camp Maxey has resulted in multiple investigation and clearance activities. This information was useful for MEC characterization activities for the overall site.

2.5.1.4 Data from the geophysical investigations with intrusive anomaly investigations were incorporated in the RI Report. MEC found at the site was documented in field logs/dig sheets and locations logged using Global Positioning System (GPS). This information was brought together in Geographical Information System (GIS), along with data available from historical review and previous investigation/removal projects, and displayed on maps that summarize the results of the field activities.

2.5.1.5 Data collected as part of the MC surface sampling and subsurface investigation was incorporated into the RI Report as supplied by the laboratory following a data quality review. Data was compared to background levels (metals) and Texas Risk Reduction Program (TRRP) Tier 1 Residential Protective Concentration Limits (PCLs) (metals and explosives). Detections were summarized and exceedances were mapped using GIS. Analytical data was used to summarize path forward recommendations for the Former Camp Maxey.

2.5.1.6 Data collected as part of the RI field activities is used to produce the FS for the Former Camp Maxey. The FS evaluates options for the site including no further action and various clearance activities with institutional controls.

2.5.2 Data Quality Objectives

2.5.2.1 Data Quality Objectives (DQO) were established for this project to incorporate the data needs of the combined RI/FS Report. The RI sections of the report provide results of the MEC and MC characterization investigations, results from previous investigations and removal actions, and historical information. The RI sections of the report were prepared first, following the conclusion of field activities. The RI sections include a logical conclusion to the status of MEC and MC at the site based on information gathered in the field as well as any new or further MRS delineations resulting from the RI results. The RI sections contain maps showing the MEC and MC investigation designs and results.

2.5.2.2 The use of DQOs is a systematic approach for establishing the quality and quantity of data needed to support project decisions. To establish DQOs, the intended use of the data, possible consequences of incorrect decisions attributed to inadequate or invalid data, and an acceptable level of uncertainty must be considered. DQOs are developed during the TPP in accordance with Engineer Manual 200-1-2.

2.5.3 Data Quality Objectives for MEC Investigation

Below are the DQOs that were established for the RI. Additionally, MEC DQOs are presented in Table 2-3.

2.5.3.1 State the Problem

- Information regarding the potential distribution of MEC at the MRS is limited or unavailable
- The MRS boundaries are unknown relative to the presence of MEC
- The extent and location of field sampling for the identification of the quantity and distribution of MEC at the MRS is currently unknown

2.5.3.2 Identify the Decision

- Obtain data regarding the presence of MEC at the MRS
- Define the MRS boundaries
- Define the areas of interest within the MRS
- Define the locations within the MRS to be covered during field sampling

2.5.3.3 Identify Inputs to the Decision

- Historical information (e.g., interview records, field notes, aerial photos, maps) regarding potential MEC
- Observations:
    - Visual field MEC confirmation
        - Type(s) of MEC
        - Location(s) of MEC items

  - Proximity to inhabited locations and structures (public roads, recreation paths, homes, etc.)
  - Accessibility of the site
- The CSM (i.e. historical information [interview records, field notes, aerial photographs, maps] anticipated MEC type(s), anticipated MEC distribution, terrain and vegetation, current/proposed land use, and natural and cultural boundaries.)
- Statistically calculated MEC densities based on historical use of area, previous MEC investigation and removals, and current field sampling data
- Present and/or future land use considerations (i.e., site coverage needs)
- Statistical analysis tools

2.5.3.4 Define Boundaries of Study

- The MRS was divided into the following data collection areas: Western Range Area; Eastern Range Area; Grenade Range; Cave Training Area; and Mine and Booby Trap Training Area. The vertical extent of the survey was from ground surface to the detection depth of MEC.
- Exclusive of areas with thick vegetative cover. Meandering transects used to collect anomaly density data avoided areas that cannot be relatively easily cleared of interfering vegetation using hand tools.
- Time frame for collection
- Spatial boundary based on geophysical equipment capabilities for particular MEC types and site conditions
- Rights of Entry

2.5.3.5 Develop a Decision Rule

- Sampling should be in an amount optimal to characterize the site. Density transects are used to determine area of low, medium and high anomaly density. The classification of areas by relative anomaly density was made by the project delivery team based on the results of the transect survey. The intent was identify potential target areas, characterized by relatively high anomaly densities; areas with minimal impact with low density; and areas impacted by military training at the edge of target areas with medium anomaly densities. The classification of the areas by anomaly density may vary with the different data collection areas (i.e., high density areas in the Grenade Area may have higher concentration than the high density areas in the West Impact Area). Anomalies were not investigated along transects; however, data relating to the anomaly density was used to select location for 50foot by 50foot or 100foot by 100foot grids. Anomaly density was determined using one meter wide transects at various spacing.

  - Western Range Area - 100 meter spacing
  - Eastern Range Area – 81 meter spacing
  - Grenade Area – nine meter spacing
  - Cave Training Area – Data was not collected along transects in the Cave Training Area because ROEs were not granted for any portion of the site.

    - Mine and Booby Trap Training – Data from an initial ground reconnaissance was used to determine MEC sampling requirements

- Historical records indicate mortar and artillery ranges in the Western Range Area, while the ranges in the Eastern Range Area were predominately used for 37mm and 2.36-inch rockets. Historical MEC finds in these areas generally support this historical use. Transect spacing was designed based on the estimated size of the target area and target area anomaly density. Target area anomaly densities are conservatively estimated to be 100 anomalies per acre. One factor in determining the target area diameter is the horizontal range of fragments produced by expected munitions. The maximum horizontal fragmentation distance provided on fragmentation data sheets represents the distance in any direction from point of detonation where fragmentation could be located (i.e., the frag radius). As an example, a 37mm rocket has a fragmentation distance of up to 1044 feet and therefore the diameter of circle around a target where there is potential for fragmentation is 2088 feet. Conservative target area diameters for each data collection area are used as inputs to Visual Sample Plan to determine transect spacing. The following target area diameters were used as inputs to Visual Sample Plan:
    - Eastern Range Area – 450 feet
    - Western Range Area – 600 feet
    - Grenade Range – 160 feet
- When reconnaissance indicates evidence of MEC use or proximity to areas of MEC use, field sampling for further characterization of MEC quantities and distribution were recommended.
- If 1) historical information and 2) field sampling or statistical predictions indicate no evidence of MEC in an area, then the area may be reduced to contain only areas exhibiting evidence of MEC.
- If a sampling methodology will provide for sampling of a statistically representative portion of the site, then it was implemented to define the locations and the area to be covered during field sampling.
- If a sampling methodology does not provide for sampling of a statistically representative portion of the site, it was revised to do so by sampling design modification, or it was not be implemented.

2.5.3.6 Specify Tolerable Limits of Decision Error

If all the inputs to the decision rule were performed to the standard of QC/Quality Assurance (QA) procedures as specified in the Quality Assurance Project Plan (QAPP) and the Work Plan, then the error is within tolerable limits.

2.5.3.7 Optimize the Design for Obtaining Data

Transects were utilized to establish a contamination boundary and possibly reduce the area of interest.

Table 2-3: MEC DQOs

DQO	***Problem Statement***	***Project Goals***	***Required Information Inputs***	***Input Boundaries***	***Analytical Approach***	***Performance Criteria***	***Plan for Obtaining Data***	***Results / Deviations***
Explanation	**Define the problem that necessitates this study**	**Identify study questions**	**Identify data and information needed to answer study questions**	**Specify the target population and define spatial limits**	**Develop the logic for drawing conclusions from findings**	**Specify probability limits for false rejections and false acceptance decision errors**	**Select the plan that meets the performance criteria**	
MRS Characterization	Determine the nature and Extent of MEC	-Determine the location and type of MEC present -Determine the spatial extent of MEC -Determine if MEC exposure pathways for humans are complete -Determine if MEC pose a human health risk.	-Historical data -CSM -Results of visual observations within transects and grids. -Geophysical data (digital instrument response). -Results of intrusive investigation of identified anomalies. -Survey of site receptors and land use.	<u>**Western Range Areas:**</u> • Non-Intrusive DGM transects- 65 acres (1 meter wide and spaced 100m apart.) • Intrusive Investigation of grids in high, medium and low density areas. • Additional transects may be added to bound smaller target areas, if initial survey results indicate that they exist. The decision to add supplemental transects will be made by the PDT, if unexpected items are located in the study area. <u>**Eastern Range Areas:**</u> • Non-Intrusive DGM transects- 16 acres (1 meter wide and spaced 81m apart.) • Intrusive Investigation of grids in high, medium and low density areas. <u>**Grenade Range Area:**</u> • Non-intrusive DGM transects 9.25 acres (1 meter wide and 9m spacing) • Intrusive Investigation of grids in high, medium and low density areas. <u>**Mine/Booby Trap Area/Cave Areas:**</u> • Visual reconnaissance • Non-intrusive DGM transects / intrusive investigation of grids, pending results of reconnaissance. <u>**Boundary Identification:**</u> MEC identified along MRS boundaries will trigger step out procedures resulting in discretionary DGM transects/grids. Investigation Areas that are **thickly vegetated will be avoided and all areas of investigation are limited to available ROE's.	-All MD, frag, and high density anomaly areas will be evaluated as possibly indicative of the location of MEC. -Dig results will be used to define the location and spatial extent of MEC. -Step out procedures will be performed to bound areas impacted by concentrated munitions use that are located at the MRS boundary. -DGM grids with 100 percent intrusive investigation will be used to assess high, medium and low density areas. -Grids saturated with anomalies will be investigated until sufficient data is obtained to characterize the area. In high density areas (>50 anomalies per 50ft x 50ft grid), if 20 percent of anomalies have been dug and all of the results indicate a similar source (e.g. frag), the USACE geophysicist will be consulted to identify additional digs or conclude that the grid is adequately characterized. -Alternative actions will be formulated in the Feasibility Study based on the location and density of MEC, land use, and other data gathered during the investigation and comparison of those data with criteria established herein.	DGM system function checks: • Personnel Test • Vibration Test • Static Background / Spike • 6 Line / 2 Line Tests • Repeat Lines (2 percent daily) Daily GPS Checks (sub-meter for DGPS RTK; larger error up to 10m for density transects allowed) DGM Coverage tool check, coverage > 95 percent at planned line spacing for all non-fiducial grids DGM Along-line measurement spacing, 98 percent < 25cm DGM Anomaly reacquisition within 1 meter. No contacts < 15 percent IVS test strip check passed daily All GSV blind seeds found IAW the Work Plan Analog geophysical instruments checked on the IVS test strip daily when in use	Determine anomaly density and distribution from DGM transects using statistical tools; perform DGM surveys of grids in high, medium and low density areas. Data collection along DGM transects -65 acres, 16 acres, 9.25 acres. Locations of all grids will be reviewed by USACE prior to field work. 100 percent intrusive investigation of selected anomalies identified in DGM grids. Intrusive results will be used in the MEC HA to determine the MEC hazard levels for the site.	<u>**Western Range Area:**</u> DQOs were achieved in areas where rights of entry were available. Areas where access was not granted are identified and recommended for additional investigation. <u>**Eastern Range Area:**</u> DQOs were achieved. Over 16 acres of transects were collected and 20 grids were mapped and investigated. <u>**Grenade Range Area:**</u> DQOs were achieved. Over 9.4 acres of transects were collected and 14 grids were mapped and investigated. <u>**Mine/Booby Trap Area:**</u> An instrument –aided visual survey (IAVS) was completed in parcels where ROEs were granted (approximately 24 percent of the total site acreage). MD turned over by a property owner is consistent with the historical training records, indicating practice mine training. <u>**Cave Area:**</u> DQOs were not achieved in this area since access was not granted by the property owner.

2.5.4 Data Quality Needs for MC Investigation

2.5.4.1 State the Problem

- Determine the nature and extent of MC associated with munitions use during training activities at the Former Camp Maxey

2.5.4.2 Identify the Decision

- What type of MC were potentially released to the surface soil at the Former Camp Maxey as a result of former activities?
- What is the range of MC concentrations across the MRS?
- What is the spatial extent of MC across the MRS?
- Are MC exposure pathways for humans/ecological complete at the Former Camp Maxey?
- Does MC pose a human health risk at the Former Camp Maxey?
- Does MC pose an ecological risk at the Former Camp Maxey?

2.5.4.3 Identify Inputs to the Decision

- Historical data
- Background soil data
- Locations of high/medium density DGM grids (50 feet by 50 feet)
- Location of range structures, firing points and other evidence of munitions based on observations in the field
- TRRP PCLs for soil
- Risk Assessment
- Survey of site receptors and land use

2.5.4.4 Define the Boundaries of the Study

- Eastern and Western Range Areas:
  - Firing Points
  - Berms
  - Incremental sampling (IS) collected in high/medium density grids (50 feet by 50 feet) in 0-6 inches of soil and 30 increments
- Grenade/Cave Areas:
  - IS collected in high/medium density grids (50 feet by 50 feet) in 0-6 inches of soil and 30 increments
- Mine/Booby Trap Area:
  - IS collected in high/medium density grids (50 feet by 50 feet) in 0-6 inches of soil and 30 increments
- Background: Eight surface background samples were collected from within the MRS boundary but in areas determined not to have been impacted by DoD use. Samples were 50 feet by 50 feet IS samples collected from 0-6 inches and sampled in triplicate
- Sub-surface samples were required, and ten discrete sub-surface background samples (6-12 inches) were collected during the sub-surface sampling mobilization in a location within the MRS

boundary that does not have any indication of MEC use. Sub-surface samples were collected in accordance with the Final Work Plan (EOTI, 2013). Sub-surface background samples were analyzed for only those metals that were found to be above the screening criteria in the IS surface samples

2.5.4.5 Develop a Decision Rule

- Compare analytical results to the Project Action Limits (PALs) shown in Table 3-4. The PALs are the higher of site specific background values and TRRP Tier 1 Residential PCLs for a 30-acre source area (June 29, 2012).
- If the analytical results exceed the agreed upon screening criteria, additional subsurface samples were collected in the affected density areas.
- If an IS sample indicates risk for human health or the environment, additional step out samples were not be collected. The extent of the horizontal contaminations equaled the extent of the density area from which the sample was collected.
- If an IS SU is detected above screening criteria, the grid was broken up into 4 quadrants, with one subsurface sample collected from each quadrant.
- If firing points or berms are identified an IS sample was collected and analyzed for target metals. Sample 10 percent of all firing points and all berms identified in the field.

2.5.4.6 Specify Tolerable Limits on Decision Errors

- Two possible decision errors for this project:
  - Type I: concluding that there is MC contamination within the MRS boundary of Camp Maxey when there is none.
  - Type II: Concluding that there is no MC contamination within the MRS boundary of Camp Maxey when there is.
- Type 1 errors are more tolerable; therefore, we need to minimize type II errors so none occur.
  - Utilize IS samples in high/medium density areas to assure samples are representative of DoD use.
  - When possible, analyze at the lab minimum detection levels that are equal to or lower than the PCL's.

2.5.4.7 Optimize the Design for Obtaining Data

- Collect IS samples at 10 percent of observed Firing Points
- Collect IS samples in High/Medium density grids associated with munitions use, as defined from previous MEC investigations or from the RI field work
- Samples will be analyzed for explosives and select metals in all of the high/medium density MEC grids
- Samples will be analyzed for select metals in the IS samples collected at the firing points.
- IS resulting in exceedance of the screening criteria require additional subsurface sampling (6-12 inches) to establish extent
- In the event that MEC items are consolidated for demolition, a post detonation composite sample will be collected. The sample results will be compared to the toxicity characteristic

leaching procedure (TCLP) values, if the results are greater than 20 times the TCLP values, then the sample would be reanalyzed by the laboratory for TCLP analysis.

- In the event that an approved screening value is below the approved laboratory's Limit of Detection, and the results indicate a non-detect, it will be assumed that the screening value has not been exceeded.

3 CHARACTERIZATION OF MEC AND MC

3.1 Remedial Investigation Field Activities Overview

3.1.1. RI field activities at the MRSs began in April 2013 and continued through December 2013. The MEC field investigation team consisted of a Senior UXO Supervisor (SUXOS), a dual UXO Safety Officer (UXOSO) / UXO Quality Control Specialist (UXOQCS), and UXO Technician IIIs, UXO Technician IIs, and UXO Technician Is. RI field activities were completed in December 2013. The following sections discuss the various portions of the field investigation and results in detail.

3.1.2. The following major tasks were performed to meet the project objectives:

- GSV
- Surface Preparation
- Geophysical Investigation
- Intrusive investigation and identification of anomalies
- Proper disposal of all recovered MEC, MD and non-MD material in accordance with federal, state and local regulations
- MC sampling

3.1.3. Before engaging in any activities on site, all personnel reviewed the ESP, RI Work Plan, and the Accident Prevention Plan. A Daily Safety Meeting was completed every morning before the commencement of the day's activities.

3.2 Munitions and Explosives of Concern Characterization

3.2.1 Geophysical System Verification

DGM was performed utilizing the Geonics EM61 MK2 time domain electromagnetic system. Prior to and during the DGM activities, a site-specific GSV was completed. The GSV consisted of an IVS and blind seeding in grids throughout the project area. The IVS was conducted prior to and throughout the duration of the DGM portion of the project to verify that the detection sensors and positioning systems were functioning properly, and to demonstrate that the geophysical data collection teams were well trained in system operation. Details concerning the GSV can be found in the Final GSV Letter Report (Appendix A).

3.2.2 Surface Preparation

Brush cutting was required to ensure effective DGM and surface / subsurface removal of MEC and MD. Surface metal removal included the visual inspection of each transect for metal ordnance related items and scrap. This activity helped ensure that only subsurface anomalies are detected during subsequent geophysical survey operations. A team consisting of at least two UXO qualified personnel (UXO Technician II or above) performed the surface metal removal.

3.2.3 MEC Field Work and Results

3.2.3.1. Approximately 200 miles of DGM investigation transects (approximately 80 acres [one meter transect width]) were collected from the Eastern and Western Range Areas and the Grenade Range Area. The results of geophysical data collected from transects was used to develop anomaly density maps to assist in determining where grids would be placed for further geophysical and intrusive anomaly investigation. Using the anomaly density maps and historic information from previous investigations 96 grids (87 [50 feet x 50 feet] and 9 [100 feet x 100 feet]) covering approximately 7 acres were established within the Eastern and Western areas and in the Grenade Range Area. 100 percent of each of the grids was geophysically surveyed and anomalies were selected for investigation. In total, 19,201 anomalies were detected along transects and in grids. A total of 1,980 anomalies detected in grids were intrusively investigated.

3.2.3.2. As stated previously, a total of 1,980 anomalies were intrusively investigated in the Eastern and Western areas and in the Grenade Range Area. During the investigation, 18 UXO items were discovered; 16 in the Western Range Area, one in the Eastern Range Area and one in the Grenade Area. A total 15 of the 18 UXO items encountered were found on the ground surface. The remaining three UXO were found in the Western Range Area at depths no greater than 12 inches. The majority of MD was found on or within 12 inches of the ground surface, with the exception of two items found at depths of 13 inches (unidentifiable frag) and 24 inches (empty 155mm illumination round). The remainder of the anomalies were identified as either non-munitions-related metallic debris, such as barbed wire and small arms ammunition not related to military use or geologic anomalies. All excavation holes were backfilled to their prior condition. Table 3-1 summarizes the MEC investigation for each MRS. Table 3-2 provides a summary of all UXO items identified with specified depths.

Table 3-1: MEC Investigation Summary

Investigation Area	Investigation	Results
Western Range Area	Transects: 213,900 meters Grids: 62 Anomalies Investigated: 1263	UXO: 16 items MD: 408 pounds (lbs)
Eastern Range Area	Transects: 67,200 meters Grids: 20 Anomalies Investigated: 459	UXO: 1 item MD: 16 lbs
Grenade Range Area	Transects: 38,200 meters Grids: 14 Anomalies Investigated: 258	UXO: 1 item MD: 12 lbs
Mine and Booby Trap Training Area	Instrument-Aided Visual Survey	No UXO or MD
Caves Training Area	No Access	N/A

Table 3-2: UXO Discoveries

Location (Grid or Transect)	Location (X and Y Coordinates)	UXO Nomenclature	Depth (inches)
Eastern Range Area			
E22A3T0001	X = 253176.00000000 Y = 3747140.0000000	37mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
Western Range Area			
W38A2T001	X = 251474.00000000 Y = 3743946.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W35A2T001	X = 252481.00000000 Y = 3744246.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W20A2T001	X = 253176.00000000 Y = 3745757.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W18A2T001	X = 253302.00000000 Y = 3745958.0000000	76mm APHE	Found on transect during geophysical operations.
W27A2T001	X = 252690.00000000 Y = 3745056.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W27A2T002	X = 252667.00000000 Y = 3745058.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W29A2T001	X = 252631.00000000 Y = 3744850.0000000	76mm APHE	Found on transect during geophysical operations.
W44A2T001	X = 251404.00000000 Y = 3743332.0000000	2.36-inch Rocket Motor with Fuze	Found on transect during surface clearance activities prior to geophysical operations.
W35A2T002	X = 252581.00000000 Y = 3744241.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W45A2T001	X = 251385.00000000 Y = 3743221.0000000	105mm Smoke Canister	Found on transect during surface clearance activities prior to geophysical operations.
W35A2T003	X = 252200.00000000 Y = 3744235.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W30A2T001	X = 252706.00000000 Y = 3744730.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.
W38A2T002	X = 252476.00000000 Y = 3743936.0000000	76mm APHE	Found on transect during surface clearance activities prior to geophysical operations.

W27A2G10001	X = 253572.54110500 Y = 3745069.6776000	155mm HE	4
W24A2G10002	X = 252218.70954600 Y = 3745327.3714300	76 mm APHE	12
W31A2G10001	X = 253212.99273700 Y = 3744671.2620400	76 mm APHE	8
Grenade Training Area			
G16AT001	X = 260597.00000000 Y = 3743997.0000000	2.36-inch Rocket	Found on transect during surface clearance activities prior to geophysical operations.

3.2.3.3. A large portion of the Western Range area could not be investigated due to the lack of authorization to access private property. This property is agricultural land located in the north-west portion of the area and is shown on Map 4-2 as a delineated MRS identified as Western Range Area A. A smaller area, identified as Western Range Area E on Map 4-2, also consists of private property where investigation could not be completed. The remaining area was investigated to collect data in accordance with the MEC DQOs described in 2.5.2. Data collection began with the digital geophysical mapping of approximately 213,900 meters of meandering transects, spaced 100 meters apart, using a GPS-integrated Geonics EM61 MK2 metal detector. Data from this survey was used to generate an anomaly density map as shown on Map 3-1. The data shows areas of high density that can be indicative of target areas within a central impact area as well as areas with moderate and light anomaly densities. Grid locations were selected throughout the area as shown on Map 3-1. Grids were geophysically mapped and select anomalies were investigated. Grids were characterized based on the presence of MEC and on MD density. Map 3-2 shows the characterization of each grid positioned in the Western Range Area. As seen on this map, all of the MEC and the majority of the grids with moderate to high MD density were located in the central portion of the Western Range Area. The data suggest a greater probability of encountering MEC in this area (identified as Western Range Area D on Map 4-2) which was likely a target area within a central impact area.

3.2.3.4. All of the area identified as the Eastern Range Area is on Government-owned property. The area was investigated to collect data in accordance with the MEC DQOs described in 2.5.2. Data collection began with the digital geophysical mapping of approximately 67,200 meters of meandering transects, spaced 81 meters apart, using a GPS-integrated Geonics EM61 MK2 metal detector. Data from this survey was used to generate an anomaly density map as shown on Map 3-1. The data shows areas of high, moderate and low anomaly densities. Grid locations were selected throughout the area as shown in Map 3-1. Grids were geophysically mapped and select anomalies were investigated. Grids were characterized based on the presence of MEC and on MD density. Map 3-2 shows the characterization of each grid positioned in the Eastern Range Area. As seen on this map, MEC was located in one grid but all others had no MEC and low MD density. Fourteen of the 20 grids contained no MD and five others contained only a single MD item. Although there is evidence of munitions use in this area, no specific suspected target areas were identified.

3.2.3.5. All of the area identified as the Grenade Range Area is on Government-owned property. The area was investigated to collect data in accordance with the MEC DQOs described in 2.5.2. Data collection began with the digital geophysical mapping of approximately 38,200 meters of meandering transects, spaced nine meters apart, using a GPS-integrated Geonics EM61 MK2 metal detector. Data from this survey was used to generate an anomaly density map as shown on Map 3-1. The data shows areas of high, moderate and low anomaly densities. Grid locations were selected throughout the area as shown on Map 3-1. Grids were geophysically mapped and select anomalies were investigated. Grids were characterized based on the presence of MEC and on MD density. Map 3-2 shows the characterization of each grid positioned in the Grenade Range Area. As seen in this map, MEC was located in one grid but all others had no MEC and low to moderate MD density. Some identifiable MD (such as spent fuzes) is indicative of previous grenade training.

3.2.3.6. Limited rights of entry were granted for the Mine and Booby Trap Training Area (approximately 25 percent of the acreage located on the periphery of the training area). An instrument-assisted visual inspection of approximately 4,000 meters of meandering transects was conducted at the training area. No MEC or MD was encountered during the visual inspection at the Mine and Booby Trap Area; however, a property owner showed the team items which had previously been found within the area from a private parcel where no access was granted. The items were identified as M1 practice mines and smoke canisters. These items are consistent with the mine and booby trap training suspected in the area. Details concerning the investigation at the Mine and Booby Trap Training Area can be found in the *Mine and Booby Trap Training Area Recon Report* (Appendix J).

3.2.3.7. No investigation took place within the Caves Training Area because the property was privately owned and rights of entry could not be established.

3.2.3.8. At the conclusion of all intrusive activities, approximately 436 lbs of MD were identified and removed from the investigated area. The majority of the MD was found in Western Range Area (408 lbs), and the remainder of the anomalies uncovered were non-munitions-related metal scrap such as barbed wire or nails. Maps 3-1, 3-2, and 3-3 show the geophysical anomaly density and remedial design; RI results; and known MEC and MD locations. A complete HA for MEC is included in Section 4.

3.2.4 Demolition and Disposal Operations

All UXO were destroyed in accordance with the Final Approved ESP and Final Work Plan. Following each demolition shot, the demolition hole was inspected, any debris was removed, and the hole was then backfilled. After the demolition was completed, any remaining items were inspected to confirm final classification (i.e., UXO).

3.3 MUNITIONS CONSTITUENTS CHARACTERIZATION

3.3.1 Sampling Summary

3.3.1.1. Environmental samples were collected in two phases during the RI. Surface soil samples were collected in September and October 2013, and following analysis of the surface soil samples, subsurface soil samples were collected in December 2013. No environmental samples were collected in the Mine and Booby Trap Training Area or the Caves Training Area due to a lack of rights-of-entry (ROE). Surface soil samples locations were collected where munitions or MD was found during the RI and in three locations where UXO was previously found (Map 3-4). Soils were categorized into one of two types (A =

coarse alluvial deposits; sandy; B = fine alluvial deposits; clayey) during the RI field effort, based on review of sample locations relative to a soil map and visual observation of soils collected for sampling. Based on the phased approach established for MC sampling, subsurface soil samples were collected at locations where the sample results exceeded PALs (Map 3-5). Background sampling locations were chosen to represent areas where contamination was considered unlikely (Map 3-4).

3.3.1.2. Surface soil samples were collected via the incremental sampling method (see Section 3.3.2 for details). 47 surface soil samples, plus QC samples in the form of triplicates, were collected from SUs where UXO was found or were designated as medium/high MD density grids. Eight surface soil background soil samples were collected. Biased samples were planned at firing point and/or berm locations; however, these range features were not identified during the field effort and no samples biased to these locations were collected.

3.3.1.3. Discrete subsurface soil samples were collected from SUs in which sample results exceeded PALs. 120 subsurface soil samples were collected, plus QC samples in the form of duplicates. Ten discrete subsurface soil samples were collected from the same eight SUs used for surface soil background.

3.3.2 Field Sampling Methods

3.3.2.1 Surface Soil Sampling

3.3.2.1.1. Incremental Sampling was conducted in accordance with the following guidance documents:

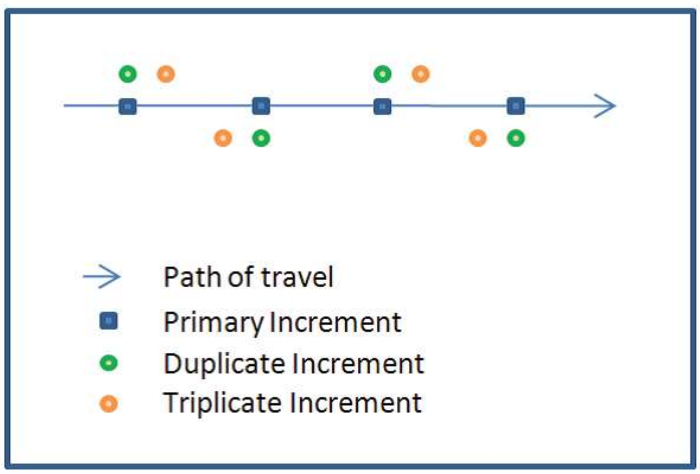
- *Interim guidance for the Implementation of Incremental Sampling of Soil for the Military Munitions Response Program, Environmental and Munitions Center of Expertise Interim Guidance Document* (IGD) 09-02 (USACE, 2009)
- *Incremental Sampling Methodology* (ITRC, 2012)

3.3.2.1.2. Soil samples were collected via incremental sampling method in 50 feet by 50 feet SUs. The location of SUs was determined following the MEC investigation and corresponds with grids where MEC was found or with medium and high MD density grids. Thirty soil increments were collected from each SU by a coring unit which removes the top six inches of soil. SUs were mapped with a handheld GPS unit with the latitude and longitude of all four corners being recorded. Six rows with five increments per row were created within each SU with flags placed to mark increment locations. After the increment rows were created, a UXO technician conducted a survey along the sample rows using a Schonstedt handheld magnetometer. Prior to coring, surface vegetation, roots, and detritus was removed from the soil surface. In instances where an increment location coincided with soil disturbed by a MEC demolition event and sand from the sand bags used for engineering controls remained on the ground surface, the increment was repositioned as close as possible to a location with undisturbed soil.

3.3.2.1.3. Incremental samples were collected via an incremental sampling instrument which collected soil plugs from the surface to 6 inches bgs. Thirty soil plugs representing the thirty increments were collected in sample bags which were labeled with the site name, date, time and sample identification number. Disposable gloves were worn by sampling personnel and discarded when a SU was completed. The incremental sampling instrument was decontaminated between SUs by scrubbing with a low phosphate detergent solution and rinsing with distilled water. The decontamination water was collected in a 5 gallon bucket brought out to the field site. Decontamination water was then stored until laboratory analyses determined it was safe for disposal.

3.3.2.1.4. Ten percent of the SUs were collected in triplicate and treated as distinctly separate samples. Triplicates were collected from grids G11CG1, W3A1G1, W31A2G1, W59A1G1, E21A3G1 and W54A3G1. Each triplicate sample was placed in a separate bag with its own label specifying collection location, date, time and sample identification number. Triplicates were collected by deviating from the increment path by 90 degrees and then also moving parallel. The next triplicate was gathered by reversing the perpendicular and parallel movement. The pattern of triplicate increments along a sampling row may be seen on Figure 3-1.

Figure 3-1: Pattern for Duplicate and Triplicate Collection



3.3.2.1.5. One in twenty of the soil samples were designated and used as Matrix Spike / Matrix Spike Duplicate (MS/MSD) samples. These samples were appropriately labeled on the bags and in the chain of custody. Additionally, temperature blanks were shipped with the samples.

3.3.2.2 Subsurface Soil Sampling

3.3.2.2.1. Discrete subsurface soil samples were collected from SUs where surface soil sample results exceeded the PAL established in the Work Plan for lead. Four samples were collected from each SU with one sample being collected from each quadrant by either a hand auger or trowel. Samples were collected between six to 12 inches bgs after removing the top six inches of soil. Each sample was mapped with a handheld GPS unit.

3.3.2.2.2. Samples were collected in laboratory provided glass jars which were labeled with the site name, date, time and sample identification number. Disposable gloves were worn by sampling personnel and discarded when each sample was completed. The sampling instrument (auger or trowel) was decontaminated between each sample location by scrubbing with a low phosphate detergent solution and rinsing with distilled water. The decontamination water was collected in a five gallon bucket brought out to the field site. Decontamination water was then stored until laboratory analyses determined it was safe for disposal.

3.3.2.2.3. Ten percent of the samples were collected in duplicate and treated as distinctly separate samples. One in twenty of the soil samples were designated and used as MS/MSD samples. These samples were appropriately labeled on the bags and in the chain of custody. Additionally, temperature blanks were shipped with the samples.

3.3.2.3 Anomaly Avoidance

Anomaly avoidance techniques were used during each MC sampling events to ensure the safety of field sampling personnel. All SU and sample locations were cleared during the previous MEC investigation; however, increment and sample locations were again cleared by the UXO Technician prior to sample collection. Background and historic sample locations not located in a previously cleared SU were also cleared by the UXO Technician prior to soil sampling. The UXO Technician had direct field responsibility for MEC avoidance and was responsible for implementing all site safety and health plan requirements, onsite training requirements and recommended changes to levels of Personal Protection Equipment as site conditions warranted. All field personnel, including the UXO technician, had Stop Work Authority for safety conditions.

3.3.3 Chemistry Analysis

The surface soil samples were analyzed for explosives and metals selected based on the munitions or their breakdown products known or suspected to have been used at the Former Camp Maxey (Table 3-3).

Table 3-3: Target Compound List and Target Analyte List

Target Compound List (TCL) Explosives USEPA Method 8330B (with Ring Puck Grinding)	Target Analyte List (TAL) Metals USEPA Method 6010C (no grinding for metals)
1,3,5-Trinitrobenzene (TNB)	Aluminum (Al)
1,3-Dinitrobenzene (DNB)	Antimony (Sb)
2,4-Dinitrotoluene (DNT)	Barium (Ba)
2,6- DNT	Copper (Cu)
2-A-4,6-DNT	Magnesium (Mg)
2,4,6-Trinitrotoluene (TNT)	Nickel (Ni)
2-Nitrotoluene (NT)	Lead (Pb)
3-NT	Zinc (Zn)
4-A-2,6-DNT	
4-NT	
2,4,6-Trinitrophenyl-N-methylnitramine (tetryl)	
1,3,5,7-tetranitro-1,3,5,7-tetrazocane (HMX)	
3,5-Dinitroaniline (3,5-DNA)	
Cyclotrimethylenetrinitramine (RDX)	
Nitrobenzene	
Nitroglycerine (NG)	
Pentaerythrite Tetranitrate (PETN)	

Table 3-4: Project Action Limits

Chemical Name	Result Unit	Background			Human Health			Project Action Limit		TCEQ Ecological Benchmark[de]
			Sample Averages[a]		TRRP Tier 1 Residential Soil PCLs (June 2012)					
		Texas Median Background Concentration	Soil Class A (Course Alluvial)	Soil Class B (Fine Alluvial)	$^{Tot}Soil_{Comb}$ (30-acre source)	$^{GW}Soil_{Ing}$ (30-acre source)	Lesser of two	Greater of Human Health Risk-Based Value and Site-Specific Background	Basis	
Aluminum	mg/kg	30,000	2,400	2,500	64,000	86,000	64,000	64,000	HH-S	soil pH<5.5
Antimony	mg/kg	1.0	0.53[b]	Not Detected	15	2.7	2.7	2.7	HH-GW	5
Barium	mg/kg	300	51	51	8,100	220	220	220	HH-GW	330
Copper	mg/kg	15	1.9	1.4	550	520	520	520	HH-GW	70
Lead	mg/kg	15	7.6	9.0	500	1.5 / 90[f]	90	90	HH-GW	120
Magnesium	mg/kg	4,902	323	228	N/A	N/A	N/A	323 (A)/228(B)	SS-BG	N/A
Nickel	mg/kg	10	2.6	2.0	840	79	79	79	HH-GW	38
Zinc	mg/kg	30	7.7	6.3	9,900	1,200	1,200	1,200	HH-GW	120
1,3,5-Trinitrobenzene	mg/kg	--	--	--	0.91	--	--	0.91	--	6.6
1,3-Dinitrobenzene	mg/kg	--	--	--	0.10[c]	--	--	0.10[c]	--	0.073
2,4,6-Trinitrotoluene	mg/kg	--	--	--	0.10[c]	--	--	0.10[c]	--	6.4
2,4-Dinitrotoluene	mg/kg	--	--	--	0.10[c]	--	--	0.10[c]	--	2.5
2,6-Dinitrotoluene	mg/kg	--	--	--	0.10[c]	--	--	0.10[c]	--	1.8
2-Amino-4,6-dinitrotoluene	mg/kg	--	--	--	0.10[c]	--	--	0.10[c]	--	10
3,5-Dinitroaniline	mg/kg	--	--	--	N/A	--	--	N/A	--	N/A
4-Amino-2,6-dinitrotoluene	mg/kg	--	--	--	0.20[c]	--	--	0.20[c]	--	3.6
HMX	mg/kg	--	--	--	1.2	--	--	1.2	--	27
Nitroglycerin	mg/kg	--	--	--	0.20[c]	--	--	0.20[c]	--	71
PETN	mg/kg	--	--	--	1,200	--	--	1,200	--	100
RDX	mg/kg	--	--	--	2.0[c]	--	--	2.0[c]	--	7.5
Tetryl	mg/kg	--	--	--	0.55	--	--	0.55	--	0.99

Chemical Name	Result Unit	Background			Human Health			Project Action Limit		TCEQ Ecological Benchmark[de]
		Texas Median Background Concentration	Sample Averages[a]		TRRP Tier 1 Residential Soil PCLs (June 2012)					
			Soil Class A (Course Alluvial)	Soil Class B (Fine Alluvial)	$^{Tot}Soil_{Comb}$ (30-acre source)	$^{GW}Soil_{Ing}$ (30-acre source)	Lesser of two	Greater of Human Health Risk-Based Value and Site-Specific Background	Basis	
2-Nitrotoluene	mg/kg	--	--	--	0.20[c]	--	--	0.20[c]	--	9.9
4-Nitrotoluene	mg/kg	--	--	--	0.22	--	--	0.22	--	22
3-Nitrotoluene	mg/kg	--	--	--	0.92	--	--	0.92	--	12

Notes:

a = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

b = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

c = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

d = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA Ecological Soil Screening Levels (EcoSSLs) are available, those values were used.

e = For explosives, the minimum NOAEL available for soil was used.

f = A Tier 2 PCL of 90 milligrams per kilogram (mg/kg) was calculated for lead using site specific inputs and the TRRP Tier 2 equations.

Table 3-5: Surface Soil Sample Results

Analytical Method	Chemical Name	Result Unit	CM-SU001			CM-SU002			CM-SU003			CM-SU004			CM-SU004A		
			9/23/2013			9/23/2013			9/23/2013			9/23/2013			9/23/2013		
			Soil Class A			Soil Class A			Soil Class A			Soil Class A			Soil Class A		
			Primary			Primary			Primary			Primary			Duplicate		
			Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val
SW846 6010B	Aluminum	mg/kg	6000		J	3300		J	2400		J	1400		J	1700		J
SW846 6010B	Antimony	mg/kg	0.59	U	UJ	0.59	U	UJ	0.60	U	UJ	0.60	U	UJ	0.56	U	UJ
SW846 6010B	Barium	mg/kg	30		J	63		J	66		J	47		J	48		J
SW846 6010B	Copper	mg/kg	2.8	J	J	2.8	J	J	2.7	J	J	1.7	J	J	1.9	J	J
SW846 6010B	Lead	mg/kg	10		J-	8.8		J-	5.6		J-	6.1		J-	8.5		J-
SW846 6010B	Magnesium	mg/kg	510		J	340		J	250		J	150		J	170		J
SW846 6010B	Nickel	mg/kg	4.7		J	3.3	J	J	3.3	J	J	1.9	J	J	2.2	J	J
SW846 6010B	Zinc	mg/kg	8.5		J	11		J	11		J	6.7	J	J	6.9	J	J
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.039	U		0.025	J	J	0.04	U	J	0.04	U		0.038	U	
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	HMX	mg/kg	0.039	U		0.04	U		0.04	U		0.04	U		0.038	U	
SW846 8330B	Nitroglycerin	mg/kg	0.39	U		0.4	U		0.4	U		0.4	U		0.38	U	
SW846 8330B	PETN	mg/kg	0.98	UQ		1.0	UQ		0.99	UQ		0.99	UQ		0.96	UQ	
SW846 8330B	RDX	mg/kg	0.078	U		0.08	U		0.079	U		0.079	U		0.077	U	
SW846 8330B	Tetryl	mg/kg	0.078	U		0.08	U		0.079	U		0.079	U		0.077	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.078	U		0.08	U		0.079	U		0.079	U		0.077	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.098	U		0.10	U		0.099	U		0.099	U		0.096	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.78	U		0.08	U		0.079	U		0.079	U		0.077	U	

Analytical Method	Chemical Name	Result Unit	CM-SU004B			CM-SU005			CM-SU006			CM-SU007			CM-SU008			CM-SU008A		
			9/23/2013			9/23/2013			9/24/2013			9/24/2013			9/24/2013			9/24/2013		
			Soil Class A			Soil Class A			Soil Class B			Soil Class B			Soil Class A			Soil Class A		
			Triplicate			Primary			Primary			Primary			Primary			Duplicate		
			Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val
SW846 6010B	Aluminum	mg/kg	1800		J	2600		J	3500		J	4700		J	3500		J	3100		J
SW846 6010B	Antimony	mg/kg	0.60	U	UJ	0.58	U	UJ	0.59	U	UJ	0.58	U	UJ	0.58	U	UJ	0.59	U	UJ
SW846 6010B	Barium	mg/kg	50		J	32		J	120		J	120		J	78		J	75		J
SW846 6010B	Copper	mg/kg	1.9	J	J	3.6	J	J	2.0	J	J	2.6	J	J	1.9	J	J	1.6	J	J
SW846 6010B	Lead	mg/kg	6.2		J-	5.5		J-	12		J-	17		J-	13		J-	11		J-
SW846 6010B	Magnesium	mg/kg	180		J	230		J	320		J	430	D	J	320		J	290		J
SW846 6010B	Nickel	mg/kg	2.2	J	J	4.8		J	3.4	J	J	4.3		J	3.0	J	J	2.8	J	J
SW846 6010B	Zinc	mg/kg	7.2	J	J	15		J	7.3	J	J	8.1		J	8.0		J	7.4	J	J
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.038	U		0.039	U		0.052	J	J	0.038	U		0.053	J	J	0.079	J	J
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	HMX	mg/kg	0.038	U		0.039	U		0.037	U		0.038	U		0.04	U		0.039	U	
SW846 8330B	Nitroglycerin	mg/kg	0.38	U		0.39	U		0.37	U		0.38	U		0.4	U		0.39	U	
SW846 8330B	PETN	mg/kg	0.96	UQ		0.99	UQ		0.92	UQ		0.95	UQ		1.0	UQ		0.97	UQ	
SW846 8330B	RDX	mg/kg	0.077	U		0.079	U		0.073	U		0.076	U		0.08	U		0.078	U	
SW846 8330B	Tetryl	mg/kg	0.077	U		0.079	U		0.073	U		0.076	U		0.08	U		0.078	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.077	U		0.079	U		0.073	U		0.076	U		0.08	U		0.078	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.096	U		0.099	U		0.092	U		0.095	U		0.1	U		0.097	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.077	U		0.079	U		0.073	U		0.076	U		0.08	U		0.11	J	J

Notes:

[a] = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

[b] = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

[c] = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

[d] = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used.

[e] = For explosives, the minimum NOAEL available for soil was used.

Laboratory Qualifiers:
J = Estimated: The analyte was positively identified; the quantitation is an estimation
M = Manual integrated compound
Q = One or more quality criteria failed
U = Undetected at the Limit of Detection

Validation Qualifiers:
J+ = Data are qualified as estimated; with a high bias likely to occur.
J- = Data are qualified as estimated; with a low bias likely to occur.
J = Data are qualified as estimated; it is not posible to assess the direction of the potential bias.
U = Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
R = Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
UJ = Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

(yellow) = exceeds PALs using site specific backround data only
(purple) = exceeds PALs using both site specific and Texas backround data

Table 3-5: Surface Soil Sample Results

Analytical Method	Chemical Name	Result Unit	CM-SU008B			CM-SU009			CM-SU0010			CM-SU0011			CM-SU0012			CM-SU0013		
			9/24/2013			9/24/2013			9/24/2013			9/25/2013			9/25/2013			9/25/2013		
			Soil Class A			Soil Class B			Soil Class A			Soil Class B			Soil Class A			Soil Class B		
			Triplicate			Primary			Primary			Primary			Primary			Primary		
			Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val
SW846 6010B	Aluminum	mg/kg	3900		J	2300		J	2500	J	J	3600			3000	J		5100		
SW846 6010B	Antimony	mg/kg	0.55	U	UJ	0.56	U	UJ	0.55	UJ	UJ	0.57	U	UJ	0.57	UJ	UJ	0.58	U	UJ
SW846 6010B	Barium	mg/kg	94		J	46		J	78	J	J	100			41			47		
SW846 6010B	Copper	mg/kg	2.0	J	J	1.5	J	J	3.1	J	J	3.9	J	J	2.9	J	J	2.5	J	J
SW846 6010B	Lead	mg/kg	14		J-	8.3		J-	42	J	J-	9.3			7.8			13		
SW846 6010B	Magnesium	mg/kg	350		J	340		J	310	J	J	870			780			520		
SW846 6010B	Nickel	mg/kg	3.2	J	J	2.8	J	J	3.5	J	J	6.1			3.6	J	J	3.8		
SW846 6010B	Zinc	mg/kg	9.4		J	7.2	J	J	9.7	J	J	12			9.5			9.5		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.04	UQ		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.029	J	J	0.022	J	J	0.039	J	J	0.038	U		0.018	J	J	0.088	J	J
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	UJ	UJ	0.038	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	HMX	mg/kg	0.04	U		0.039	U		0.038	U		0.038	U		0.037	U		0.038	U	
SW846 8330B	Nitroglycerin	mg/kg	0.04	U		0.039	U		0.038	U		0.38	U		0.37	U		0.38	U	
SW846 8330B	PETN	mg/kg	1.0	UQ		0.97	UQ		0.94	UQ		0.96	UQ		0.92	UQ		0.95	UQ	
SW846 8330B	RDX	mg/kg	0.08	U		0.078	U		0.076	U		0.076	U		0.074	U		0.076	U	
SW846 8330B	Tetryl	mg/kg	0.08	U		0.078	U		0.076	U		0.076	U		0.074	U		0.076	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.08	U		0.078	U		0.076	U		0.076	U		0.074	U		0.076	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.1	U		0.097	U		0.094	U		0.096	U		0.092	U		0.095	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.092	J	J	0.078	U		0.076	U		0.076	U		0.074	U		0.076	U	

Analytical Method	Chemical Name	Result Unit	CM-SU0014			CM-SU0015			CM-SU0016			CM-SU0017			CM-SU0018		
			9/25/2013			9/25/2013			9/26/2013			9/26/2013			9/26/2013		
			Soil Class A			Soil Class A			Soil Class A			Soil Class A			Soil Class A		
			Primary			Primary			Primary			Primary			Primary		
			Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val
SW846 6010B	Aluminum	mg/kg	2700			3200			4600			2900			8900		
SW846 6010B	Antimony	mg/kg	0.58	U	UJ	0.59	U	UJ	0.56	U	UJ	0.56	U	UJ	0.62	U	UJ
SW846 6010B	Barium	mg/kg	49			47			110			85			180		
SW846 6010B	Copper	mg/kg	2.0	J	J	2.0	J	J	4.8			3.9	J	J	9.5		
SW846 6010B	Lead	mg/kg	9.9			12			13			11			21		
SW846 6010B	Magnesium	mg/kg	330			350			1400			370			2700		
SW846 6010B	Nickel	mg/kg	2.9	J	J	2.9	J	J	8.2			4.3			13		
SW846 6010B	Zinc	mg/kg	7.1	J	J	7.7	J	J	16			9.4			23		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.061	J	J	0.072	J	J	0.024	J	J	0.039	U		0.078	J	J
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	HMX	mg/kg	0.039	U		0.038	U		0.036	U		0.039	U		0.038	U	
SW846 8330B	Nitroglycerin	mg/kg	0.39	U		0.38	U		0.36	U		0.39	U		0.38	U	
SW846 8330B	PETN	mg/kg	0.97	UQ		0.94	UQ		0.91	UQ		0.97	UQ		0.94	UQ	
SW846 8330B	RDX	mg/kg	0.078	U		0.075	U		0.073	U		0.078	U		0.075	U	
SW846 8330B	Tetryl	mg/kg	0.078	U		0.075	U		0.073	U		0.078	U		0.075	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.078	U		0.075	U		0.073	U		0.078	U		0.075	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.097	U		0.094	U		0.091	U		0.097	U		0.094	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.078	U		0.075	U		0.073	U		0.078	U		0.075	U	

Notes:

[a] = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

[b] = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

[c] = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

[d] = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used.

[e] = For explosives, the minimum NOAEL available for soil was used.

Laboratory Qualifiers:

J = Estimated: The analyte was positively identified; the quantitation is an estimation

M = Manual integrated compound

Q = One or more quality criteria failed

U = Undetected at the Limit of Detection

Validation Qualifiers:

J+ = Data are qualified as estimated; with a high bias likely to occur.

J- = Data are qualified as estimated; with a low bias likely to occur.

J = Data are qualified as estimated; it is not posible to assess the direction of the potential bias.

U = Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.

R = Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.

UJ = Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

(yellow) = exceeds PALs using site specific backround data only

(purple) = exceeds PALs using both site specific and Texas backround data

Table 3-5: Surface Soil Sample Results

Analytical Method	Chemical Name	Result Unit	CM-SU0018A			CM-SU0018B			CM-SU0019			CM-SU0020			CM-SU0021		
			9/26/2013			9/26/2013			9/26/2013			9/26/2013			9/26/2013		
			Soil Class A			Soil Class A			Soil Class A			Soil Class B			Soil Class A		
			Duplicate			Triplicate			Primary			Primary			Primary		
			Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers	
				Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val
SW846 6010B	Aluminum	mg/kg	9100			8800			1800			2000			1300		
SW846 6010B	Antimony	mg/kg	0.63	U	UJ	0.59	U	UJ	0.58	U	UJ	0.55	U	UJ	0.59	U	UJ
SW846 6010B	Barium	mg/kg	170			190			75			93			44		
SW846 6010B	Copper	mg/kg	9.3			9.6			1.6	J	J	1.8	J	J	1.6	J	J
SW846 6010B	Lead	mg/kg	21			23			7.1			10			5.4		
SW846 6010B	Magnesium	mg/kg	2700			2700			290			320			180		
SW846 6010B	Nickel	mg/kg	12			14			3.0	J	J	3.1	J	J	2.0	J	J
SW846 6010B	Zinc	mg/kg	23			23			10			8.2			5.1	J	J
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.088	J	J	0.045	J	J	0.038	U		0.02	J	J	0.023	J	J
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	HMX	mg/kg	0.04	U		0.038	U		0.038	U		0.039	U		0.039	U	
SW846 8330B	Nitroglycerin	mg/kg	0.4	U		0.38	U		0.38	U		0.39	U		0.39	U	
SW846 8330B	PETN	mg/kg	1	UQ		0.94	UQ		0.95	UQ		0.97	UQ		0.98	UQ	
SW846 8330B	RDX	mg/kg	0.08	U		0.075	U		0.076	U		0.078	U		0.079	U	
SW846 8330B	Tetryl	mg/kg	0.08	U		0.075	U		0.076	U		0.078	U		0.079	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.08	U		0.075	U		0.076	U		0.078	U		0.079	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.1	U		0.094	U		0.095	U		0.097	U		0.098	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.08	U		0.075	U		0.076	U		0.078	U		0.079	U	

Analytical Method	Chemical Name	Result Unit	CM-SU0022			CM-SU0023			CM-SU0024			CM-SU0025			CM-SU0026			CM-SU0027		
			9/27/2013			9/27/2013			9/27/2013			9/27/2013			9/29/2013			9/29/2013		
			Soil Class A			Soil Class A			Soil Class B			Soil Class A			Soil Class A			Soil Class A		
			Primary			Primary			Primary			Primary			Primary			Primary		
			Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers	
				Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val
SW846 6010B	Aluminum	mg/kg	1800			1200			3000	J		2400			3500			3300		
SW846 6010B	Antimony	mg/kg	0.58	U	UJ	0.59	U	UJ	0.58	UJ	UJ	0.58	U	UJ	0.60	U	UJ	0.56	U	UJ
SW846 6010B	Barium	mg/kg	62			34			110			59			65			74		
SW846 6010B	Copper	mg/kg	2.4	J	J	1.5	J	J	1.9	J	J	1.5	J	J	2.3	J	J	2.0	J	J
SW846 6010B	Lead	mg/kg	6.7			4.3			14			9.1			11			11		
SW846 6010B	Magnesium	mg/kg	320			150			370			310			460			470		
SW846 6010B	Nickel	mg/kg	3.6	J	J	1.9	J	J	2.7	J	J	2.3	J	J	3.5	J	J	4.1		
SW846 6010B	Zinc	mg/kg	9.4			5.8	J	J	9.3			8.4			11			15		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.037	U		0.037	U		0.099		J	0.089	J	J	0.039	U		0.075	J	J
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	HMX	mg/kg	0.037	U		0.037	U		0.037	U		0.039	U		0.039	U		0.038	U	
SW846 8330B	Nitroglycerin	mg/kg	0.37	U		0.37	U		0.37	U		0.39	U		0.39	U		0.38	U	
SW846 8330B	PETN	mg/kg	0.94	UQ		0.91	UQ		0.94	UQ		0.97	UQ		0.98	U		0.95	U	
SW846 8330B	RDX	mg/kg	0.075	U		0.073	U		0.075	U		0.078	U		0.078	U		0.076	U	
SW846 8330B	Tetryl	mg/kg	0.075	U		0.073	U		0.075	U		0.078	U		0.078	U		0.076	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.075	U		0.073	U		0.075	U		0.078	U		0.078	U		0.096	J	J
SW846 8330B	4-Nitrotoluene	mg/kg	0.094	U		0.091	U		0.094	U		0.054	JM	J	0.098	U		0.095	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.075	U		0.073	U		0.075	U		0.078	U		0.078	U		0.076	U	

Notes:

[a] = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

[b] = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

[c] = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

[d] = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used.

[e] = For explosives, the minimum NOAEL available for soil was used.

Laboratory Qualifiers:
J = Estimated: The analyte was positively identified; the quantitation is an estimation
M = Manual integrated compound
Q = One or more quality criteria failed
U = Undetected at the Limit of Detection

Validation Qualifiers:
J+ = Data are qualified as estimated; with a high bias likely to occur.
J- = Data are qualified as estimated; with a low bias likely to occur.
J = Data are qualified as estimated; it is not posible to assess the direction of the potential bias.
U = Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
R = Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
UJ = Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

(yellow) = exceeds PALs using site specific backround data only
(purple) = exceeds PALs using both site specific and Texas backround data

Table 3-5: Surface Soil Sample Results

Analytical Method	Chemical Name	Result Unit	CM-SU0028			CM-SU0029			CM-SU0030			CM-SU0031			CM-SU0032			CM-SU0033		
			9/29/2013			9/29/2013			9/30/2013			9/30/2013			9/30/2013			9/30/2013		
			Soil Class A			Soil Class A			Soil Class A			Soil Class A			Soil Class A			Soil Class A		
			Primary			Primary			Primary			Primary			Primary			Primary		
			Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers	
				Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val
SW846 6010B	Aluminum	mg/kg	5300			2000			2000			4900			4300			2300		
SW846 6010B	Antimony	mg/kg	0.58	U	UJ	0.58	U	UJ	0.55	U	UJ	0.56	U	UJ	0.59	U	UJ	0.57	U	UJ
SW846 6010B	Barium	mg/kg	110			30			37			52			60			64		
SW846 6010B	Copper	mg/kg	3.9	J	J	1.5	J		1.5	J	J	3.1	J	J	15			1.9	J	J
SW846 6010B	Lead	mg/kg	14			6.6			5.5			9.3			19			9.6		
SW846 6010B	Magnesium	mg/kg	780			240			220			450			530			270		
SW846 6010B	Nickel	mg/kg	8.3			2.0	J		2.4	J	J	2.9	J	J	4.0			2.7	J	J
SW846 6010B	Zinc	mg/kg	16			5.7	J		5.3	J	J	9.2			21			8.1		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.035	J	J	0.039	U		0.039	U		0.04	U		0.036	J	J	0.039	U	
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.038	U		0.039	U		0.039	U		0.04	UM		0.037	U		0.039	U	
SW846 8330B	HMX	mg/kg	0.038	U		0.039	U		0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	Nitroglycerin	mg/kg	0.38	U		0.39	U		0.39	U		0.4	U		0.37	U		0.39	U	
SW846 8330B	PETN	mg/kg	0.96	U		0.98	U		0.98	U		0.99	U		0.93	U		0.97	U	
SW846 8330B	RDX	mg/kg	0.077	U		0.078	U		0.078	U		0.079	U		0.074	U		0.078	U	
SW846 8330B	Tetryl	mg/kg	0.077	U		0.078	U		0.078	U		0.079	U		0.074	U		0.078	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.077	U		0.078	U		0.078	U		0.079	U		0.074	U		0.078	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.096	U		0.098	U		0.098	U		0.099	U		0.093	U		0.097	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.077	U		0.078	U		0.078	U		0.079	U		0.074	U		0.078	U	

Analytical Method	Chemical Name	Result Unit	CM-SU0034			CM-SU0035			CM-SU0036			CM-SU0037			CM-SU0038		
			9/30/2013			10/1/2013			10/1/2013			10/1/2013			10/1/2013		
			Soil Class B			Soil Class A			Soil Class A			Soil Class B			Soil Class A		
			Primary			Primary			Primary			Primary			Primary		
			Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers	
				Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val
SW846 6010B	Aluminum	mg/kg	13000			2000			5500	J		2700			2400		
SW846 6010B	Antimony	mg/kg	0.57	U	UJ	0.57	U	UJ	0.60	UJ	UJ	0.61	U	UJ	0.56	U	UJ
SW846 6010B	Barium	mg/kg	110			22			45			34			74		
SW846 6010B	Copper	mg/kg	7.0			1.2	J	J	5.8	J		1.8	J	J	2.3	J	J
SW846 6010B	Lead	mg/kg	19			5.0			10			8.2			5.8		
SW846 6010B	Magnesium	mg/kg	1300			190			530			220			270		
SW846 6010B	Nickel	mg/kg	9.3			1.5	J	J	4.0			2.9	J	J	6.9		
SW846 6010B	Zinc	mg/kg	34			5.3	J	J	21			8.7			8.5		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.039	U		0.039	U		0.095	M		0.038	U		0.038	U	
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	HMX	mg/kg	0.039	U		0.039	U		0.038	U		0.038	U		0.038	U	
SW846 8330B	Nitroglycerin	mg/kg	0.39	U		0.39	U		0.38	U		0.38	U		0.38	U	
SW846 8330B	PETN	mg/kg	0.98	U		0.98	U		0.95	U		0.94	U		0.96	U	
SW846 8330B	RDX	mg/kg	0.078	U		0.079	U		0.076	U		0.075	U		0.076	U	
SW846 8330B	Tetryl	mg/kg	0.078	U		0.079	U		0.076	U		0.075	U		0.076	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.078	U		0.079	U		0.076	U		0.075	U		0.076	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.098	U		0.098	U		0.095	U		0.094	U		0.096	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.078	U		0.079	U		0.076	U		0.075	U		0.076	U	

Notes:

[a] = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

[b] = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

[c] = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

[d] = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used.

[e] = For explosives, the minimum NOAEL available for soil was used.

Laboratory Qualifiers:
J = Estimated: The analyte was positively identified; the quantitation is an estimation
M = Manual integrated compound
Q = One or more quality criteria failed
U = Undetected at the Limit of Detection

Validation Qualifiers:
J+ = Data are qualified as estimated; with a high bias likely to occur.
J- = Data are qualified as estimated; with a low bias likely to occur.
J = Data are qualified as estimated; it is not posible to assess the direction of the potential bias.
U = Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
R = Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
UJ = Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

(yellow) = exceeds PALs using site specific backround data only
(purple) = exceeds PALs using both site specific and Texas backround data

Table 3-5: Surface Soil Sample Results

Analytical Method	Chemical Name	Result Unit	CM-SU0038A			CM-SU0038B			CM-SU0039			CM-SU0039A			CM-SU0039B		
			10/1/2013			10/1/2013			10/2/2013			10/2/2013			10/2/2013		
			Soil Class A			Soil Class A			Soil Class A			Soil Class A			Soil Class A		
			Duplicate			Tripicate			Primary			Duplicate			Triplicate		
			Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers	
				Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val
SW846 6010B	Aluminum	mg/kg	2400			2200			1400			1600			1500		
SW846 6010B	Antimony	mg/kg	0.56	U	UJ	0.59	U	UJ	0.59	U	UJ	0.55	U	UJ	0.58	U	UJ
SW846 6010B	Barium	mg/kg	83			84			43			46			44		
SW846 6010B	Copper	mg/kg	2.5	J	J	2.3	J	J	1.1	J	J	1.2	J	J	1.2	J	J
SW846 6010B	Lead	mg/kg	6.1			6.0			4.5			4.5			4.5		
SW846 6010B	Magnesium	mg/kg	280			270			220			240			240		
SW846 6010B	Nickel	mg/kg	6.6			4.9			1.8	J	J	2.0	J	J	1.9	J	J
SW846 6010B	Zinc	mg/kg	9.5			8.7			4.8	J	J	5.3	J	J	5.0	J	J
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	HMX	mg/kg	0.039	U		0.038	U		0.039	U		0.038	U		0.038	U	
SW846 8330B	Nitroglycerin	mg/kg	0.39	U		0.38	U		0.39	U		0.38	U		0.38	U	
SW846 8330B	PETN	mg/kg	0.99	U		0.95	U		0.98	UQ		0.94	UQ		0.94	UQ	
SW846 8330B	RDX	mg/kg	0.079	U		0.076	U		0.078	U		0.075	U		0.075	U	
SW846 8330B	Tetryl	mg/kg	0.079	U		0.076	U		0.078	U		0.075	U		0.075	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.079	U		0.076	U		0.078	U		0.075	U		0.075	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.099	U		0.095	U		0.098	U		0.094	U		0.094	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.079	U		0.076	U		0.078	U		0.075	U		0.075	U	

Analytical Method	Chemical Name	Result Unit	CM-SU0040			CM-SU0040A			CM-SU0040B			CM-SU0041			CM-SU0042			CM-SU0043		
			10/2/2013			10/2/2013			10/2/2013			10/2/2013			10/3/2013			10/3/2013		
			Soil Class B			Soil Class B			Soil Class B			Soil Class B			Soil Class B			Soil Class B		
			Primary			Duplicate			Triplicate			Primary			Primary			Primary		
			Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers		Result	Qualifiers	
				Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val		Lab	Val
SW846 6010B	Aluminum	mg/kg	7800			5500		J	6100	J	J	2600			10000			2000		
SW846 6010B	Antimony	mg/kg	0.62	U	UJ	0.63	U		0.61	U		0.56	U	UJ	0.64	U	UJ	0.56	U	UJ
SW846 6010B	Barium	mg/kg	86			67		J	76	J	J	55			93			44		
SW846 6010B	Copper	mg/kg	6.8			5.5			6.4			2.4	J	J	8.7			2.1	J	J
SW846 6010B	Lead	mg/kg	9.4			6.9			7.8			7.9			9.8			6.0		
SW846 6010B	Magnesium	mg/kg	910			610		J	680		J	320			1200			230		
SW846 6010B	Nickel	mg/kg	9.2			7.2		J	8.2		J	3.5	J	J	13			3.2	J	J
SW846 6010B	Zinc	mg/kg	27			19		J	21		J	8.4			30			9.5		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	HMX	mg/kg	0.038	U		0.04	U		0.037	U		0.037	U		0.039	U		0.04	U	
SW846 8330B	Nitroglycerin	mg/kg	0.38	U		0.4	U		0.37	U		0.37	U		0.39	U		0.4	U	
SW846 8330B	PETN	mg/kg	0.95	UQ		0.99	UQ		0.91	UQ		0.93	UQ		0.98	UQ		1.0	UQ	
SW846 8330B	RDX	mg/kg	0.076	U		0.079	U		0.073	U		0.074	U		0.079	U		0.08	U	
SW846 8330B	Tetryl	mg/kg	0.076	U		0.079	U		0.073	U		0.074	U		0.079	U		0.08	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.076	U		0.079	U		0.073	U		0.074	U		0.079	U		0.08	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.095	U		0.099	U		0.091	U		0.093	u		0.098	U		0.1	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.076	U		0.079	U		0.073	U		0.074	U		0.079	U		0.08	U	

Notes:

[a] = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

[b] = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

[c] = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

[d] = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used.

[e] = For explosives, the minimum NOAEL available for soil was used.

Laboratory Qualifiers:
J = Estimated: The analyte was positively identified; the quantitation is an estimation
M = Manual integrated compound
Q = One or more quality criteria failed
U = Undetected at the Limit of Detection

Validation Qualifiers:
J+ = Data are qualified as estimated; with a high bias likely to occur.
J- = Data are qualified as estimated; with a low bias likely to occur.
J = Data are qualified as estimated; it is not posible to assess the direction of the potential bias.
U = Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
R = Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
UJ = Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

(yellow) = exceeds PALs using site specific backround data only
(purple) = exceeds PALs using both site specific and Texas backround data

Table 3-5: Surface Soil Sample Results

Analytical Method	Chemical Name	Result Unit	CM-SU0044			CM-SU0045			CM-SU0046			CM-SU0047		
			10/3/2013			10/3/2013			10/3/2013			10/4/2013		
			Soil Class B			Soil Class A			Soil Class A			Soil Class A		
			Primary			Primary			Primary			Primary		
			Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val	Result	Qualifiers Lab	Qualifiers Val
SW846 6010B	Aluminum	mg/kg	14000			1500			1800			3000		
SW846 6010B	Antimony	mg/kg	0.65	U	UJ	0.58	U	UJ	0.58	U	UJ	0.59	UJ	UJ
SW846 6010B	Barium	mg/kg	130			50			46			53		
SW846 6010B	Copper	mg/kg	12			3.9	J	J	2.1	J	J	2.3	J	J
SW846 6010B	Lead	mg/kg	12			6.8			6.1			11		
SW846 6010B	Magnesium	mg/kg	1400			170			200			360		
SW846 6010B	Nickel	mg/kg	12			1.9	J	J	1.6	J	J	3.4	J	J
SW846 6010B	Zinc	mg/kg	34			7.7			7.0	J	J	8.3		
SW846 8330B	1,3,5-Trinitrobenzene	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	1,3-Dinitrobenzene	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	2,4,6-Trinitrotoluene	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	2,4-Dinitrotoluene	mg/kg	0.039	U		0.04	U		0.037	U		0.014	J	J
SW846 8330B	2,6-Dinitrotoluene	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	2-Amino-4,6-dinitrotoluene	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	3,5-Dinitroaniline	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	4-Amino-2,6-dinitrotoluene	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	HMX	mg/kg	0.039	U		0.04	U		0.037	U		0.039	U	
SW846 8330B	Nitroglycerin	mg/kg	0.39	U		0.4	U		0.37	U		0.39	U	
SW846 8330B	PETN	mg/kg	0.98	U		1.0	UQ		0.92	UQ		0.98	UQ	
SW846 8330B	RDX	mg/kg	0.079	U		0.08	U		0.074	U		0.078	U	
SW846 8330B	Tetryl	mg/kg	0.079	U		0.08	U		0.074	U		0.078	U	
SW846 8330B	2-Nitrotoluene	mg/kg	0.079	U		0.08	U		0.074	U		0.078	U	
SW846 8330B	4-Nitrotoluene	mg/kg	0.098	U		0.1	U		0.092	U		0.098	U	
SW846 8330B	3-Nitrotoluene	mg/kg	0.079	U		0.08	U		0.074	U		0.078	U	

Notes:

[a] = Background averages were calculated from background samples corresponding to either Soil Class A or Soil Class B.

[b] = Analyte only detected in one background sample. Average could not be determined and non-detect samples were not compared to single background value.

[c] = In these cases, the Project Action Limit (PAL) is the Analytical Method LOQ instead of the listed TRRP value. The TRRP allows for media-specific PALs to be established based on the analytical limitations (30 TAC 350.78(c)). TRRP states that if a critical PAL for a COC is less than the Method Quantitation Limit (MQL), then the MQL is the critical PAL for that COC. In this case, the MQLs are the Analytical Method LOQs.

[d] = For metals, the TCEQ ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used.

[e] = For explosives, the minimum NOAEL available for soil was used.

Laboratory Qualifiers:
J = Estimated: The analyte was positively identified; the quantitation is an estimation
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U = Undetected at the Limit of Detection

Validation Qualifiers:
J+ = Data are qualified as estimated; with a high bias likely to occur.
J- = Data are qualified as estimated; with a low bias likely to occur.
J = Data are qualified as estimated; it is not posible to assess the direction of the potential bias.
U = Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.
R = Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
UJ = Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

(yellow) = exceeds PALs using site specific backround data only
(purple) = exceeds PALs using both site specific and Texas backround data

Table 3-6: Subsurface Soil Sampling Results

Date	Grid	Sample ID	Lead Results (mg/kg)	Qualifiers		Soil Class
				Lab	Val	
12/4/2013	W59A1G1	CM-SU-01-SUB01	9	--	--	A
		CM-SU-01-SUB02	10	--	--	
		CM-SU-01-SUB03	12	--	--	
		CM-SU-01-SUB04	9.7	--	--	
	W54A3G1	CM-SU-02-SUB01	9.8	--	--	B
		CM-SU-02-SUB02	9.3	--	--	
		CM-SU-02-SUB03	9.3	--	--	
		CM-SU-02-SUB04	9.5	--	--	
		CM-SU-02-SUB04DUP	9.7	--	--	
	W49A2G1	CM-SU-03-SUB01	11	--	--	B
		CM-SU-03-SUB02	14	--	--	
		CM-SU-03-SUB03	9.9	--	--	
		CM-SU-03-SUB04	13	--	--	
12/5/2013	W44A2G2	CM-SU-04-SUB01	14	--	--	A
		CM-SU-04-SUB02	10	--	--	
		CM-SU-04-SUB03	21	--	--	
		CM-SU-04-SUB04	10	--	--	
		CM-SU-04-SUB04DUP	10	--	--	
	W47A2G3	CM-SU-05-SUB01	8.1	--	--	A
		CM-SU-05-SUB02	6.2	--	--	
		CM-SU-05-SUB03	7.8	--	--	
		CM-SU-05-SUB04	13	--	--	
		CM-SU-05-SUB04DUP	27	--	--	
	W44A2G3	CM-SU-06-SUB01	3.2	--	--	A
		CM-SU-06-SUB02	8.2	--	--	
		CM-SU-06-SUB03	12	--	--	
		CM-SU-06-SUB04	6.5	--	--	
		CM-SU-06-SUB04DUP	5.4	--	--	
	W39A2G2	CM-SU-07-SUB01	6.4	--	--	A
		CM-SU-07-SUB02	10	--	--	
		CM-SU-07-SUB03	5.4	--	--	
		CM-SU-07-SUB04	10	--	--	
12/7/2013	W40A2G1	CM-SU-08-SUB01	4.9	--	--	A
		CM-SU-08-SUB02	8.5	--	--	
		CM-SU-08-SUB03	7.3	--	--	
		CM-SU-08-SUB04	5.6	--	--	

Date	Grid	Sample ID	Lead Results (mg/kg)	Qualifiers		Soil Class
				Lab	Val	
		CM-SU-08-SUB04DUP	6.4	--	--	
	W44A2G1	CM-SU-09-SUB01	5.6	--	--	A
		CM-SU-09-SUB02	9.6	--	--	
		CM-SU-09-SUB03	4.9	--	--	
		CM-SU-09-SUB04	4.8	--	--	
	W38A2G1	CM-SU-10-SUB01	5.7	--	--	A
		CM-SU-10-SUB02	9	--	--	
		CM-SU-10-SUB03	7.6	--	--	
		CM-SU-10-SUB04	4.6	--	--	
		CM-SU-10-SUB04DUP	10	--	--	
	W37A2G1	CM-SU-11-SUB01	5.9	--	--	B
		CM-SU-11-SUB02	8.8	--	--	
		CM-SU-11-SUB03	14	--	--	
		CM-SU-11-SUB04	9.7	--	--	
	W35A2G2	CM-SU-12-SUB01	9.2	--	--	B
		CM-SU-12-SUB02	7.1	--	--	
		CM-SU-12-SUB03	21	--	--	
		CM-SU-12-SUB04	12	--	--	
12/9/2013	W54A3G2	CM-SU-13-SUB01	11	--	--	B
		CM-SU-13-SUB02	13	--	--	
		CM-SU-13-SUB03	13	--	--	
		CM-SU-13-SUB04	10	--	--	
	W29A2G1	CM-SU-14-SUB01	6.3	--	--	A
		CM-SU-14-SUB02	20	--	--	
		CM-SU-14-SUB03	13	--	--	
		CM-SU-14-SUB04	14	--	--	
	W27A2G2	CM-SU-15-SUB01	9.2	--	--	A
		CM-SU-15-SUB02	11	--	--	
		CM-SU-15-SUB03	9.5	--	--	
		CM-SU-15-SUB04	7.8	--	--	
	W27A2G1	CM-SU-16-SUB01	12	--	--	A
		CM-SU-16-SUB02	18	--	--	
		CM-SU-16-SUB03	10	--	--	
		CM-SU-16-SUB04	6.6	--	--	
12/10/2013	W23A2G1	CM-SU-17-SUB01	6.6	--	--	A
		CM-SU-17-SUB02	4.4	--	--	
		CM-SU-17-SUB03	6.7	--	--	
		CM-SU-17-SUB04	7	--	--	
	W24A2G1	CM-SU-18-SUB01	4	--	--	A

Date	Grid	Sample ID	Lead Results (mg/kg)	Qualifiers Lab	Qualifiers Val	Soil Class
		CM-SU-18-SUB02	3.1	--	--	
		CM-SU-18-SUB03	4.7	--	--	
		CM-SU-18-SUB04	3.9	--	--	
	W18A2G2	CM-SU-19-SUB01	9.9	--	--	B
		CM-SU-19-SUB02	9.9	--	--	
		CM-SU-19-SUB03	15	--	--	
		CM-SU-19-SUB04	9.4	--	--	
	W18A2G1	CM-SU-20-SUB01	9.1	--	--	B
		CM-SU-20-SUB02	8	--	--	
		CM-SU-20-SUB03	8.2	--	--	
		CM-SU-20-SUB04	5.2	--	--	
12/11/2013	W11A2G1	CM-SU-21-SUB01	14	--	--	B
		CM-SU-21-SUB02	7.6	--	--	
		CM-SU-21-SUB03	20	--	--	
		CM-SU-21-SUB04	7.8	--	--	
	W9A2G1	CM-SU-22-SUB01	5.4	--	--	A
		CM-SU-22-SUB02	86	--	--	
		CM-SU-22-SUB03	6.3	--	--	
		CM-SU-22-SUB04	17	--	--	
	W5A1G2	CM-SU-23-SUB01	12	--	--	B
		CM-SU-23-SUB02	11	--	--	
		CM-SU-23-SUB03	8.7	--	--	
		CM-SU-23-SUB04	9.6	--	--	
	W3A1G1	CM-SU-24-SUB01	12	--	--	A
		CM-SU-24-SUB02	15	--	--	
		CM-SU-24-SUB03	19	--	--	
		CM-SU-24-SUB04	6.7	--	--	
12/12/2013	W46A1G1	CM-SU-25-SUB01	13	--	--	A
		CM-SU-25-SUB02	10	--	--	
		CM-SU-25-SUB03	14	--	--	
		CM-SU-25-SUB04	12	--	--	
		CM-SU-25-SUB04DUP	12	--	--	
	Historical 3	HIST3-SUB01	6.4	--	--	A
		HIST3-SUB02	6.5	--	--	
		HIST3-SUB03	6.1	--	--	
		HIST3-SUB04	6.2	--	--	
12/13/2013	W31A2G1	CM-SU-26-SUB01	19	--	--	A
		CM-SU-26-SUB01DUP	13	--	--	
		CM-SU-26-SUB02	16	--	--	

Date	Grid	Sample ID	Lead Results (mg/kg)	Qualifiers		Soil Class
				Lab	Val	
		CM-SU-26-SUB03	14	--	--	
		CM-SU-26-SUB04	23	--	--	
		CM-SU-26-SUB04DUP	23	--	--	
12/14/2013	G06BG1	CM-SU-27-SUB01	10	--	--	A
		CM-SU-27-SUB02	6.8	--	--	
		CM-SU-27-SUB03	6.6	--	--	
		CM-SU-27-SUB04	9.6	--	--	
		CM-SU-27-SUB04DUP	8.2	--	--	
	G23CG1	CM-SU-28-SUB01	4.5	--	--	A
		CM-SU-28-SUB02	3.2	--	--	
		CM-SU-28-SUB03	3.1	--	--	
		CM-SU-28-SUB04	6.8	--	--	
		CM-SU-28-SUB04DUP	8.2	--	--	
	G11CG1	CM-SU-29-SUB01	16	--	--	A
		CM-SU-29-SUB02	4.8	--	--	
		CM-SU-29-SUB03	7.4	--	--	
		CM-SU-29-SUB04	5.4	--	--	
		CM-SU-29-SUB04DUP	5.3	--	--	

3.3.4 Munitions Constituents Results Summary

3.3.4.1 Munitions Constituents Data Analysis

3.3.4.1.1. The surface soil data were evaluated by comparing detected constituent concentrations to the PALs presented in Table 3-4. The PALs are the higher of site-specific background values and TRRP Tier 1 Residential PCLs for a 30-acre source area (June 29, 2012). The TRRP Tier 1 soil PCL considered for each constituent was the lower (*i.e.,* more health-protective) of the Tier 1 PCL for combined soil exposures ($^{Tot}Soil_{Comb}$) and the Tier 1 PCL protective of leaching from soil to groundwater ($^{GW}Soil_{Ing}$).

3.3.4.1.2. Based on the phased approach established for MC sampling, subsurface soil samples were collected at locations where the surface soil sample results exceeded PALs. As shown in Table 3-5 and described in Section 3.3.4.2 below, lead and magnesium were detected in surface soil at concentrations exceeding the PALs, which for both constituents was a site-specific background value. However, subsurface soil samples were collected and analyzed for lead and not magnesium, as there are no risk-based screening values available for magnesium.

3.3.4.1.3. Subsurface soil samples were also analyzed for pH, to allow for determination of a site-specific Tier 2 GWSoilIng PCL protective of leaching from soil to groundwater. A Tier 2 GWSoilIng PCL was calculated using site-specific inputs (e.g., soil pH) and the TRRP Tier 2 equations; the calculation is presented in Appendix L. An average pH of 5.2 in background soil samples collected at the Site was used to calculate the Tier 2 PCL for lead. The default leachate dilution factor for a 30-acre source area, along with the compound-specific Ksw (calculated using default parameters and pH-specific Kd from Figure 30 Texas Annotated Code (TAC) §350.73(f)(1)(A), assuming a loamy soil type) and the groundwater ingestion PCL for lead, were used to calculate the Tier 2 GWSoilIng PCL.

3.3.4.1.4. A discussion of the subsurface soil sampling results is presented in Section 3.3.4.3.

3.3.4.2 Surface Soil

A total of 47 surface soil samples were collected from Former Camp Maxey. No explosives were detected and lead and magnesium were detected in levels exceeding the original PALs using site specific background data (7.6 mg/kg for lead and 228 mg/kg for magnesium) in several samples (see Table 3-5).

3.3.4.3 Subsurface Soil

A total of 120 subsurface soil samples, plus QC samples in the form of duplicates, were collected from Former Camp Maxey at locations that exceeded the original PAL for lead in surface soil. Lead was not detected in any samples at levels exceeding the revised PAL of 90 mg/kg using the values adjusted based on the TRRP Tier 2 calculations shown in Appendix L (see Table 3-6).

3.4 INVESTIGATIVE DERIVED WASTE

Investigative Derived Waste generated as part of the MC field investigation was properly collected, labeled, profiled, manifested, transported, and disposed of. Decontamination water generated during the incremental sampling activities was contained in five-gallon buckets temporarily staged on-site. Three TCLP samples were collected from the decontamination water (two from the surface sampling event and one from the subsurface sampling event) and compared to regulatory levels. All TCLP sampling results came back well below regulatory levels and the water was disposed accordingly.

3.5 Deviations from the Final Work Plan

3.5.1 MEC

3.3.5.1.1. The most significant deviation from the work plan resulted in the lack of access to some private parcels which prevented the collection of data in portions of the MRS. Rights of entry were not granted to any of the suspected previous Cave Training Area as well as to portions of the Western Range Area and Mine and Booby-trap Area. The lack of access limited the ability to collect data as described in the work plan. Other minor deviations were addressed in field change requests (FCR) and are described below.

3.3.5.1.2. The accuracy of GPS equipment used to mark transects and collect geophysical data could not meet the +1 meter required in the work plan under some field conditions. Based on the results of the IVS (see Appendix A), an FCR was submitted to adjust the accuracy to match the capability of the equipment. The FCR changed the accuracy to + 5 meters which still met the DQO required accuracy of + 10 meters along transects. Data in grids were collected in fiducial mode and accuracy was within + 1 meter.

3.3.5.1.3. A second FCR was submitted following a USACE/TCEQ visit to address recommendations. The QC requirement for a search effectiveness inspection was changed from 10 percent of the grid area to an area defined by a one meter radius around excavated anomalies. The work plan was also revised to require a single measurement of the off-set of the anomaly from its predicted location.

3.5.2 MC

The work plan stated subsurface sampling will be conducted and analyzed for those analytes that exceeded PALs. While both lead and magnesium were detected at levels above PALs, subsurface soil samples were only analyzed for lead as no human health or ecological risk-based screening values are available for magnesium. As described in Section 6.2.2.1, magnesium is an essential nutrient and soil concentrations of magnesium are not expected to be a health concern (TNRCC, 2001b). Additionally, the average pH of background subsurface soil samples was used to develop a site-specific TRRP Tier 2 PCL that is protective of the potential for migration of lead from soil to groundwater.

3.6 Quality Control

3.6.1 Employee Process Training Program

3.6.1.1. All site personnel received the applicable training as specified in the Accident Prevention Plan. In addition, UXO-qualified personnel met the qualification standards for personnel conducting MEC operations, as set forth in DoD Explosives Safety Board Technical Paper 18 Minimum Qualifications for UXO Technicians and Personnel (2004).

3.6.1.2. Documentation of training requirements for each UXO Technician was reviewed by the SUXOS/UXOSO and filed in on-site project files before personnel were allowed to enter the Exclusion Zone. No one was permitted to work in an Exclusion Zone without the appropriate training and medical clearances.

3.6.2 Munitions and Explosives of Concern Quality Assurance/Quality Control

A three-phase control system was used in the implementation of the QC program to ensure that all project work conformed to project DQOs, with the phases being Preparatory, Initial, and Follow-up. The Preparatory Phase included familiarization by project personnel with established DQOs and incorporation of any required follow-up work to ensure the process would pass QC. The Initial Phase was the start of the QC checks on the project process. The Follow-Up Phase included checks conducted after the initial QC check to ensure any discrepancies discovered during the initial QC checks were corrected. All of the areas in which surface and subsurface investigations were completed were subjected to a QC analysis by the UXOQCS.

3.6.2.1 Munitions and Explosives of Concern Quality Control Results

Although ultimately the quality of the data is sufficient for making project decisions, there were some concerns identified by the QC/QA process that were addressed during the collection of data. Geophysical data was collected in some grids prior to installing blind seeds. This issue was identified early and corrected so that subsequent grids were seeded prior to geophysical mapping. In two cases (Grid E-11-A3-G1 and Grid W-20-A1-G1), the grid location was adjusted slightly following the placement of seed items and prior to geophysical mapping, resulting in seeds falling outside of the mapped area. An analysis of the geophysical data was completed to confirm the quality of the data. Surveyed corner stakes placed on grid corners (either 100 feet x 100 feet or 50 feet x 50 feet) served to guide the DGM operations. To ensure accurate positioning survey ropes were placed across each grid at regular intervals (every 25 feet), perpendicular to the line direction. Painted marks on the ropes were used to maintain straight-line profiling at the project design line spacing of 2.5 feet. To show that the data is positioned correctly, two lines of data were recollected at each grid. All repeat and original data was comparable for both response and position. Additionally, sources of anomalies were located at their predicted location and all seeds properly placed in grids were located. The evidence shows that the DGM data is accurate and usable. In one instance (Grid W-27-A2-G2) reported data indicated that a seed was not properly located; however a review of field notes indicated that the seed was found but not properly reported.

3.6.3 Munitions Constituents Quality Control

QC procedures for the MC investigation are documented in the QAPP. Samples were analyzed for the purpose of assessing the quality of the sampling effort and the analytical data.

3.6.3.1 Quality Control Samples

QC for analytical samples was provided through the use of temperature blanks, MS/MSDs and field splits samples. The QC samples were handled as regular samples. QC for the analytical samples was provided through the use of field split samples (triplicate for surface soil and duplicate for subsurface soil). The following QC samples were collected for analytical samples:

- MS/MSDs: Samples were collected to be split in the laboratory and run as MS/MSDs in an amount equal to at least 5 percent of the field samples for laboratory analysis for soil.
- Field Replicate Samples: Field replicate samples were collected in triplicate at six locations during the surface sampling effort and duplicates were collected at 12 locations during the subsurface sampling event. These samples were collected in a quantity equal to at least 10 percent of the field samples for soil.

3.6.3.2 Data Quality Controls

3.6.3.2.1. An independent third party conducted analytical data validation for this project and Data Validation Reports are provided in Appendix C. Objectives for this review are in accordance with the QA/QC objectives stated in the QAPP. Outlying data were flagged, as appropriate, in accordance with laboratory Standard Operating Procedures. Validation qualifiers are included on Table 3-5.

3.6.3.2.2. The data review by automated and manual validation of this sampling event met project requirements and analytical completeness levels. The data set is deemed useable for the intended use. Validation activities were performed in accordance with the following:

- Draft Final Remedial Investigation/Feasibility Study, RI/FS, Quality Assurance Protection Plan, QAPP, for Former Camp Maxey, Lamar County, Texas,August2012
- Engineer Manual Guidance for Evaluating Performance-Based Chemical Data, EM-200-1-10, June 2005
- USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, June 2008
- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review, January 2010
- EPA SW 846, Third Edition, Test Methods for Evaluating Solid Waste, update I, July 1992; update IIA, August 1993; update II, September 1994; update lIB, January 1995; update Ill, December 1996; update lIIA, April 1998; 1118, November 2004; Update IV, February 2007

3.7 DATA GAPS

3.7.1 Spatial Data from Previous Investigations

3.7.1.1. Spatial data relative to several previous investigations was not available and could therefore not be included with any certainty in the RI results.

- 1997 TCRA UXO locations and clearance boundaries
- 2001 NTCRA clearance boundaries
- 2007 clearance boundaries

3.7.1.2. The quality of data associated with these previous investigations was known during the TPP and DQOs were developed based on data needs considering the lack of data associated with these investigations. The data gaps associated with previous investigations has no impact on the RI/FS.

3.7.2 Private Property with No Rights-Of-Entry

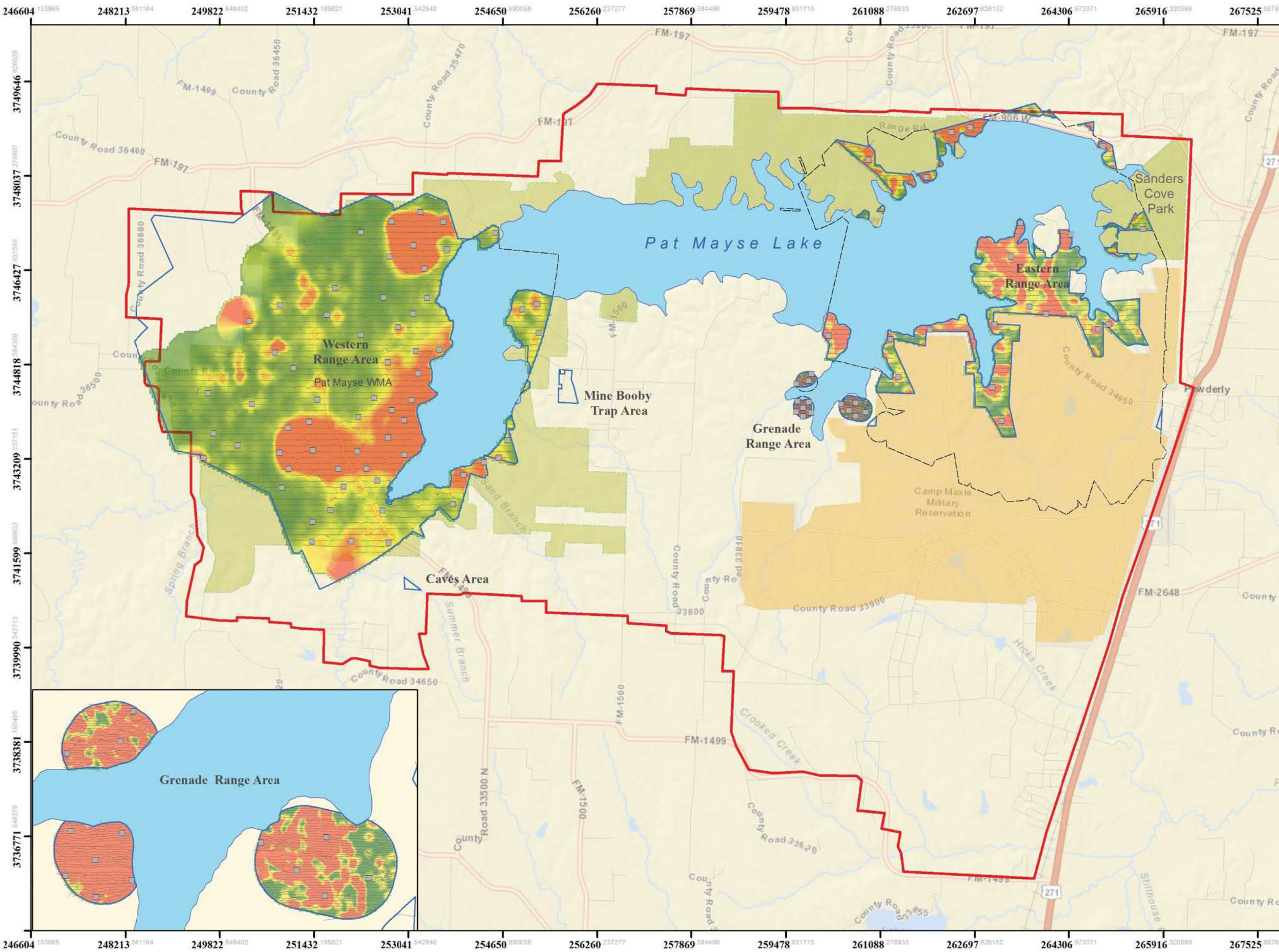
3.7.2.1. All or some areas within the following areas were inaccessible because ROEs were not granted.

- Caves Area
- Mine and Booby Trap Area
- Western Range Area (NW and southern areas)

3.7.2.2. The lack of data associated with the Caves Area and inaccessible portions of the Western Range Area prevent sufficient characterization required to evaluate risk and risk reduction alternatives and therefore additional investigation is recommended. The data gaps associated with inaccessible portions of the Mine and Booby Trap Area are filled with historical data and information as well as evidence (MD) provide by the owner of one of the large parcels that was unavailable during the reconnaissance. Details related to the reconnaissance are included in the report at Appendix J.

3.7.3 Accurate and Current Land Use Spatial Data

Limited public spatial data information is available on current and future planned land use in the area which comprises the Former Camp Maxey footprint. When necessary, data from field teams was used to determine current land use and future land use is expected to remain the same as the current land use. The supplemental data collected by the field teams fills data gaps sufficiently to make necessary decision in the FS.



Legend

- Geophysical Investigation Grids
- Geophysical Transect Paths
- RI Investigation Boundary
- Camp Maxey Range Complex (MRA R01)
- Former Camp Maxey Installation Boundary
- Pat Mayse Lake
- National Guard Installation
- Pat Mayse State Park and WMA

Anomaly Density Estimation

High : 400

Low : 0

03°68'

UTM Zone 15 NAD 83 (Meters)
Data Provided By:
Texas Parks & Wildlife Dept.
U.S. Army Corps of Engineers
ESRI

Miles: 1 0.5 0 1

Kilometers: 1.6 0.8 0 1.6

Location Map:
Former Camp Maxey Lamar County, TX

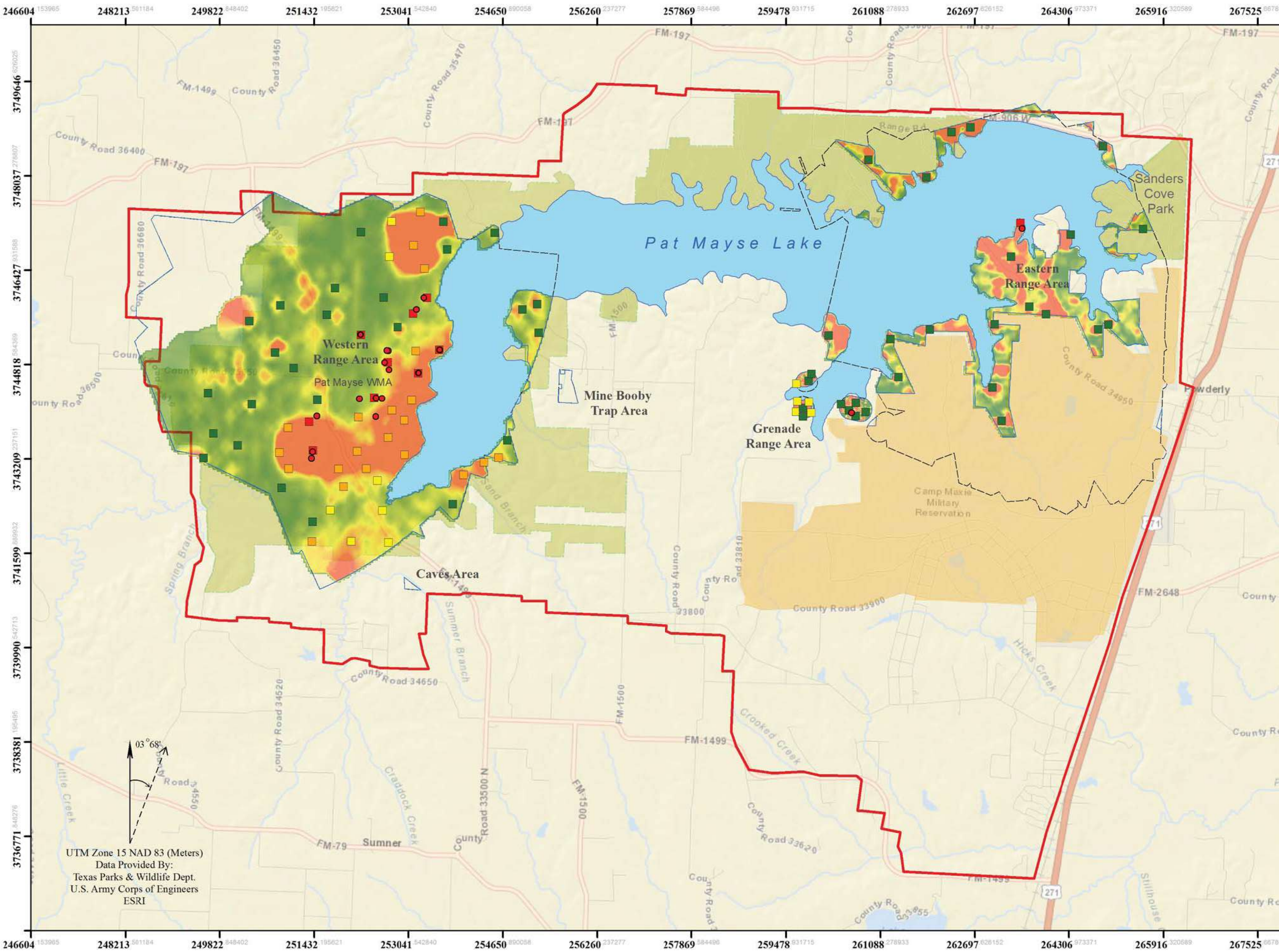
Map 3-1:
MEC Investigation Design

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 11/19/13	FILE Map 3-1 RI Design MEC Figure 4.mxd	
PAGE # 3-1	SCALE 1 inch = 5,280 feet	



Legend

- MEC Item Locations (Within Transects)

MEC Grid Results

- MEC in or near
- No MEC, >250 MD
- No MEC, < 250 MD, > 52 MD
- No MEC, <52 MD/AC
- RI Investigation Boundary
- Camp Maxey Range Complex (MRA R01)
- Former Camp Maxey Installation Boundary
- National Guard Installation
- Pat Mayse State Park and WMA

Anomaly Density Estimation

High : 400

Low : 0

Miles: 1 0.5 0 1

Kilometers: 1.6 0.8 0 1.6

Location Map:
Former Camp Maxey Lamar County, TX

Map 3-2:
MEC Investigation Results

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
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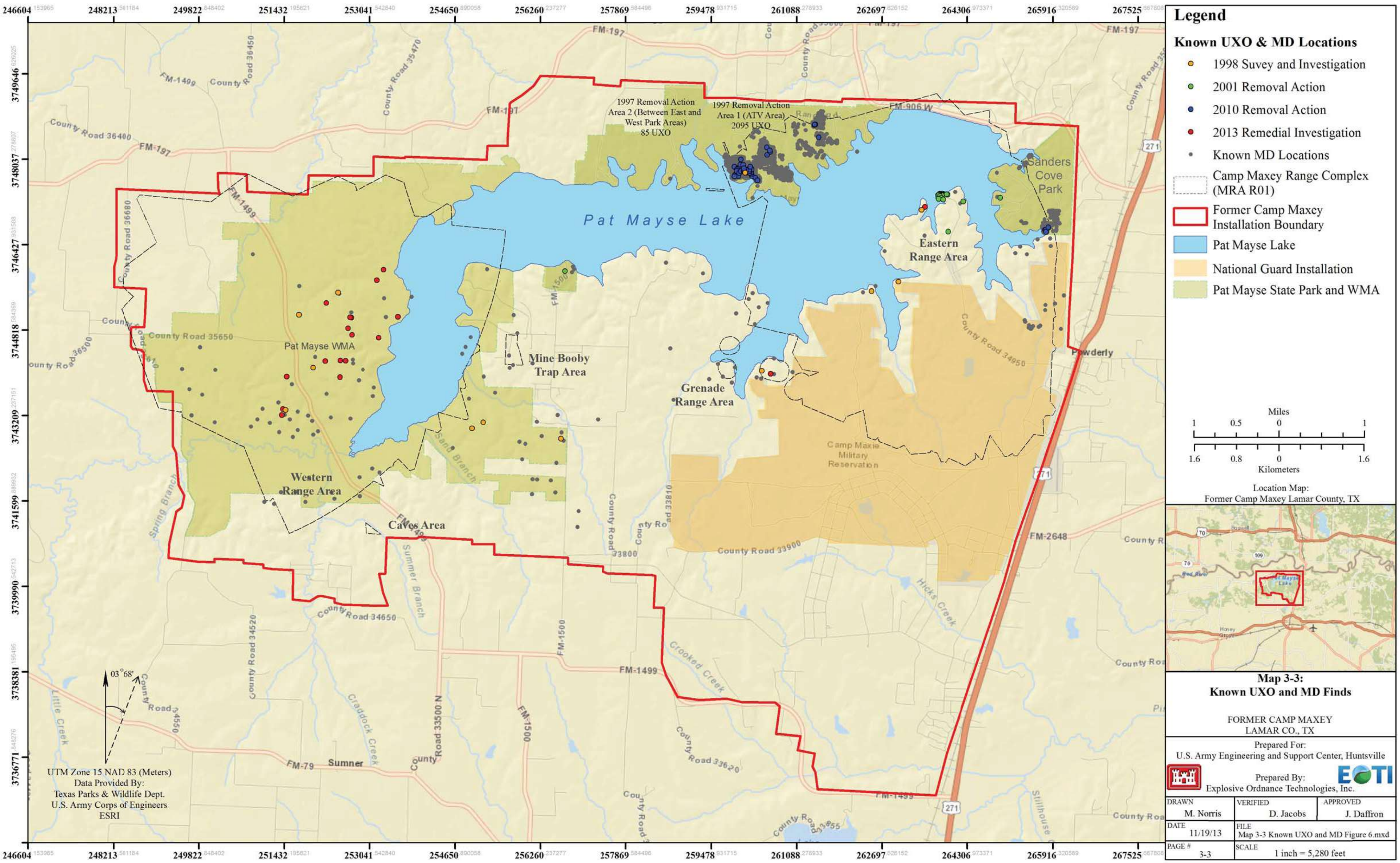
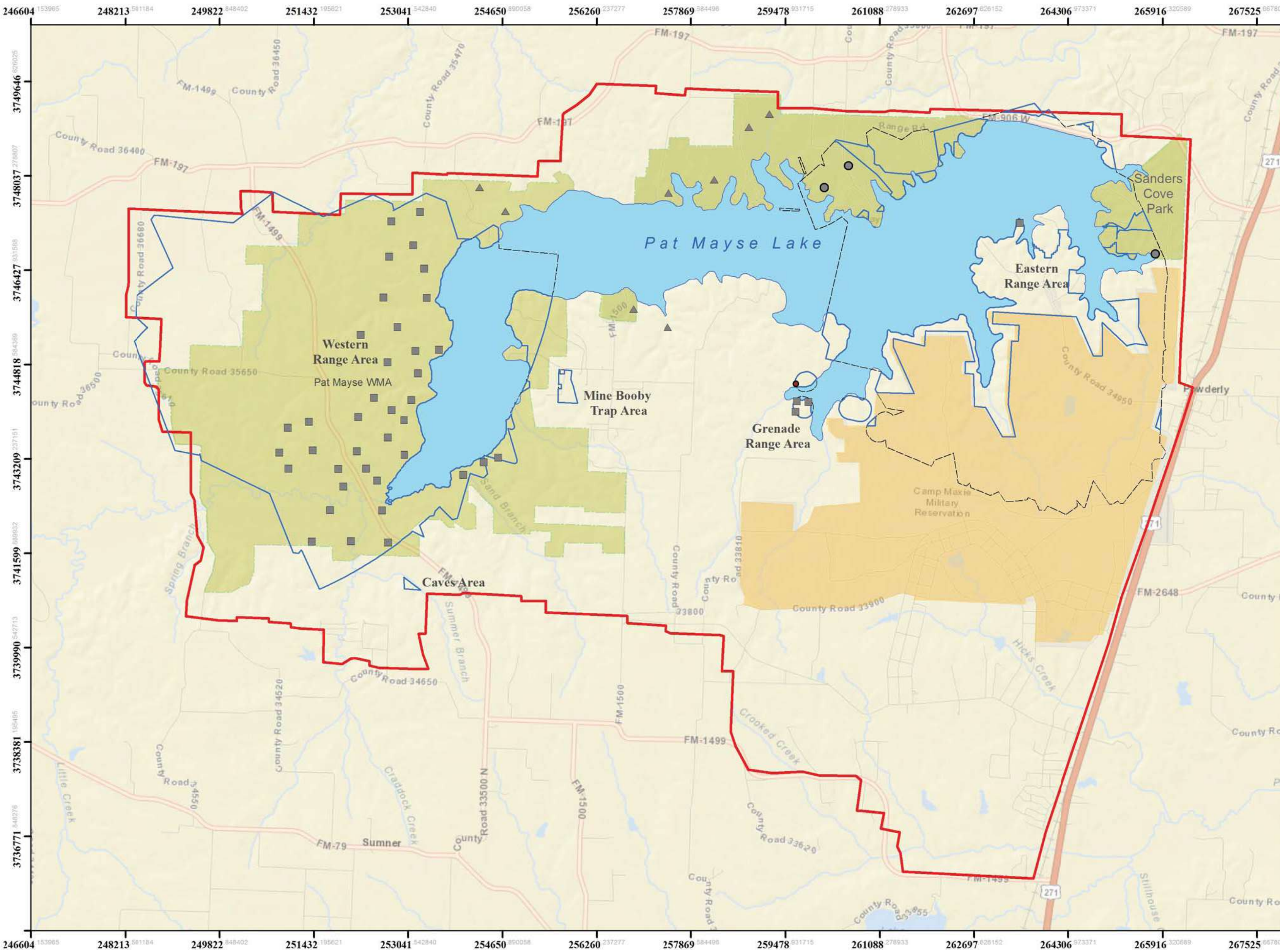

Legend
Known UXO & MD Locations
1998 Suvey and Investigation
2001 Removal Action
2010 Removal Action
2013 Remedial Investigation
Known MD Locations
Camp Maxey Range Complex (MRA R01)
Former Camp Maxey Installation Boundary
Pat Mayse Lake
National Guard Installation
Pat Mayse State Park and WMA
Miles
Kilometers
Location Map:
Former Camp Maxey Lamar County, TX
Pat Mayse Lake
1997 Removal Action Area 2 (Between East and West Park Areas) 85 UXO
1997 Removal Action Area 1 (ATV Area) 2095 UXO
Sanders Cove Park
Eastern Range Area
Mine Booby Trap Area
Grenade Range Area
Western Range Area
Caves Area
Pat Mayse WMA
Camp Maxie Military Reservation
Powderly
Sumner
UTM Zone 15 NAD 83 (Meters)
Data Provided By:
Texas Parks & Wildlife Dept.
U.S. Army Corps of Engineers
ESRI
Map 3-3:
Known UXO and MD Finds
FORMER CAMP MAXEY
LAMAR CO., TX
Prepared For:
U.S. Army Engineering and Support Center, Huntsville
Prepared By:
Explosive Ordnance Technologies, Inc.
DRAWN M. Norris
VERIFIED D. Jacobs
APPROVED J. Daffron
DATE 11/19/13
FILE Map 3-3 Known UXO and MD Figure 6.mxd
PAGE # 3-3
SCALE 1 inch = 5,280 feet



Legend

- RI MC DUs
- Background Sample
- Previous UXO Find MC Samples
- RI Investigation Boundary
- Camp Maxey Range Complex
- National Guard Installation
- Former Camp Maxey Installation Boundary
- Pat Mayse Lake
- Pat Mayse State Park and WMA

03°68'

UTM Zone 15 NAD 83 (Meters)
Data Provided By:
Texas Parks & Wildlife Dept.
U.S. Army Corps of Engineers
ESRI

Miles: 1 0.5 0 1
Kilometers: 1.6 0.8 0 1.6

Location Map:
Former Camp Maxey Lamar County, TX

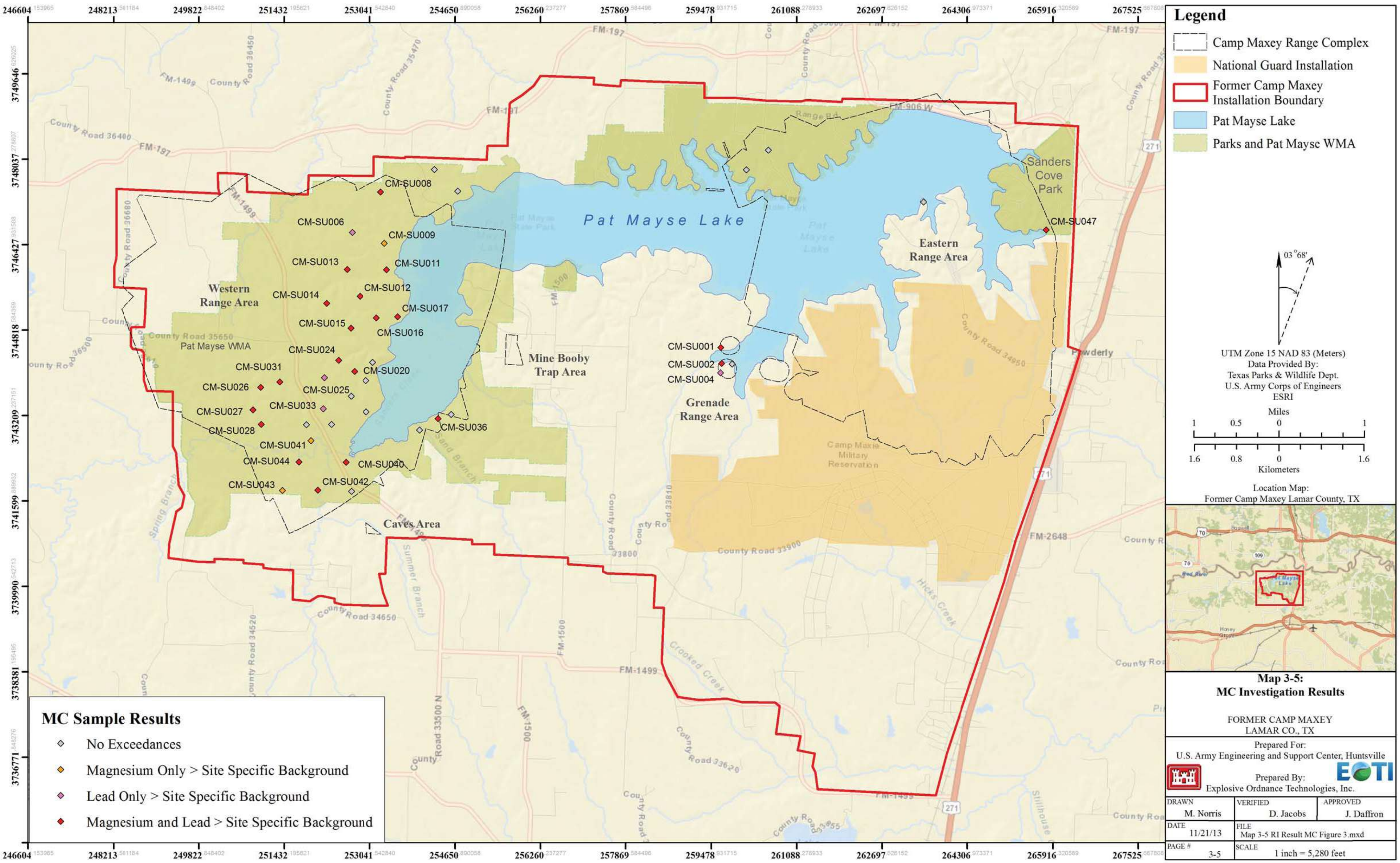
Map 3-4:
MC Investigation Design

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 11/19/13	FILE Map 3-4 RI Design MC Figure 2.mxd	
PAGE # 3-4	SCALE 1 inch = 5,280 feet	



Legend
Camp Maxey Range Complex
National Guard Installation
Former Camp Maxey Installation Boundary
Pat Mayse Lake
Parks and Pat Mayse WMA
MC Sample Results
No Exceedances
Magnesium Only > Site Specific Background
Lead Only > Site Specific Background
Magnesium and Lead > Site Specific Background
Pat Mayse Lake
Western Range Area
Eastern Range Area
Grenade Range Area
Mine Booby Trap Area
Caves Area
Sanders Cove Park
Pat Mayse WMA
Camp Maxie Military Reservation
CM-SU001
CM-SU002
CM-SU004
CM-SU006
CM-SU008
CM-SU009
CM-SU011
CM-SU012
CM-SU013
CM-SU014
CM-SU015
CM-SU016
CM-SU017
CM-SU020
CM-SU024
CM-SU025
CM-SU026
CM-SU027
CM-SU028
CM-SU031
CM-SU033
CM-SU036
CM-SU040
CM-SU041
CM-SU042
CM-SU043
CM-SU044
CM-SU047
Powderly
FM-197
FM-1499
FM-1500
FM-2648
FM-906 W
County Road 36400
County Road 35650
County Road 34650
County Road 34950
County Road 33900
County Road 33620
County Road 33500 N
Summer Branch
Sand Branch
Spring Branch
Crooked Creek
Hicks Creek
Stillhouse
246604
248213
249822
251432
253041
254650
256260
257869
259478
261088
262697
264306
265916
267525
3749646
3748037
3746427
3744818
3743209
3741599
3739990
3738381
3736771
UTM Zone 15 NAD 83 (Meters)
Data Provided By:
Texas Parks & Wildlife Dept.
U.S. Army Corps of Engineers
ESRI
03°68'
Miles
1 0.5 0 1
1.6 0.8 0 1.6
Kilometers
Location Map:
Former Camp Maxey Lamar County, TX
Map 3-5:
MC Investigation Results
FORMER CAMP MAXEY
LAMAR CO., TX
Prepared For:
U.S. Army Engineering and Support Center, Huntsville
Prepared By:
Explosive Ordnance Technologies, Inc.
DRAWN M. Norris
VERIFIED D. Jacobs
APPROVED J. Daffron
DATE 11/21/13
FILE Map 3-5 RI Result MC Figure 3.mxd
PAGE # 3-5
SCALE 1 inch = 5,280 feet

4 REVISED CONSEPTUAL SITE MODEL AND RESULTS

Based on the results of the RI MEC and MC investigations the Camp Maxey Range Complex MRS is being recommended to be separated into 12 MRSs based on the revised MEC, land use, and exposure profiles. The MC results indicate MC is not a significant concern at the Former Camp Maxey and is not included in the revised CSM analysis. Details concerning the human health and ecological risk associated with exposure to MC at Camp Maxey are provided in Section 6.

4.1 MUNITIONS AND EXPLOSIVES OF CONCERN, LAND USE, AND EXPOSURE PROFILE

The overall site profile has not changed from the original CSM discussed in Section 2.1.2. However, following the RI activities and based on differences in land ownership, current and reasonably anticipated future land use, and potential MEC and MD density, it was determined that specific areas within the Former Camp Maxey should be delineated and evaluated separately moving forward to the FS. Table 4-1 provides details on these parameters as well as a brief description of the recommended MRSs. Map 4-1 shows land use at the Former Camp Maxey and Map 4-2 identifies the revised MRS recommendations.

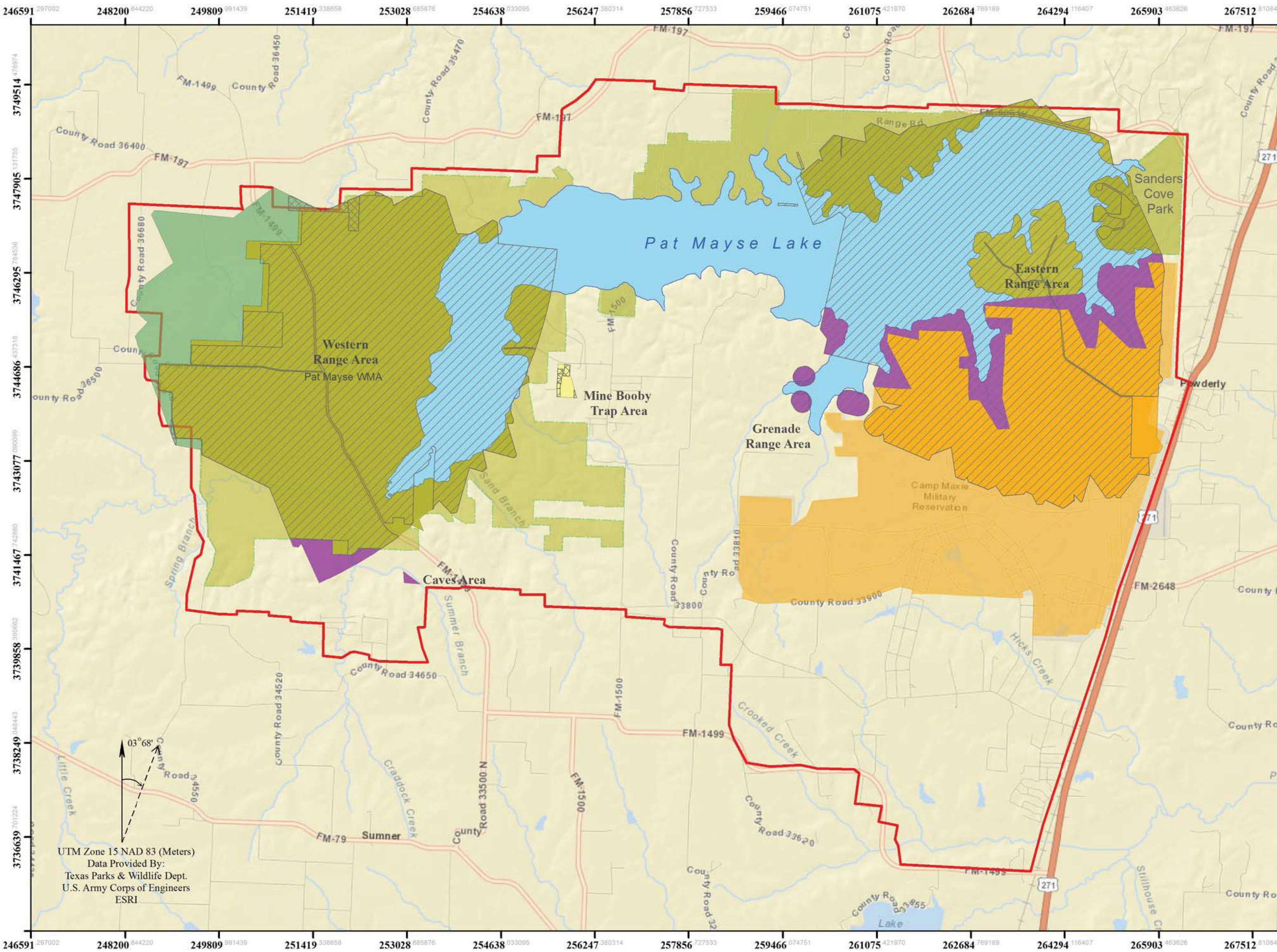
Table 4-1: Revised MRS Delineations

Potential MRS	Land Ownership	Reasonably Anticipated Future Land Use	MEC / MD Density	MRS Description
Western Range Area A (1,310 Acres)	Private	Undeveloped/ Agricultural (i.e., pasture land)	Unconfirmed (no access)	This MRS is located in the northwest portion of the Western Range Area. It is on private property primarily used for agriculture. There was no access to this area during the RI. Historical data indicated that it includes firing points and portions of ranges fans for several ranges. Additional data is needed to characterize the MRS.
Western Range Area B (2,166 Acres)	Public/Private (Pat Mayse WMA)	Recreational (i.e., hunting, hiking, lake access)	Low	This MRS is located in the Western Range Area and included portions of several range fans. It is located primarily within a WMA that is Government owned but accessed by the public for surface recreational activities, such as hiking and hunting. It is a noncontiguous area located east Western Range Area A and along the north and east side of the lake within the Western Range Area. RI data supports the historical data. No MEC was identified during the RI or during previous investigations. The MRS primarily includes area with low MD density. This may indicate that it was on the edge of the main impact/target area.

Potential MRS	Land Ownership	Reasonably Anticipated Future Land Use	MEC / MD Density	MRS Description
Western Range Area C (1,104 Acres)	Public (Pat Mayse WMA)	Recreational (i.e., hunting, hiking, lake access)	Medium/High	This MRS is located in the North-Central and South-Central sections of the Western Range Area. It is located within a WMA that is Government owned but accessed by the public for surface recreational activities, such as hiking and hunting. No MEC was located in this MRS during the RI or during previous investigations; however there are areas with medium and high MD densities that is consistent with potential target areas within impact areas.
Western Range Area D (1,870 Acres)	Public (Pat Mayse WMA)	Recreational (i.e., hunting, hiking, lake access)	Medium/High	This MRS is located in what is believed to be the central impact area for the western ranges. It is located within a WMA that is Government owned but accessed by the public for surface recreational activities, such as hiking and hunting. RI results include UXO located on or just below the ground surface and several areas with high or medium MD density.
Western Range Area E (133 Acres)	Private	Undeveloped	Medium/High	This MRS includes private, undeveloped property in the southern portion of the Western Range Area. Access was not provided to this area during the RI.
Eastern Range Area A (1,124 Acres)	Public (Pat Mayse State Park)	Recreational (i.e., camping, hunting, hiking, lake access)	Low/Medium	This MRS is located along the North and East shore of the lake within the Eastern Range Area. It includes area primarily within a state park, used for recreation, which may include activities such as camping, hiking and accessing the lake. It includes the dam area and former ranges that were investigated and partially cleared in a previous removal action. The previous removal action included the use of geophysical transects to locate potential former target areas and then selected grids were cleared in order to reduce the potential for exposure to MEC. No MEC was encountered in this MRS during the RI and only low concentrations of MD were identified.

Potential MRS	Land Ownership	Reasonably Anticipated Future Land Use	MEC / MD Density	MRS Description
Eastern Range Area B (540 Acres)	Public	Recreational (i.e., camping, hunting, hiking, lake access)	Medium/High	This MRS is located on the peninsula that extends into the south side of Pat Mayse Lake in the center of the Eastern Range Area. The property is used for camping and other recreational activities. Recreational activities in this MRS are primarily on the surface but there may be some shallow subsurface exposure associated with some camping activities. Although only one MEC was located within this MRS during the RI, previous investigation/removal projects have identified some MEC in the MRS.
Eastern Range Area C (563 Acres)	Public (Pat Mayse State Park)	Undeveloped/ Recreational (i.e., hiking, lake access)	Medium/High	This MRS is located on the southern shore of the lake within the Eastern Range Area. It is located along a narrow band between the National Guard facility and Pat Mayse Lake. Although not designated for public recreational use, the area can be accessed by lake or over land. Potential exposure could result from surface related recreational activities, such as hiking or fishing along the lake shore. No MEC item was located on the surface during the RI and MD density was generally low throughout the MRS.
Grenade Range Area (97 Acres)	Public	Undeveloped	Medium/High	This MRS includes three areas identified in historical documents as grenade training areas, located on the south side of the lake west of the Eastern Range Area. The MRS is located on public land that may be accessed for recreational activities associated with Pat Mayse Lake, such as hiking and fishing. The RI results identified MD which could be an indication of potential MEC in the area.
Cave Training Area (7 Acres)	Private	Undeveloped	Unconfirmed (no access)	This MRS is a small area located south of the Western Range Area. It is located within a privately owned parcel which was not accessible during the RI. There is little historical information but anecdotal information suggests that the area was used to simulated cave clearing operations. Additional data is needed to characterize the MRS.

Potential MRS	Land Ownership	Reasonably Anticipated Future Land Use	MEC / MD Density	MRS Description
Mine and Booby Trap Training Area (35 Acres)	Private	Residential	Low/Medium	This MRS is located east of the Western Range Area and is on privately owned residential parcels. Historical records indicated that the area was used to train with practice mines. Collection of data during the RI was limited by a lack of access to several private parcels in the area; however during a reconnaissance of the area a property owner provided information and evidence that confirmed mine training in the area. Practice mines used during the time that the Former Camp Maxey was in operation, contained a small “puff charge” that was not intended to cause harm.
Bivouac Area (1,125 Acres)	Public and Private	Recreational (i.e., hunting and hiking) and Residential	Unconfirmed (not investigated)	This MRS fall outside of the current MRS boundary identified in FUDSMIS and was not characterized or evaluated in the RI/FS. It is an area previously identified as a Bivouac area. MEC has been located in portions of this area. Additional data is needed to characterize the MRS.



Legend

- Private
- State and Federal Property
- Agricultural
- Recreational
- Residential
- Texas National Guard
- Undeveloped
- Lake
- Former Camp Maxey Installation Boundary
- Pat Mayse Lake
- National Guard Installation
- Pat Mayse State Park and WMA

Location Map:
Former Camp Maxey Lamar County, TX

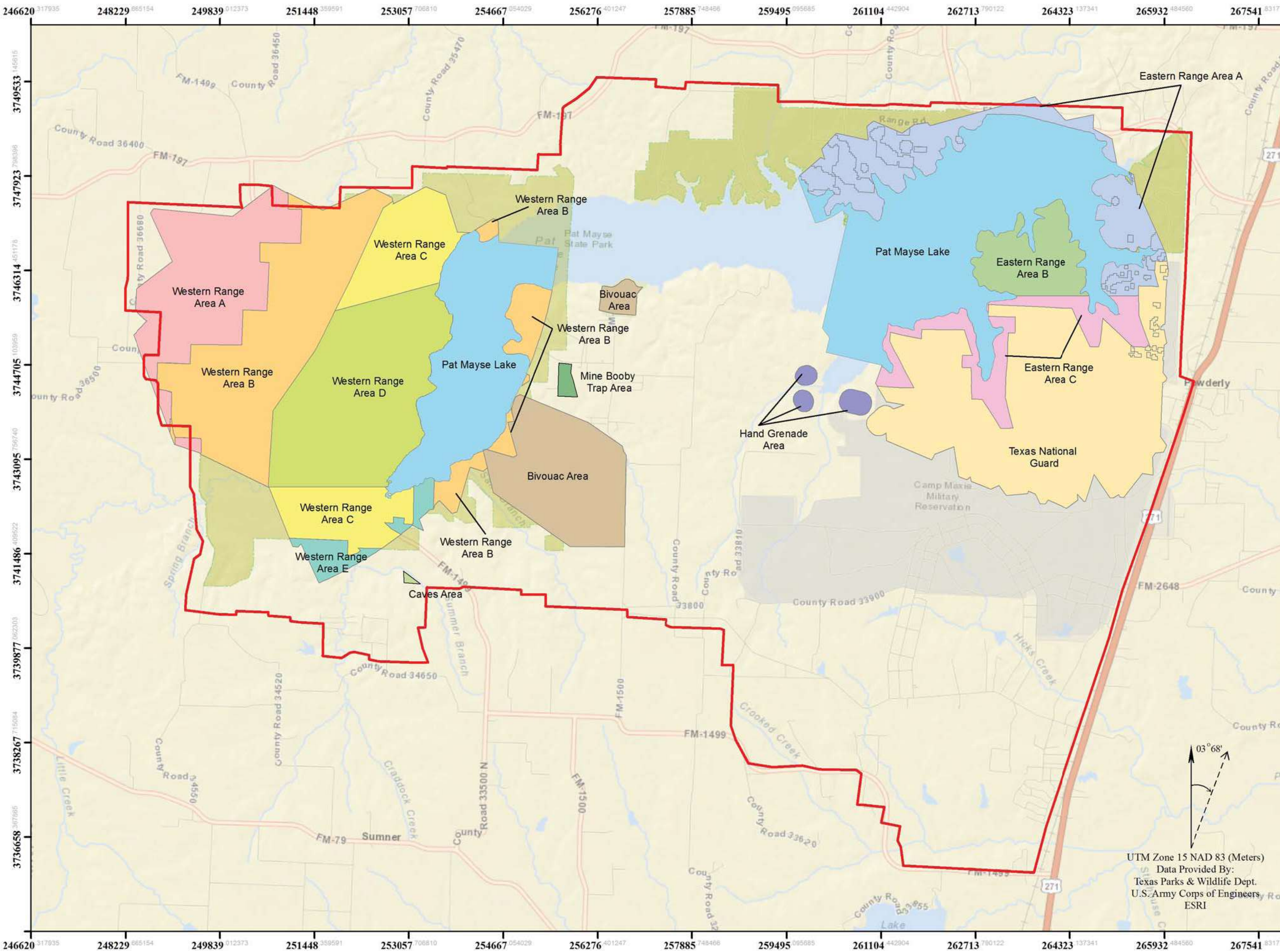
Map 4-1:
Land Use

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 11/21/13	FILE Map 4-1 Land Use Map Figure 7.mxd	
PAGE # 4-1	SCALE 1 inch = 5,300 feet	



Legend

MRS

- Bivouac Area
- Grenade Range Area
- Caves Area
- Mine Booby Trap Area
- Pat Mayse Lake
- Texas National Guard
- Eastern Range Area A
- Eastern Range Area B
- Eastern Range Area C
- Western Range Area A
- Western Range Area B
- Western Range Area C
- Western Range Area D
- Western Range Area E
- National Guard Installation
- Pat Mayse State Park and WMA
- Former Camp Maxey Installation Boundary

Miles: 1 0.5 0 1
Kilometers: 1.6 0.8 0 1.6

Location Map:
Former Camp Maxey Lamar County, TX

Map 4-2:
Revised MRS Delineations

FORMER CAMP MAXEY
LAMAR CO., TX

Prepared For:
U.S. Army Engineering and Support Center, Huntsville

Prepared By:
Explosive Ordnance Technologies, Inc.

DRAWN	VERIFIED	APPROVED
M. Norris	D. Jacobs	J. Daffron
DATE 12/09/13	FILE Name: Map 4-2 Porposed MRS.mxd	
PAGE # 4-2	SCALE 1 inch = 5,280 feet	

5 CONTAMINANT FATE AND TRANSPORT

5.1 CONTAMINANT FATE AND TRANSPORT PATHWAY ANALYSIS

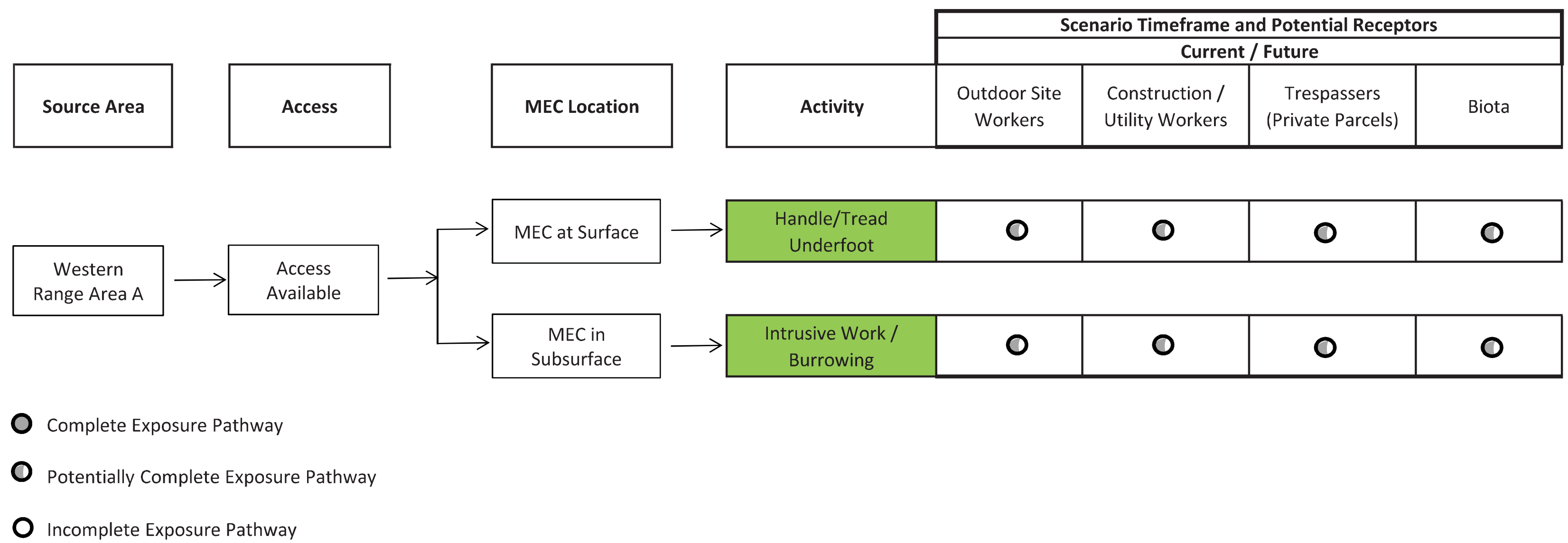
5.1.1 Munitions and Explosives of Concern Pathway Analysis

The MEC pathway analysis for the Former Camp Maxey, shows that there are complete and potentially complete pathways for all human and ecological receptors of MEC at each of the 12 MRSs above based on the results of the RI field work, previous investigations, and existing data gaps. This includes receptors for handle/treads underfoot contact (surface), as well as work that may be conducted on the ground surface. Complete and potentially complete exposure pathways also exist in the subsurface soil for human receptors, such as outdoor site workers who may perform intrusive work and recreational visitors who may visit the site and disturb subsurface soil. Recreational visitors to the parks and wildlife management areas are authorized to camp in designated areas and may engage in intrusive activity involving hand excavations to depths generally less than 12 inches. The subsurface pathway is also complete for biota that may nest or burrow at the MRS. Figures in Section 5 include details concerning specific pathways for each recommended MRS.

5.1.2 Munitions Constituent Pathway Analysis

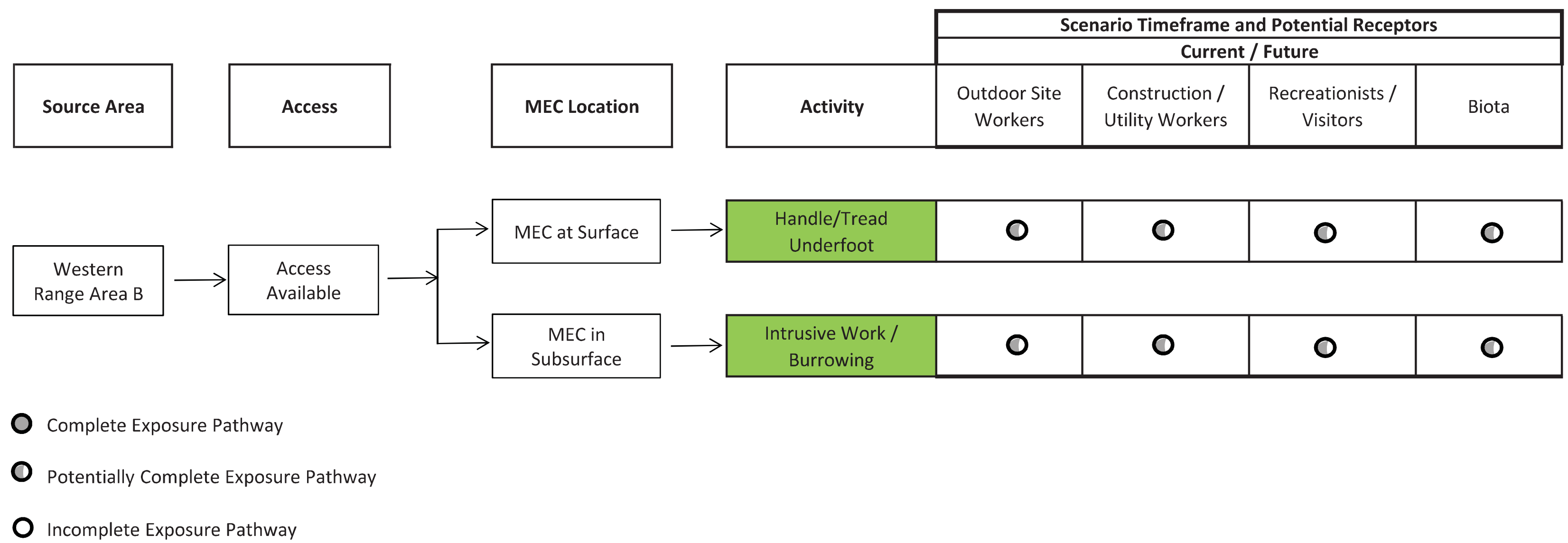
5.1.2.1. Due to the nature of historical military activities at the site, MC can exist and may present a risk of adverse health effects, if human exposure occurs. MC can be released from fully intact munitions through corrosion and breaching of the casing or the development of cracks, from dissolved filler leaking through screw threads on the munitions casing, or exposed filler that resulted from incomplete detonation. This explosive filler may be scattered over the MRS or partially encased in the remains of the munitions casing. Migration of MC may occur naturally through surface soil erosion, plant or animal uptake, or by human activities such as maintenance and site work. MC in surface soil may migrate to the subsurface with infiltrating water. If soil erosion and subsequent surface runoff carries MC into inland impounded water bodies, migration of MC through surface water and sediment may occur as well. MC in soil/sediment may also migrate through leaching to groundwater; however, shallow groundwater is not a source of potable water at the Former Camp Maxey.

5.1.2.2. Based on sampling data, a Human Health Risk Assessment (HHRA) and Screening Level Ecological Risk Assessment (SLERA) were conducted (presented in Section 6). The results of the HHRA and SLERA demonstrate that no Contaminants of Concern (COCs) were identified for either at the site. As such, the exposure pathways are all incomplete for human receptors of MC. Figures in Section 5 illustrate the incomplete pathways to human and ecological receptors for the entire Former Camp Maxey.



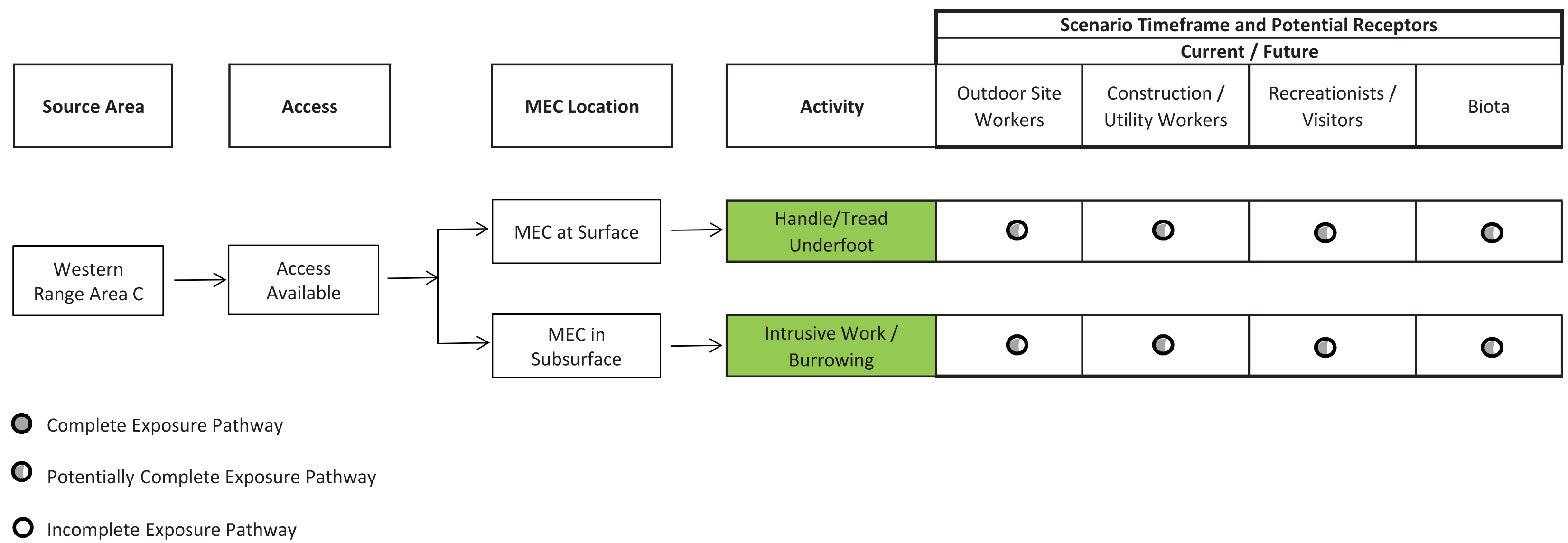
EXPOSURE PATHWAY ANALYSIS FOR MEC - WESTERN RANGE AREA A
Remedial Investigation
Paris, Texas

FIGURE 5-1



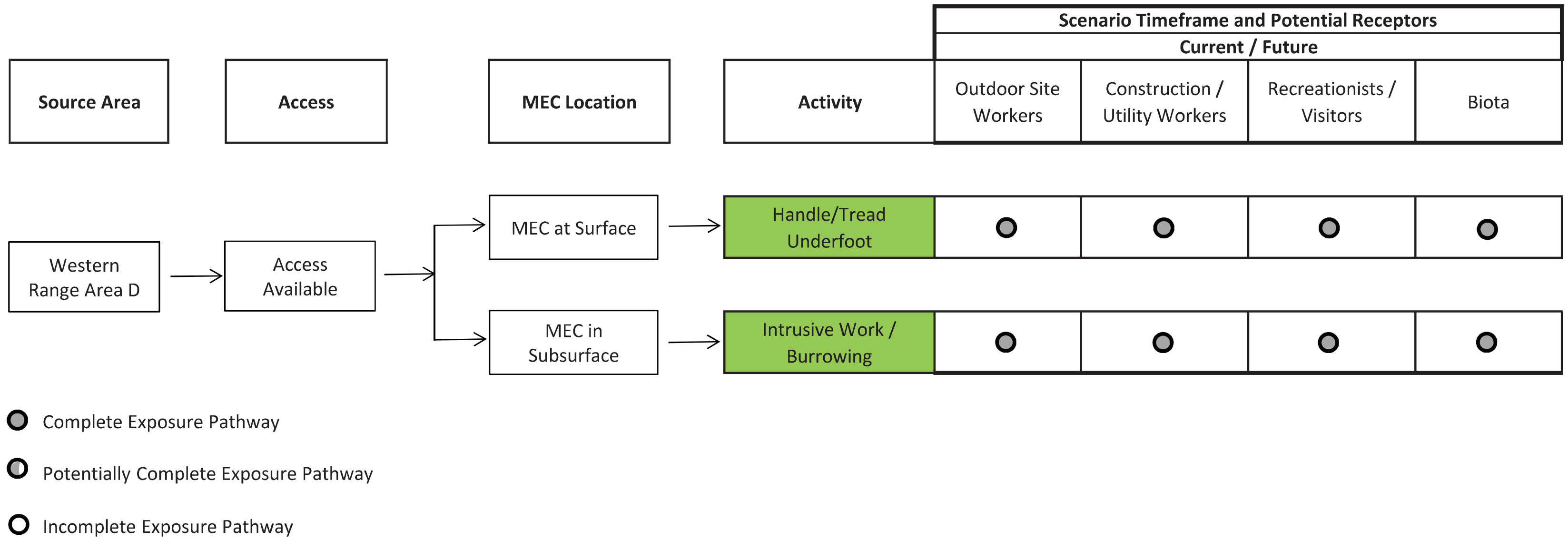
EXPOSURE PATHWAY ANALYSIS FOR MEC - WESTERN RANGE AREA B
Remedial Investigation
Paris, Texas

FIGURE 5-2



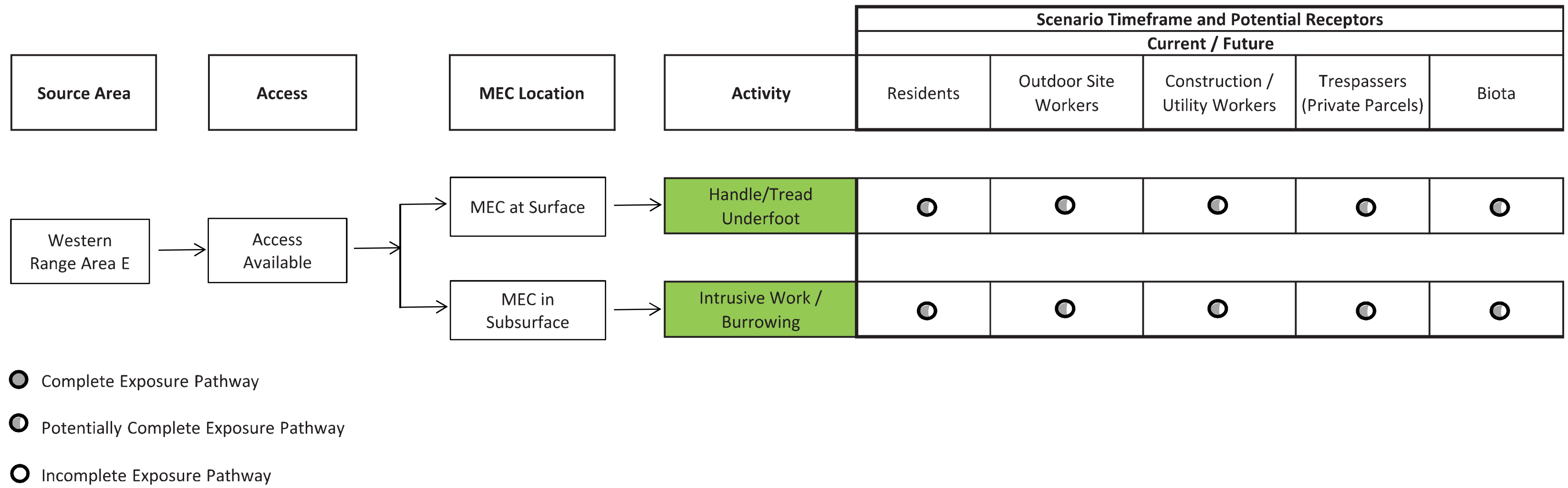
EXPOSURE PATHWAY ANALYSIS FOR MEC - WESTERN RANGE AREA C
Remedial Investigation
Paris, Texas

FIGURE 5-3



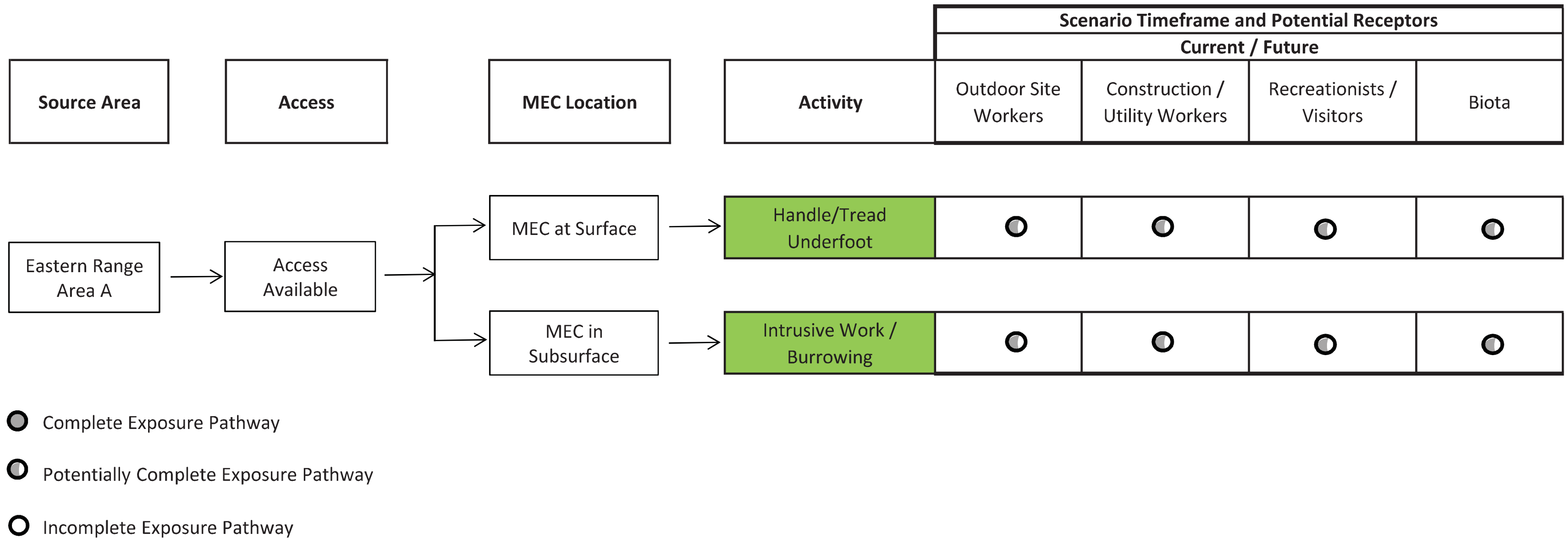
EXPOSURE PATHWAY ANALYSIS FOR MEC - WESTERN RANGE AREA D
Remedial Investigation
Paris, Texas

FIGURE 5-4



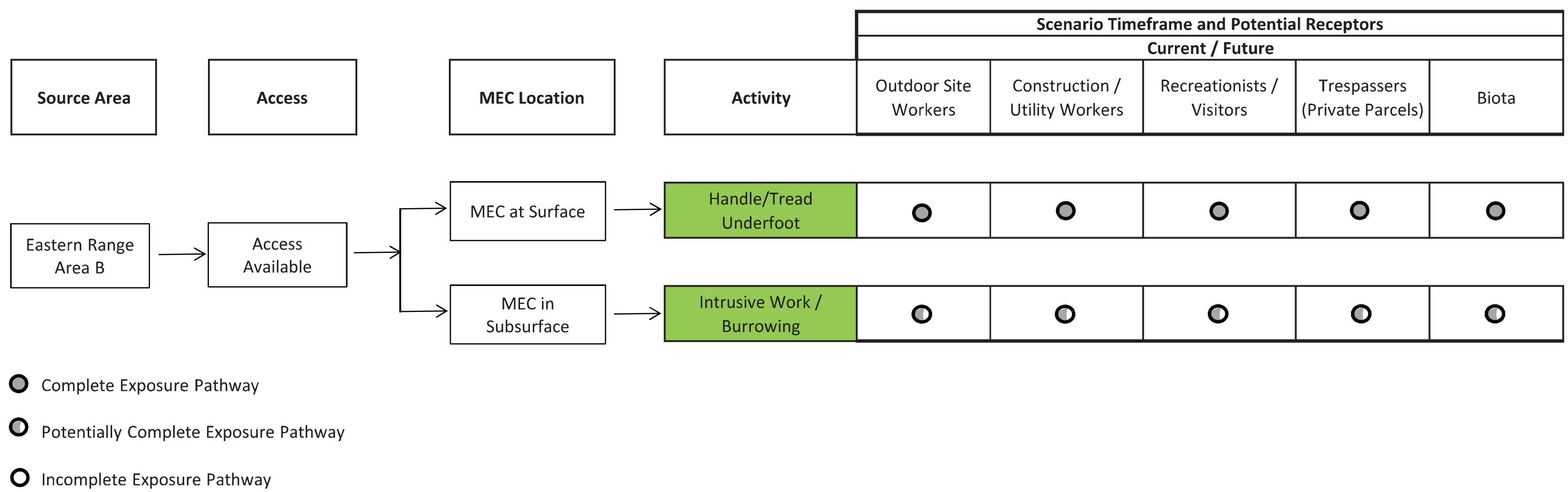
EXPOSURE PATHWAY ANALYSIS FOR MEC - WESTERN RANGE AREA E
Remedial Investigation
Paris, Texas

FIGURE 5-5



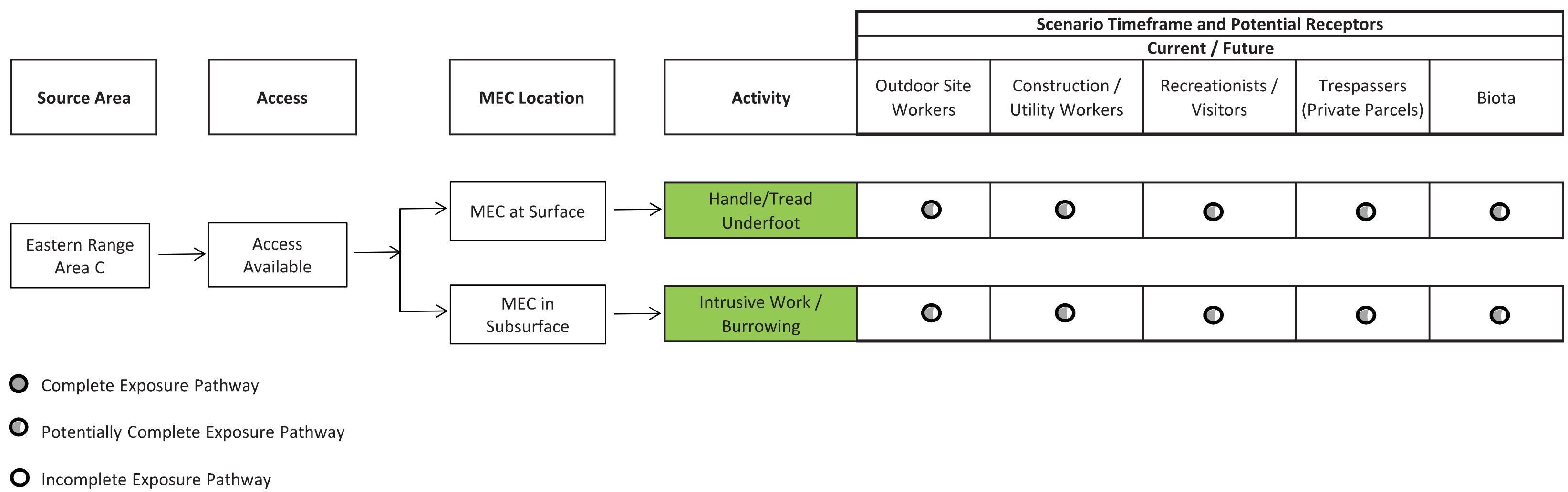
EXPOSURE PATHWAY ANALYSIS FOR MEC - EASTERN RANGE AREAS A
Remedial Investigation
Paris, Texas

FIGURE 5-6



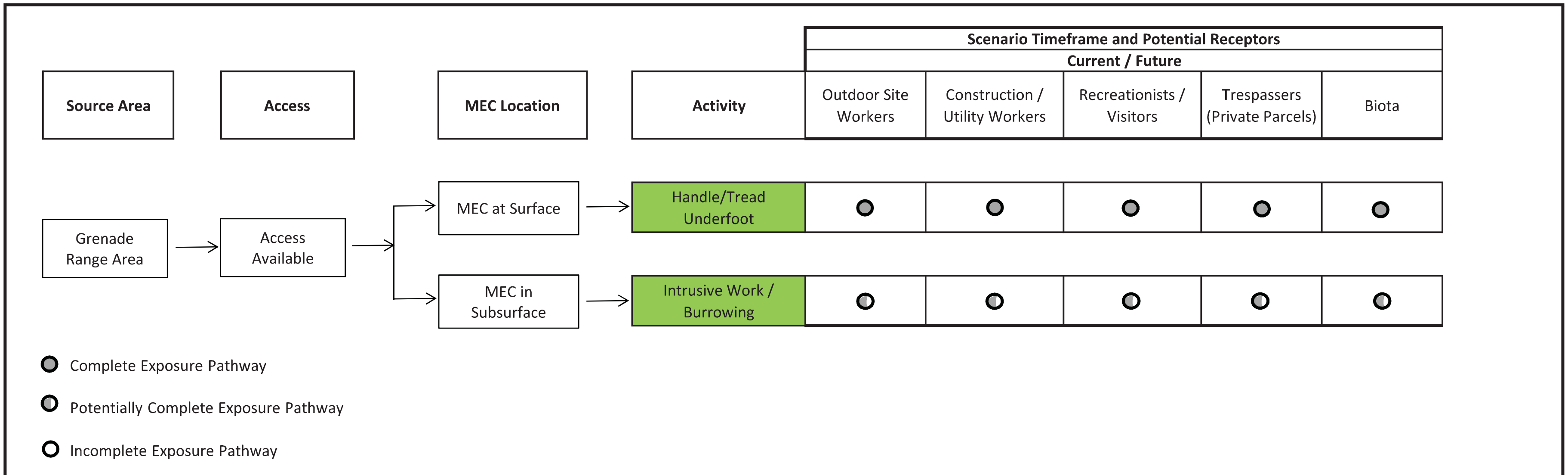
EXPOSURE PATHWAY ANALYSIS FOR MEC - EASTERN RANGE AREA B
Remedial Investigation
Paris, Texas

FIGURE 5-7



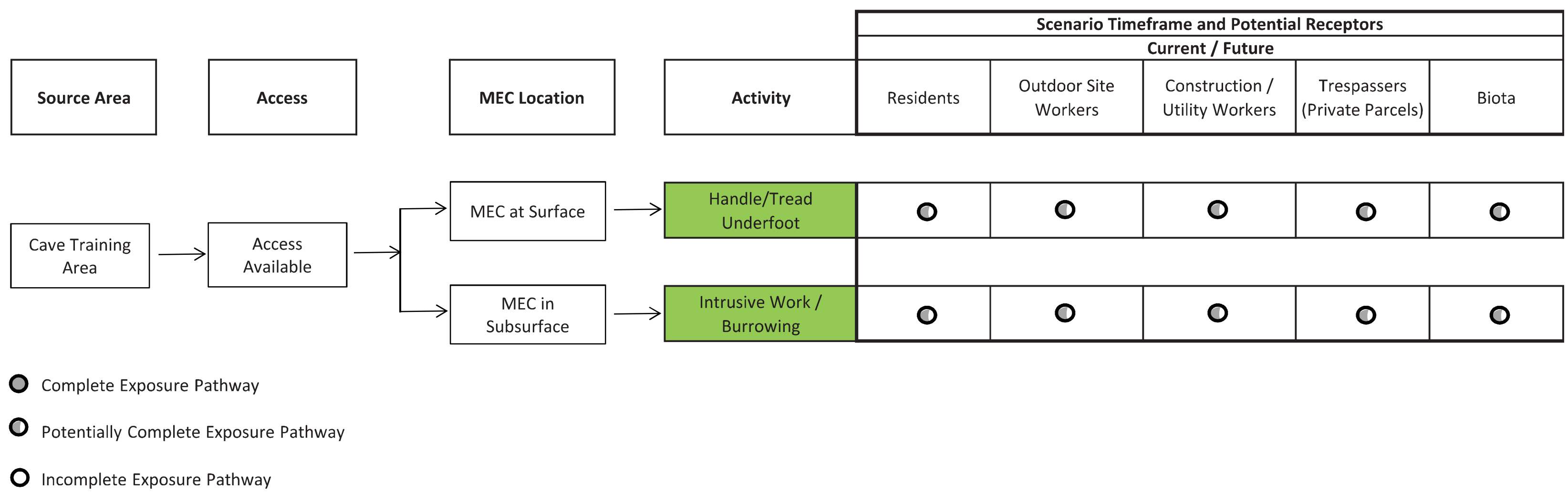
EXPOSURE PATHWAY ANALYSIS FOR MEC - EASTERN RANGE AREA C
Remedial Investigation
Paris, Texas

FIGURE 5-8



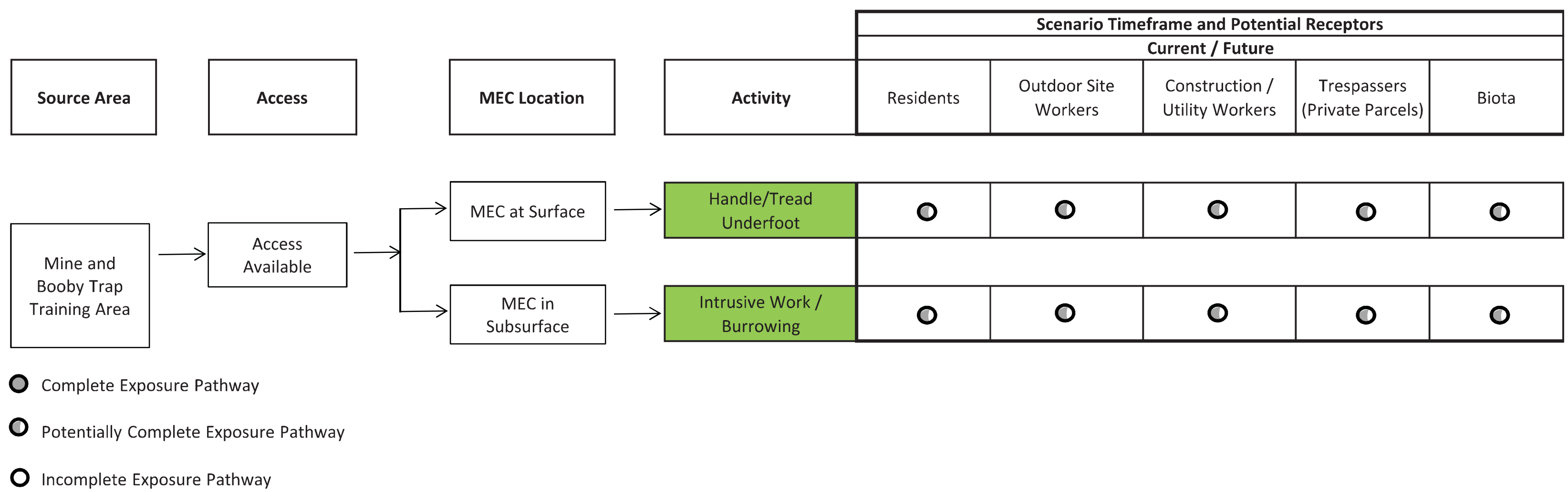
EXPOSURE PATHWAY ANALYSIS FOR MEC - GRENADE RANGE AREA
Remedial Investigation
Paris, Texas

FIGURE 5-9



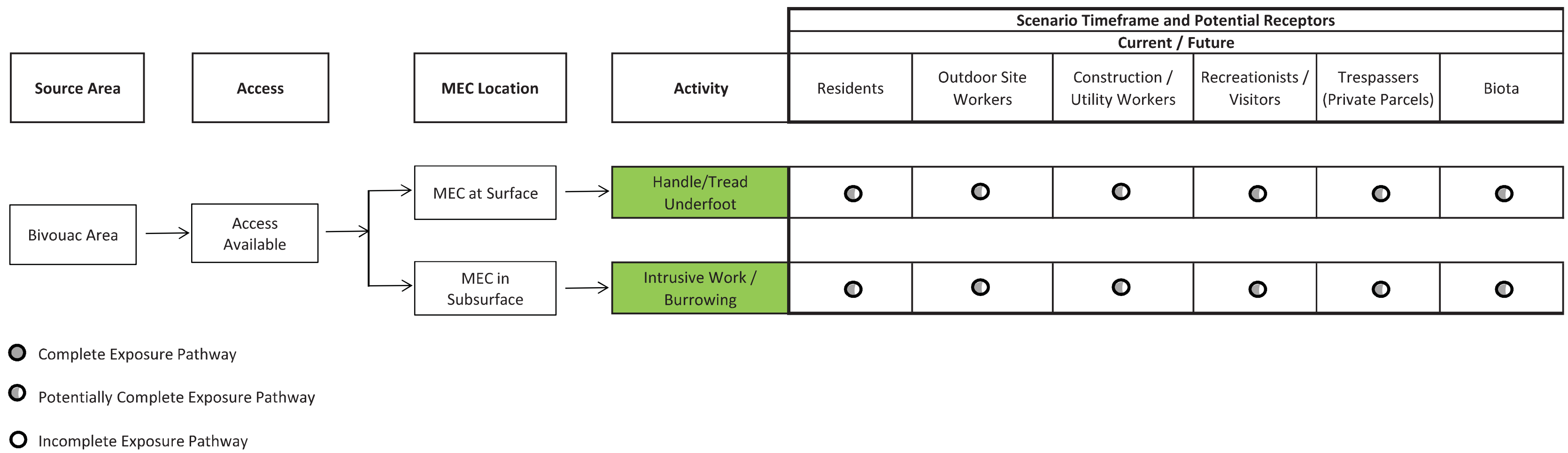
EXPOSURE PATHWAY ANALYSIS FOR MEC - CAVE TRAINING AREA
Remedial Investigation
Paris, Texas

FIGURE 5-10



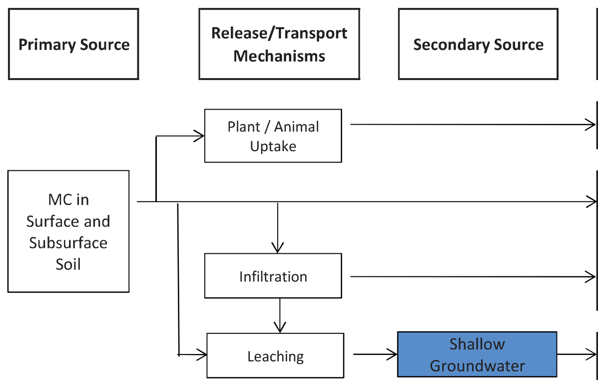
EXPOSURE PATHWAY ANALYSIS FOR MEC - MINE AND BOOBY TRAP TRAINING AREA
Remedial Investigation
Paris, Texas

FIGURE 5-11



EXPOSURE PATHWAY ANALYSIS FOR MEC - BIVUOAC AREA
Remedial Investigation
Paris, Texas

FIGURE 5-12



Exposure Media	Exposure Routes	Residents (Current / Future)	Outdoor Site Workers (Current / Future)	Construction / Utility Workers (Current / Future)	Recreationists / Visitors / Tourists (Current / Future)	Trespassers (Private Parcels) (Current / Future)	Construction Workers (Future)
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

Scenario Timeframe and Potential Human Receptor Populations

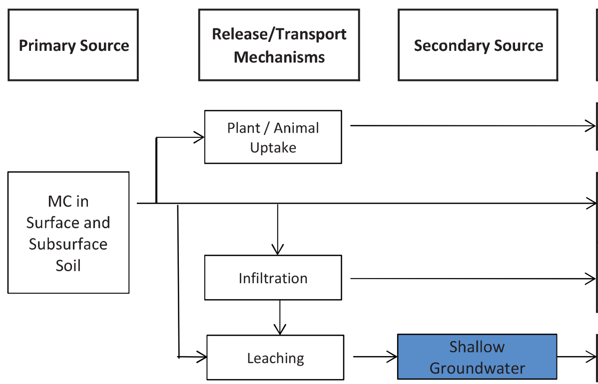
● Complete Exposure Pathway
◐ Potentially Complete Exposure Pathway
O Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - WESTERN RANGE AREA A
Remedial Investigation
Paris, Texas

FIGURE 5-13



Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					Future
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

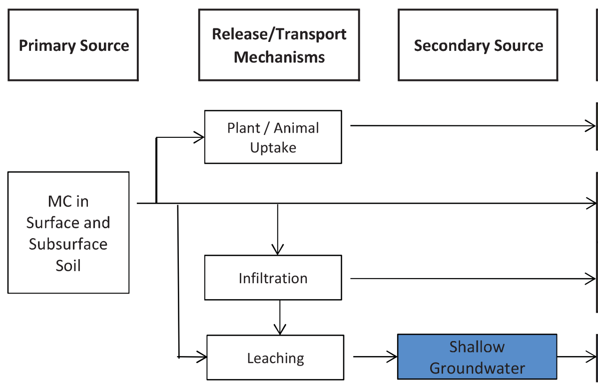
- ● Complete Exposure Pathway
- ◉ Potentially Complete Exposure Pathway
- O Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - WESTERN RANGE AREA B
Remedial Investigation
Paris, Texas

FIGURE 5-14



Exposure Media	Exposure Routes	Residents (Current / Future)	Outdoor Site Workers (Current / Future)	Construction / Utility Workers (Current / Future)	Recreationists / Visitors / Tourists (Current / Future)	Trespassers (Private Parcels) (Current / Future)	Construction Workers (Future)
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

Scenario Timeframe and Potential Human Receptor Populations

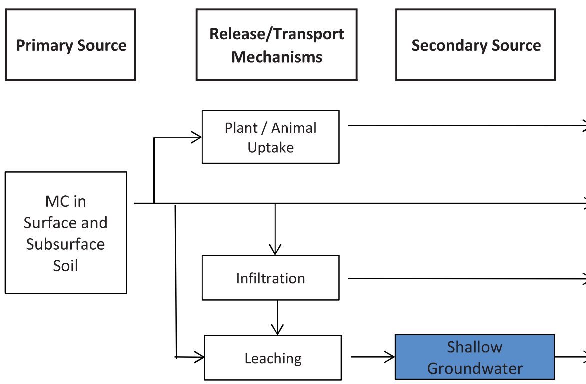
- ● Complete Exposure Pathway
- ◉ Potentially Complete Exposure Pathway
- O Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - WESTERN RANGE AREA C
Remedial Investigation
Paris, Texas

FIGURE 5-15



Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					**Future**
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

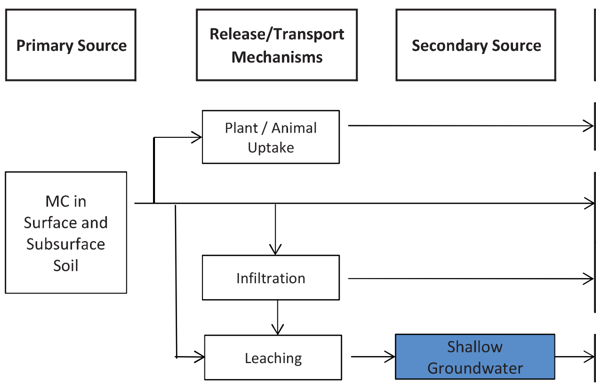
- ● Complete Exposure Pathway
- ◐ Potentially Complete Exposure Pathway
- O Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - WESTERN RANGE AREA D
Remedial Investigation
Paris, Texas

FIGURE 5-16



Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
		Scenario Timeframe and Potential Human Receptor Populations: Current / Future					Future
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

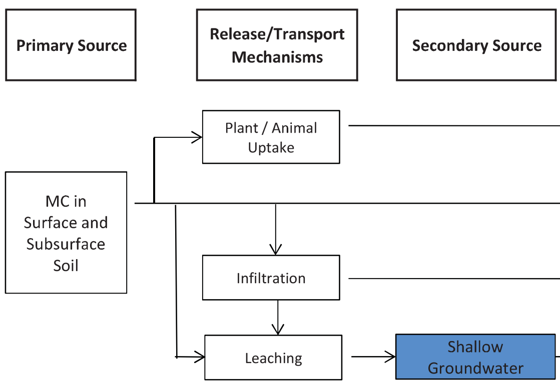
● Complete Exposure Pathway
◐ Potentially Complete Exposure Pathway
O Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - WESTERN RANGE AREA E
Remedial Investigation
Paris, Texas

FIGURE 5-17



Exposure Media	Exposure Routes	Residents (Current / Future)	Outdoor Site Workers (Current / Future)	Construction / Utility Workers (Current / Future)	Recreationists / Visitors / Tourists (Current / Future)	Trespassers (Private Parcels) (Current / Future)	Construction Workers (Future)
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

Scenario Timeframe and Potential Human Receptor Populations

● Complete Exposure Pathway

◐ Potentially Complete Exposure Pathway

O Incomplete Exposure Pathway

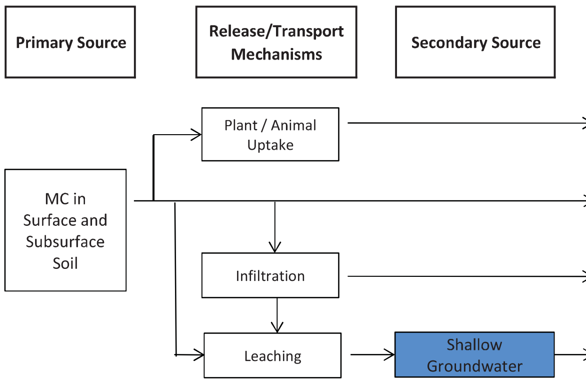
Notes:

1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - EASTERN RANGE AREA A
Remedial Investigation
Paris, Texas

FIGURE 5-18



Exposure Media	Exposure Routes	Residents (Current / Future)	Outdoor Site Workers (Current / Future)	Construction / Utility Workers (Current / Future)	Recreationists / Visitors / Tourists (Current / Future)	Trespassers (Private Parcels) (Current / Future)	Construction Workers (Future)
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

Scenario Timeframe and Potential Human Receptor Populations

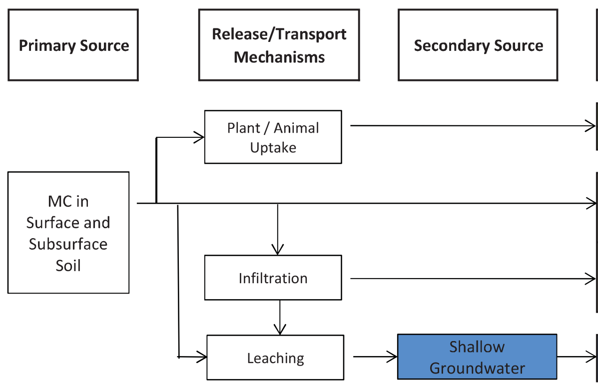
● Complete Exposure Pathway
◉ Potentially Complete Exposure Pathway
○ Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - EASTERN RANGE AREA B
Remedial Investigation
Paris, Texas

FIGURE 5-19



Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					Future
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

● Complete Exposure Pathway

◐ Potentially Complete Exposure Pathway

O Incomplete Exposure Pathway

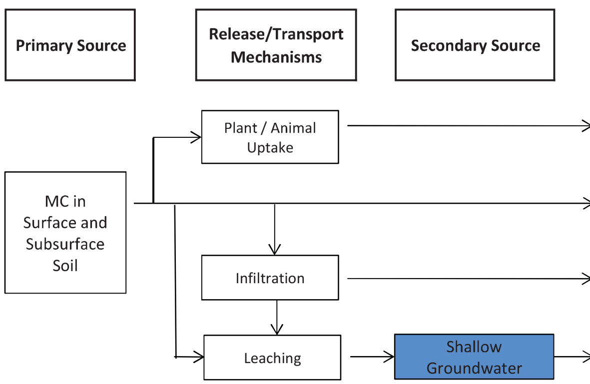
Notes:

1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - EASTERN RANGE AREA C
Remedial Investigation
Paris, Texas

FIGURE 5-20



Exposure Media	Exposure Routes	Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					Future
		Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
Vegetation	Ingestion	O	O	O	O	O	O
Domestic Animals/Game	Ingestion	O	O	O	O	O	O
Surface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Subsurface Soil	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O
	Inhalation (Dust)	O	O	O	O	O	O
Shallow Groundwater	Ingestion	O	O	O	O	O	O
	Dermal Contact	O	O	O	O	O	O

● Complete Exposure Pathway

◉ Potentially Complete Exposure Pathway

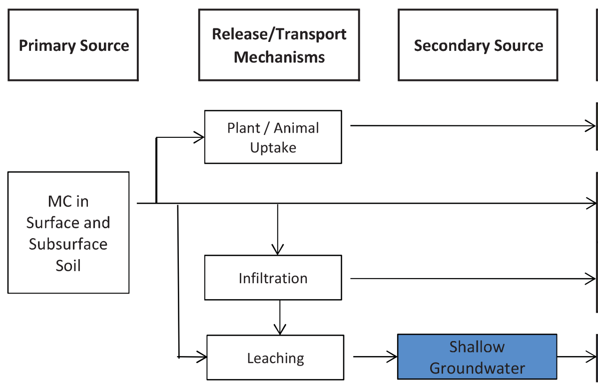
O Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - GRENADE RANGE AREA
Remedial Investigation
Paris, Texas

FIGURE 5-21



Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					**Future**
Vegetation	Ingestion	○	○	○	○	○	○
Domestic Animals/Game	Ingestion	○	○	○	○	○	○
Surface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Subsurface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Shallow Groundwater	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○

● Complete Exposure Pathway

◉ Potentially Complete Exposure Pathway

○ Incomplete Exposure Pathway

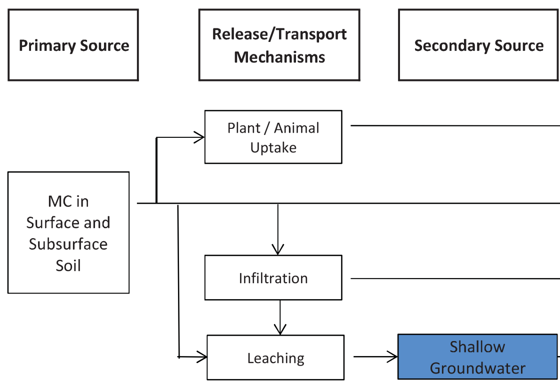
Notes:

1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - CAVE TRAINING AREA
Remedial Investigation
Paris, Texas

FIGURE 5-22



Exposure Media	Exposure Routes	Residents (Current / Future)	Outdoor Site Workers (Current / Future)	Construction / Utility Workers (Current / Future)	Recreationists / Visitors / Tourists (Current / Future)	Trespassers (Private Parcels) (Current / Future)	Construction Workers (Future)
Vegetation	Ingestion	○	○	○	○	○	○
Domestic Animals/Game	Ingestion	○	○	○	○	○	○
Surface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Subsurface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Shallow Groundwater	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○

Scenario Timeframe and Potential Human Receptor Populations

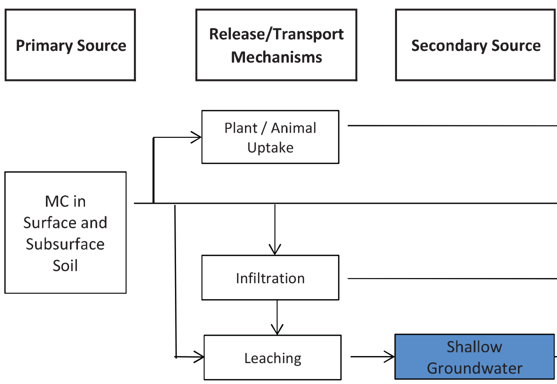
● Complete Exposure Pathway
◉ Potentially Complete Exposure Pathway
○ Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - MINE AND BOOBY TRAP TRAINING AREA
Remedial Investigation
Paris, Texas

FIGURE 5-23



Exposure Media	Exposure Routes	Residents	Outdoor Site Workers	Construction / Utility Workers	Recreationists / Visitors / Tourists	Trespassers (Private Parcels)	Construction Workers
		Scenario Timeframe and Potential Human Receptor Populations					
		Current / Future					Future
Vegetation	Ingestion	○	○	○	○	○	○
Domestic Animals/Game	Ingestion	○	○	○	○	○	○
Surface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Subsurface Soil	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○
	Inhalation (Dust)	○	○	○	○	○	○
Shallow Groundwater	Ingestion	○	○	○	○	○	○
	Dermal Contact	○	○	○	○	○	○

● Complete Exposure Pathway
◐ Potentially Complete Exposure Pathway
○ Incomplete Exposure Pathway

Notes:
1. Inhalation of volatile chemicals is not a potential exposure route, because the MC of concern for the Site are not volatile.

1. The determination of incomplete exposure pathways is dependent on the data evaluated for this RI and is based on analyte concentrations being less than human health risk-based screening levels. Data gaps and other sources of uncertainty are described in the RI Report text.

EXPOSURE PATHWAY ANALYSIS FOR MC - BIVOUAC AREA
Remedial Investigation
Paris, Texas

FIGURE 5-24

6 HAZARD ASSSESSMENT AND BASELINE RISK ASSESSMENT

6.1 HAZARD RISK ASSESSMENT FOR MUNITIONS AND EXPLOSIVES OF CONCERN

6.1.1 Munitions Response Site Prioritization Protocol

The MRSPP provides a framework to use with stakeholders to determine the relative risks posed at each MRS within its MRS Inventory. Through application of the MRSPP, each MRS is assigned a relative priority for munitions response actions based on its overall conditions. The MRSPP is divided into three modules to evaluate the unique characteristics of each hazard type:

6.1.1.1 Explosive Hazard Evaluation (EHE):

The EHE Module provides the approach for assigning a relative priority to an MRS where MEC (i.e., UXO, Discarded Military Munitions [DMM], and MC in high enough concentrations to pose an explosive hazard) are known or suspected to be present. The EHE Module assesses the explosive hazard through the evaluation of three factors. Using MRS-specific data, these factors consider the presence of MEC, the likelihood of encountering MEC, and potential receptors.

6.1.1.2 Chemical Warfare Materiel Hazard Evaluation (CHE):

The CHE Module provides a consistent approach for assigning a relative priority to an MRS where Chemical Weapons Materiel (CWM) hazards are known or suspected to be present. The CHE Module is used to evaluate the hazards associated with the physiological effects of CWM. The CHE Module is only applied where CWM are known or suspected to be present at an MRS. If historical or physical evidence indicates that CWM is not present, the appropriate data element tables will be omitted from the MRSPP in accordance with DoD guidance.

6.1.1.3 Health Hazard Evaluation (HHE):

The HHE Module provides a consistent DoD-wide approach for evaluating the relative risk to human health and the environment potentially posed by MC and any incidental nonmunitions-related contaminants. The HHE Module has three-factors; the Contaminant Hazard Factor, Migration Pathway Factor, and Receptor Factor. The Contaminant Hazard Factor assesses the potential hazards to receptors from MC and any incidental nonmunitions-related contaminants. The Migration Pathway Factor evaluates the potential for contaminant migration from the MRS to other areas, while the Receptor Factor assesses the presence of receptors to potentially become exposed to or come in contact with MRS-related contamination from MC and any incidental nonmunitions-related contaminants.

6.1.2 MRSPP Scoring

Each of the modules is assigned a rating from G (lowest) to A (highest). Besides the ratings, there are three other possible outcomes of scoring for each module; evaluation pending (insufficient data are available to conduct the scoring), no longer required (a response has already been conducted and completed), or no known or suspected hazard. Based on the scores of the three modules, each MRS is assigned one of eight priorities. Priority 1 indicates the highest MRS priority and Priority 8 indicates the lowest MRS priority. Table 6-1 provides a summary of the MRSPP results for each MRS addressed during the RI. The MRSPP worksheets, with details on how each MRS was scored, are included in Appendix F.

Table 6-1: Summary of MRSPP Results

MRS	EHE Rating	CHE Rating	HHE Rating	MRS Priority or Alternative Rating
Western Range Area A	D	No Known or Suspected	Evaluation Pending	5
Western Range Area B	D		No Known or Suspected	5
Western Range Area C	D		No Known or Suspected	5
Western Range Area D	C		No Known or Suspected	4
Western Range Area E	C		Evaluation Pending	4
Eastern Range Area A	B		No Known or Suspected	3
Eastern Range Area B	C		No Known or Suspected	4
Eastern Range Area C	C		No Known or Suspected	4
Grenade Range Area	C		No Known or Suspected	4
Cave Training Area	F		Evaluation Pending	7
Mine and Booby Trap Training Area	E		No Known or Suspected	6
Bivouac Area	B		Evaluation Pending	3

6.1.3 Baseline Munitions and Explosives of Concern Hazard Assessment

6.1.3.1. The MEC HA is a tool used to assess the risk from MEC at an MRS and is completed in accordance with the *Interim Munitions and Explosives of Concern Hazard Assessment (MEC HA) Methodology* (USEPA, 2008a). The purpose of the MEC HA is twofold:

1) Support the hazard management decision-making process by analyzing site-specific information to:
    a) Assess existing explosives hazards
    b) Evaluate hazard reductions associated with removal and remedial alternatives
    c) Evaluate hazard reductions associated with land use activity decisions
2) Support hazard communication:
    a) Between members of the project team and among other stakeholders

6.1.3.2. By organizing MRS information in a consistent manner the MEC HA helps understand the hazards associated with a MRS if no action is taken, and to evaluate the hazard reductions associated with removal or remedial alternatives. As with any CERCLA-based cleanup process, several different alternatives may be protective of human health and the environment. The information collected for the MEC HA as well as the results can provide input into the CERCLA remedy evaluation and selection process.

6.1.3.3. The MEC HA addresses human health and safety concerns associated with potential exposure to MEC at each MRS. It does not directly address environmental or ecological concerns that might be associated with MEC, including the risks associated with exposure to MC as environmental contaminants. It does not address operational ranges. It does not address locations where military munitions are known or suspected to be present underwater.

6.1.3.4. The MEC HA assesses the acute hazard presented by the explosive component(s) of military munitions. Although military munitions include CWM, and thus CWM is MEC, the chemical agent component of the CWM presents a greater hazard to human health than the explosive components of CWM. Additionally, the toxic chemical hazard presented by the CWM can be calculated by current commonly acceptable methods. This does not dismiss the potential explosive hazard associated with many CWM but rather reflects the recognition that the greatest risk to human health from CWM is the chemical agent, not the explosive. There is no historical or physical evidence of CWM use at the Former Camp Maxey and therefore no expected CWM hazard. The MEC HAs are included in Appendix E.

6.1.4 Hazard Assessment Scoring

6.1.4.1. An input factor category is applied for each input factor based on site-specific conditions and the previously determined numerical value for the selected category is prescribed for each associated input factor. The sum of the input factors assessed by the MEC HA produces a score that is associated with one of four Hazard Levels. These Hazard Levels reflect the interaction between the current or future human activities in an MRS, and the types, amounts, and conditions of MEC items within the MRS. The maximum MEC HA score is 1,000 and the minimum score is 125.

6.1.4.2. The Hazard Levels and associated scores represent groupings of sites with common or similar attributes with respect to conditions that constitute the explosive hazards. As noted in the MEC HA guidance, the scores have meaning only with respect to one another. Table 6-4 contains the Hazard Level Ranges.

Table 6-2: Hazard Level Scoring Ranges

Hazard Level	Maximum MEC HA Score	Minimum MEC HA Score
1	1,000	840
2	835	725
3	720	530
4	525	125

6.1.4.3. A Hazard Level of 1 identifies MRSs with the *highest* potential explosive hazard conditions. Typical characteristics of Hazard Level 1 MRS conditions include the following:

- High-explosive-filled UXO, usually "Sensitive UXO" on the surface
- A former target area or Open Burn/Open Detonation (OB/OD) area
- An MRS with full or moderate accessibility
- Has the presence of additional human receptors inside the MRS or Explosive Safety Quantity Distance
- May include subsurface MEC with intrusive

6.1.4.4. A Hazard Level of 2 identifies MRSs with high potential explosive hazard conditions. Typical characteristics of a Hazard Level 2 MRS include the following:

- Former target area, OB/OD area, function test range, or maneuver area
- UXO, or Fuzed Sensitive DMM on the surface, or intrusive activities that overlap with minimum depths of UXO or Fuzed Sensitive DMM located only subsurface
- Has full or moderate accessibility to people who will engage in intrusive activities

6.1.4.5. A Hazard level of 3 identifies MRSs with moderate potential explosive hazard conditions. Typical characteristics of a Hazard Level 3 MRS include the following:

- DMM on the surface, or intrusive activities that overlap with minimum depths of DMM located only subsurface
- Former target area, OB/OD area, function test range, or maneuver area that has undergone a surface cleanup
- An MRS with moderate or limited accessibility, and a low number of contact hours

6.1.4.6. A Hazard Level of 4 identifies MRS with low potential explosive hazard conditions. The presence of MEC at an MRS means that an explosive hazard may exist. Therefore, MEC may still pose a hazard at a Hazard Level 4 MRS. Typical characteristics of an MRS in Hazard Level 4 include the following:

- A MEC cleanup was performed or MEC is only located subsurface, below the depth of receptor intrusive activities
- Energetic Material Type is propellant, spotting charge, or incendiary
- Accessibility is Limited or Very Limited, and contact hours are few or very few. This may be the result of LUCs.

6.1.5 Baseline Scoring Results

The baseline scoring results for the MRSs with historical or RI MEC finds are included in Table 6-3. Scoring results are based on results from previous investigations, to include the RI, and current site conditions only. MEC HA scores were not developed for MRSs where no MEC has ever been found, either historically or during the RI, because the most significant driver of the MEC HA score requires that MEC finds be included. MEC HA scores were not developed for MRSs excluded from the FS due to the need for additional characterization. MEC HA scores for the evaluated remedial alternatives are addressed in Section 9. The MEC HA worksheets, with details on how each MRS was scored, are included in Appendix E.

Table 6-3: Baseline Hazard Level Scores

MRS	MEC HA Score	Hazard Level
Western Range Area B	MEC HA not scored because no MEC encountered.	
Western Range Area C	MEC HA not scored because no MEC encountered.	
Western Range Area D	920	1
Eastern Range Area A	950	1
Eastern Range Area B	735	2
Eastern Range Area C	760	2
Grenade Range Area	920	1
Mine and Booby Trap Area	MEC HA not scored because no MEC encountered.	

6.1.6 Munitions and Explosives of Concern Qualitative Risk

To further evaluate risk at the MRSs and to address limitations encountered during the MEC HA development (i.e., MEC required, limited parameters for selection, etc.), a qualitative risk evaluation was completed for each MRS investigated during the RI and addressed in the FS. This evaluation is qualitative in nature and captures site attributes such as MEC and MD density and current and future land uses in a more flexible and subjective manner not allowed in the MEC HA analysis.

6.1.6.1 Western Range Area B

This MRS is located in the West Range Area and included portions of several range fans. It is a noncontiguous area located east of Western Range Area A and along the north and east side of Pat Mayse Lake. It is located primarily within a WMA that is Government owned but accessed by the public for surface recreational activities, such as hiking and hunting. Small portions of the MRS are privately owned undeveloped property where ROEs were granted for RI field work. No MEC was identified during the RI or during previous investigations and the MRS is classified as having relatively low MD density. RI data supports the historical data. This may indicate that it was on the edge of the main impact/target area. Based on the light recreational use in the area (e.g., hunting and hiking), and because no MEC was found and the MD density from the RI is low, there is a relatively low explosive hazard risk associated with the MRS.

6.1.6.2 Western Range Area C

This MRS is located in the North-Central and South-Central sections of the West Range Area. It is located within a WMA that is Government owned but accessed by the public for surface recreational activities, such as hiking and hunting. No MEC was located in this MRS during the RI or during previous investigations; however there are areas with medium and high MD densities that is consistent with potential target areas within impact areas. Based on the light recreational use in the area (e.g., hunting and hiking), and because no MEC was found and the MD density from the RI is medium to high, there is a low to moderate explosive hazard risk associated with the MRS.

6.1.6.3 Western Range Area D

This MRS is located in what is believed to be the central impact area for the west ranges. It is located within a WMA that is Government owned but accessed by the public for surface recreational activities, such as hiking and hunting. RI results include UXO located on or just below the ground surface (within 12 inches) and several areas with high or medium MD density. Based on the light recreational use in the area (e.g., hunting and hiking), and because UXO was found on the ground surface and in the subsurface and the MD density from the RI is medium to high, there is a moderate to high explosive hazard risk associated with the MRS.

6.1.6.4 Eastern Range Area A

This MRS is located along the North and East shore of the Pat Mayse Lake within the East Range Area. The area is primarily within a state park, used for recreation, which may include activities such as camping, hiking and accessing the lake. It includes the dam area and former ranges that were investigated and partially cleared in a previous removal action. The previous removal action included the use of geophysical transects to locate potential former target areas and then selected grids were cleared in order to reduce the potential for exposure to MEC. No MEC was encountered in this MRS during the RI and only low concentrations of MD were identified. While removal actions have been completed in the MRS and no MEC was found during the RI, because of the intrusive subsurface activities associated with camping and the high number of receptors utilizing the area, there is a moderate to high explosive hazard associated with the MRS.

6.1.6.5 Eastern Range Area B

This MRS is located on the peninsula that extends into the south side of Pat Mayse Lake in the center of the East Range Area. The property is used for camping and other recreational activities. Recreational activities in this MRS are primarily on the surface but there may be some shallow subsurface exposure associated with some camping activities. Although only one UXO was located within this MRS during the RI, previous investigation/removal projects have identified some MEC in the MRS. While removal actions have been completed in the MRS, because a UXO item was found during the RI and based on the intrusive subsurface activities associated with camping and the high number of receptors utilizing the area, there is a moderate to high explosive hazard associated with the MRS.

6.1.6.6 Eastern Range Area C

This MRS is located on the southern shore of the lake within the East Range Area. It is located along a narrow band between the National Guard facility and Pat Mayse Lake. Although not designated for public recreational use, the area can be accessed by lake or over land. Potential exposure could result from surface related recreational activities, such as hiking or fishing along the lakeshore. No MEC was located during the RI and MD density was generally low throughout the MRS. Based on the light recreational use in the area (e.g., hiking and fishing), and because no MEC was found and the MD density from the RI is low, there is a relatively low explosive hazard risk associated with the MRS.

6.1.6.7 Grenade Range Area

This MRS includes three areas identified in historical documents as grenade training areas, located on the south side of the lake west of the Eastern Range Area. The MRS is located on public land that may be accessed for recreational activities associated with Pat Mayse Lake, such as hiking and fishing. One UXO was found on the ground surface during the RI along with MD, which could be an indication of potential MEC in the area. Based on the light recreational use in the area (e.g., hiking) and the difficulty associated with accessing the area, and because MEC was found during the RI, there is a moderate explosive hazard risk associated with the MRS.

6.1.6.8 Mine and Booby Trap Training Area

This MRS is located east of the West Range Area and is on privately owned residential parcels. Historical records indicated that the area was used to train with practice mines. Collection of data during the RI was limited by a lack of access to several private parcels in the area; however during a reconnaissance of the area a property owner provided information and evidence that confirmed mine training in the area. Practice mines used during the time that the Former Camp Maxey was in operation, contained a small "puff charge" that was not intended to cause harm. Based on the residential use of the area and the type of munitions historically noted and identified during the RI (practice only), there is a relatively low explosive hazard risk associated with the MRS.

6.2 Baseline Risk Assessment for Munitions Constituents

This section presents an evaluation of potential human health and ecological risks associated with exposure to MC in soil at the Former Camp Maxey. The risk assessment is based on the analytical results of 47 surface soil samples collected in September and October 2013 and 120 subsurface soil samples collected in December 2013. The baseline risk assessment contains a HHRA and SLERA. The risk assessments were conducted in accordance with the USEPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (USEPA, 1989) and *Ecological Risk Assessment Guidance for Superfund* (USEPA, 1997), the USACE's *Risk Assessment Handbook, Volume I: Human Health Evaluation* (USACE, 1999) and *Volume II: Environmental Evaluation* (USACE, 2010), and the Texas Commission on Environmental Quality (TCEQ; formerly known as Texas Natural Resource Conservation Commission [TNRCC]) *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas* (TNRCC, 2001a). The objectives of the risk assessment are to:

- Assess potential human health risks, currently and in the future, in the absence of any major action to control or mitigate soil contamination (if present).
- Evaluate potential adverse effects to ecological receptors, currently and in the future, in the absence of any major action to control or mitigate soil contamination.
- Assist in determining the need for and extent of soil remediation.
- Provide a basis for comparing various remedial alternatives and determining which of them will meet the goals of protection of human health and the environment, as defined in the NCP (NCP; 40 CFR Part 300.5).

6.2.1 Data Evaluation

This section presents the available MC data from soil samples collected at the Former Camp Maxey. Fieldwork and environmental sampling for the RI were conducted in accordance with the Performance Work Statement for the Former Camp Maxey, with field investigation procedures further developed in the RI/FS Work Plan (EOTI, 2013) and minor deviations noted in Section 3.5.2, above. Laboratory analytical methods and data validation procedures were selected to meet the DQOs identified in the QAPP.

6.2.1.1 Surface Soil

6.2.1.1.1. Forty-seven surface soil (*i.e.,* 0-0.5 feet bgs) samples (plus QC samples in the form of triplicates) were collected for MC analysis during the RI. Forty-four of the 47 surface soil samples were collected at locations identified as high or medium anomaly (*i.e.,* potential MD) density during the RI MEC investigation. Three of the 47 surface soil samples were collected at "historical" locations where prior MEC investigations and removals occurred but no MC sampling was performed. Map 3-4 depicts the surface soil sample locations. As shown, the majority or 38 soil samples were collected from the Western Range Area, and five soil samples were collected from the Grenade Range Area. Only one soil sample was noted as being collected from the Eastern Range Area; however, the three historical samples were also located in the Eastern Range Area. Eight background surface soil samples were also collected during the RI, from within the MRS boundary but at locations presumed to be un-impacted by military activities based on a review of historic investigations/removals and the RI MEC investigation.

6.2.1.1.2. Surface soil samples were collected according to IS methodology (ITRC 2012). Field sampling procedures are described in Section 3.3.1, and the MC analyses are described in Section 3.3.2. Soil samples were analyzed for the MC of concern listed in Table 5-1 of the Sampling and Analysis Plan, which was presented as Appendix E to the RI/FS Work Plan (EOTI, 2013). These MC include explosives and the following metals: aluminum, antimony, barium, copper, magnesium, lead, nickel, and zinc. The MC of concern list was developed based on the known chemical components of the types of military munitions used during training activities at the Former Camp Maxey.

6.2.1.1.3. Data were evaluated consistent with USEPA (1989, 1992b, 2006) guidance for developing exposure concentrations and with available guidance on IS methodology (ITRC 2012), as follows:

- If a constituent was not detected in any of the samples and the reporting limit was below risk-based screening levels, that constituent was not evaluated further.
- For six SUs with surface soil samples collected in triplicate, the three sample results were averaged for a single mean concentration for that SU. If all triplicate sample results were non-detect (ND), the sample was considered ND. If triplicate results were a mixture of detects and NDs, the detected values were averaged with the ND using half the sample detection limit as a proxy concentration.

6.2.1.1.4. Statistical summaries, including frequency of detection, range of detected concentrations, and arithmetic mean concentration, were prepared for the analytes in surface soil. Data summary tables are presented in the HHRA Section 6.2.2 (Table 6-6) and SLERA Section 6.2.3 (Table 6-8), where constituent concentrations are evaluated in the context of the potential for risk.

6.2.1.2 Subsurface Soil

6.2.1.2.1. Based on the phased approach established for MC sampling, subsurface soil (*i.e.,* 0.5-1 foot bgs) samples were collected from the SUs at which surface soil sample results exceeded PALs. Four discrete subsurface soil samples were collected from each of 30 SUs; therefore, a total of 120 subsurface soil samples (plus QC samples in the form of duplicates) were collected. While both lead and magnesium were detected in surface soil at concentrations above PALs, subsurface soil samples were only analyzed for lead, as no human health or ecological risk-based screening values are available for magnesium. Ten discrete subsurface soil samples were also collected from the same eight SUs used for surface soil background sampling. Background subsurface soil samples were also analyzed for pH, percent moisture, and percent solids.

6.2.1.2.2. Data were evaluated as follows:

- For 12 SUs with subsurface soil samples collected in duplicate, the two sample results were averaged to yield a single mean concentration.
- For each SU, the four sample results were averaged to yield a single mean concentration.

6.2.1.2.3. A statistical summary, including frequency of detection, range of detected concentrations, and arithmetic mean concentration, was prepared for lead in subsurface soil. Lead was detected in all 120 subsurface soil samples. Data summary tables are presented in the HHRA Section 6.2.2 (Table 6-7)[1] and SLERA Section 6.2.3 (Table 6-9), where lead in subsurface soil is evaluated in the context of the potential for risk.

6.2.2 Human Health Risk Assessment

The HHRA addresses the potential for adverse human health effects associated with exposure to MC in soil at the Former Camp Maxey. The HHRA methodology follows the USEPA CERCLA RI/FS process. The goal of the Superfund HHRA process is to provide a framework for developing the risk information necessary to assist in determination of possible remedial actions at a site. Risk assessment is a tool used to characterize and assess the toxicity of contaminants, evaluate the potential pathways and routes through which an individual may be exposed to contaminated environmental media, and characterize the cancer risks and non-cancer hazards at a site (USEPA, 1989). There are four components to the HHRA process: data evaluation, exposure assessment, toxicity assessment, and risk characterization (USEPA, 1989). The data evaluation entails the initial evaluation presented in Section 6.2.1, above, and focuses in this HHRA (Section 6.2.2.1) on the identification of COCs. In the exposure assessment, assumptions about the potential for human exposure to COCs originating at a site are established. Representative exposure point concentrations for each COC are derived from the relevant data sets and used to model human exposure, in the form of constituent intakes, dermally absorbed doses, and exposure concentrations. The likelihood and magnitude of adverse health effects are expressed as

[1] Although separate data summary tables are presented for surface and subsurface soil samples collected during this RI, both data sets are considered representative of surface soil for the HHRA. Surface soils are defined by TCEQ to extend from ground surface to 15 feet bgs at residential properties and from ground surface to 5 feet bgs at commercial/industrial properties (TCEQ, 2009).

incremental lifetime cancer risks and non-cancer hazard quotients, which are estimated in the risk characterization by combining the estimates of exposure with constituent-specific toxicity information. Sources of uncertainty associated with the HHRA process and the extent to which human health risks may be over- or under-estimated are also discussed.

6.2.2.1 Identification of COCs

6.2.2.1.1. The decision process for the identification of COCs in soil is dictated by relevant USEPA (1989), USACE (1999), and TCEQ guidance. A risk-based screen of detected MC concentrations was implemented, using the TRRP Tier 1 Residential Soil PCLs for a 30 acre source area[2] as screening values. The Tier 1 PCLs are constituent- and medium-specific concentrations derived to be protective of adverse health effects. The Tier 1 PCLs for total soil combined ($^{Tot}Soil_{Comb}$) pathways were used and are protective of incidental ingestion of soil, dermal contact with soil, inhalation of volatiles and particulates, and ingestion of above-ground and below-ground vegetables grown in soil. Depending on the toxic effect, PCLs are based on either a cancer risk of one-in-one-hundred-thousand (*i.e.,* $1x10^{-5}$ or 1E-05) or a non-cancer HQ of 1. PCLs based on non-cancer health effects were reduced by a factor of 10 (to represent a target HQ of 0.1) to address potential non-cancer health effects from exposure to multiple constituents. This approach is consistent with standard risk assessment practice for COC selection.

6.2.2.1.2. Constituents with maximum detected concentrations greater than their respective Tier 1 PCLs were selected as COCs. However, magnesium was categorically eliminated as a COC, because it is an essential nutrient and soil concentrations of magnesium are not expected to be a health concern (TNRCC, 2001b). In addition, if the maximum concentration of a metal was less than background soil concentrations, the metal was not selected as a COC regardless of comparison to the PCL. For the HHRA, the comparison of metals data to background concentrations was performed with consideration of soil type. All soil samples, including site-specific background samples, were categorized into one of two soil types (*i.e.,* A = coarse alluvial deposits; sandy or B = fine alluvial deposits; clayey) during the RI field effort, based on review of sample locations relative to a Department of Agriculture soil map and visual observation of soils collected for sampling, in order to allow for screening of detected metals in soil samples against concentrations in background soils representative of the same soil type. The background values used to identify constituents as COCs were the greater of the average site-specific background concentrations for soil type A or B (as applicable) and Texas-specific background concentrations (30 TAC §350.51[m]). This approach is consistent with the TRRP Rule Adoption Preamble (TNRCC, 1999) and TRRP general requirements (30 TAC §350.71(k)(2)(D)).

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[2] Although the actual sampled area of each SU is only 2,500 square feet or 0.06 acres, PCLs for a 30 acre source area (rather than 0.5 acre source area) were selected because they are more conservative than the 0.5 acre source area PCLs. In addition, the 30 acre source area PCLs are likely more representative of the actual geographic area over which human (and wildlife) exposures are averaged within the Former Camp Maxey. Rather than evaluating the potential for exposure and associated health risk on a SU-by-SU basis, exposure units would likely be established and data from multiple SUs would be combined to calculate a single exposure point concentration for each COC in each exposure unit. In this case, the area of each exposure unit would likely be much larger than 0.5 acre.

6.2.2.1.3. Table 6-6 presents the MC surface soil data summary, and Table 6-7 presents the MC subsurface soil data summary. While separate surface and subsurface soil data summary tables are presented, both data sets are considered representative of surface soil as a potential human exposure medium. Surface soils are defined by TCEQ to extend from ground surface to 15 feet bgs at residential properties and from the ground surface to 5 feet bgs at commercial/industrial properties (TCEQ, 2006). Tables 6-6 and 6-7 also present the constituent-specific risk-based screening value, background value for each metal in each soil type, Texas-specific background soil concentrations, and whether the analyte was identified as a COC. Based on the decision process described above, no analytes were identified as COCs in surface soil or subsurface soil.

6.2.2.2 HHRA Findings

In this HHRA, no COCs were identified in soil at the Former Camp Maxey. Therefore, human exposure was not modeled, and the HHRA process is complete. Conclusions and recommendations based on the results of the HHRA are presented in Section 6.2.5.

6.2.3 Screening Level Ecological Risk Assessment

The SLERA is a tool to systematically evaluate the potential for site conditions to pose an unacceptable risk to ecological receptors in accordance with the TCEQ risk assessment guidelines (TNRCC, 2001a). As stated in the RI/FS Work Plan, an area-specific SLERA was prepared for the 16,235-acre Former Camp Maxey MRS. This section presents the results of the SLERA. The objectives of the SLERA are to evaluate the potential for adverse health effects in ecological receptors and present the results in a manner that facilitates risk management decision-making. The need for further ecological evaluation will be determined by USACE and the regulatory agencies based on the SLERA findings and recommendations. Sources of uncertainty in the baseline risk assessment and the potential effects of these uncertainties on the Tier 2 SLERA conclusions are discussed in Section 6.2.4, Consideration of Uncertainty. In accordance with TCEQ ERA Guidance (2001a), this section provides information and support for Required Element 8, as defined in the TRRP (§350.77(c)). Conclusions and recommendations based on the screening analysis and uncertainty analysis for terrestrial vegetation and soil-dwelling invertebrates are presented in Section 6.2.5 and provide support for Required Element 10, as defined in the TRRP (§350.77(c)). The SLERA is organized as follows:

- Section 6.2.3.1 – Environmental Setting describes the natural setting of the Former Camp Maxey, including the habitat and wildlife that occur or may occur on site. Details on the environmental setting at the Former Camp Maxey are provided in Section 2.1.2.5.
- Section 6.2.3.2 – Problem Formulation discusses the first phase of a Tier 2 SLERA. In accordance with TCEQ Ecological Risk Assessment (ERA) Guidance (2001a), this section provides information and support for Required Element 1, as defined in the TRRP (§350.77(c)). Environmental Setting

The Former Camp Maxey lies within the gently rolling landscape of the Northern Post Oak Savanna ecoregion. Due to the undisturbed nature of most of the area, the site provides a suitable habitat for various forms of wildlife, including mammals, birds, reptiles, amphibians, and aquatic life. Details concerning the environmental setting to include specifics related to vegetation, wildlife, and protected species (Table 2-1) are included in Section 2.1.2.5.

6.2.3.1 Problem Formulation

The first step of a Tier 2 SLERA addresses elements of problem formulation (TNRCC, 2001a; USEPA, 1992a, 1997 and 1998). The problem formulation phase of the Tier 2 SLERA for this site establishes the breadth and focus of the assessment and includes data evaluation, and the required Element 1 of the TCEQ SLERA process. Data evaluation is described in Section 6.2.1. Constituents were screened against ecological benchmarks and background concentrations as part of Tier 2 SLERA Element 1 (Section 6.2.3.2.2). The remaining elements, with the exception of Elements 8 and 10 (Uncertainty Analysis and Recommendations, respectively), were not necessary for this SLERA because, as discussed in Section 6.2.3.2.2, no COCs were identified for the site. Under the Tier 2 SLERA Element 1, a screening analysis was conducted to select COCs to evaluate potential effects and to eliminate constituents that do not pose unacceptable ecological risks. The screening analysis for the site was performed using a two-step process: 1) comparison to background and 2) ecological benchmark screening. The first step was to compare analytical results for constituents detected in soil to background concentrations. Maximum concentrations of metals in soil were compared to Texas-specific background concentrations presented in 30 TAC 350.51(m), or from site-specific background levels presented in Table 3-4, whichever are higher (TNRCC, 1999; 30 TAC§350.71(k)(2)(D)). The second step was to compare concentrations to established ecological benchmarks for soil. In accordance with TCEQ guidance (TNRCC 2001a), initial screening was conducted using the maximum detected concentration in soil. The development of background concentrations and constituent screening against ecological benchmark values are described in the sections that follow.

6.2.3.1.1 Background Screening

6.2.3.2.1.1. Site-specific background sampling is discussed in Section 3.3.1. Concentrations of the metal constituents, which include four bioaccumulative metals (copper, lead, nickel and zinc [TCEQ, 2006]) were compared to site-specific and Texas-specific background concentrations.

6.2.3.2.1.2. In the Grenade Range Area, five incremental surface samples and 20 discrete subsurface samples were collected and all metal concentrations were reported below Texas-specific background for all samples with one exception. One subsurface sample reported a lead concentration above the Texas-specific background concentration of 15 mg/kg (21 mg/kg). In the Eastern Range Area, one incremental surface sample, three incremental historical surface samples, and four discrete historical subsurface samples were collected and all concentrations were reported below background concentrations. The majority of the samples collected for the site were collected from the Western Range Area. Thirty-eight incremental surface samples and 96 subsurface samples were collected from this area. Of the thirty-eight, only five surface samples reported lead concentrations above the Texas-specific background concentration of 15 mg/kg (13 percent) and range from 17 to 42 mg/kg. Two of the thirty-eight samples reported nickel concentrations above the Texas-specific background concentration of 10 mg/kg and range from 12 to 13 mg/kg. Finally, two of the thirty-eight samples reported zinc concentrations of 34 mg/kg, slightly above the Texas-specific background concentration of 30 mg/kg. Of the ninety-six discrete subsurface samples, 11 reported lead concentrations above the Texas-specific background concentration of 15 mg/kg (11 percent) and range from 16 to 86 mg/kg.

6.2.3.2.1.3. Since the samples with reported concentrations above background were located sporadically across the Western Range Area, arithmetic means and 95 percent upper confidence limits on the mean (UCLs) were calculated and compared to site-specific and Texas-specific background concentrations. UCLs were calculated using USEPA's ProUCL 5.0.00 (USEPA, 2013a; 2013b). The ProUCL output is presented in Appendix G. The UCL and mean concentrations were used because these concentrations are considered to be more representative (than a maximum concentration) of what ecological receptors would be exposed to during foraging activities throughout their life cycle. The following tables present the arithmetic mean, UCL and background concentrations for copper, lead, nickel and zinc in surface soil and the arithmetic mean, UCL and background concentration for lead in subsurface soil.

Table 6-4: Surface Soil Background Levels

Metal	Western Range Area Surface Soil Arithmetic Mean (mg/kg)	Western Range Area Surface Soil UCL Concentration (mg/kg)	Texas-Specific Background Concentration (mg/kg)	Soil Type A Background Surface Soil Concentration Range (mg/kg) [a]	Soil Type B Background Surface Soil Concentration Range (mg/kg) [a]
Copper	3.5	5.7	15	1.8 - 2.0 (1.9)	0.9 - 1.8 (1.4)
Lead	11.2	12.8	15	6 – 11 (7.6)	4.5 – 13 (9.0)
Nickel	4.5	6.7	10	2 – 4 (2.6)	1.1 - 2.7 (2.0)
Zinc	12.2	17.6	30	7 – 10 (7.7)	4.4 - 8.1 (6.3)

Note: a - Value in parenthesis is average

Table 6-5: Subsurface Soil Background Levels

Metal	Western Range Area Subsurface Soil Arithmetic Mean (mg/kg)	Western Range Area Subsurface Soil UCL Concentration (mg/kg)	Texas-Specific Background Concentration (mg/kg)	Soil Type A Background Subsurface Soil Concentration Range (mg/kg) [a]	Soil Type B Background Subsurface Soil Concentration Range (mg/kg) [a]
Lead	10.31	11.08	15	3.6 - 8.7 (5.6)	5.9 - 17 (11.3)

Note: a - Value in parenthesis is average

6.2.3.2.1.4. As seen in these tables, the mean and UCL concentrations for bioaccumulative metals are below their respective Texas-specific background concentrations and are similar to the Type A and B site background concentrations. Based on these considerations, site concentrations in soil are not expected to represent a concern to wildlife. Additionally, all metals concentrations are well below established and conservative ecological screening benchmarks, as discussed in the following section.

6.2.3.1.2 Screening against Ecological Benchmarks

6.2.3.2.2.1. The next step of a Tier 2 SLERA is the comparison of constituent concentrations to the ecological screening benchmarks (ESBs) for soil presented in Table 3-4 of the TCEQ ERA guidance (TCEQ, 2006). The details of the TCEQ literature sources and mathematical derivation of the ESBs can be found in Appendix A of the ERA guidance (TCEQ, 2006). There are no existing ESBs, criteria, or guidelines for explosive or energetic compounds that have been developed by TCEQ or the USEPA. Therefore, a search for available screening values was expanded to include other potential sources. The Los Alamos National Laboratory (LANL) ECORISK Database was identified as a source of screening levels for explosives. LANL has derived these screening levels based on evaluation of peer-reviewed toxicity study literature using LANL's primary toxicity study evaluation process as documented in Toxicity Reference Value Development Methods for the Los Alamos National Laboratory (LANL, 2010) and by compiling others from secondary sources such as the USEPA, Oak Ridge National Laboratory, the International Atomic Energy Agency, and other acceptable secondary source compendiums of toxicity data or screening levels. The LANL ECORISK database (LANL, 2013) was searched and the minimum no observed adverse effect level available for an explosive in a soil medium was used as the ESB in this SLERA (Table 6-9, 6-10).The ESBs are meant to conservatively represent the upper limit of constituent concentrations that will not cause adverse effects to exposed biota inhabiting the environmental medium.

6.2.3.2.2.2. The measurement of total aluminum in soils is not considered suitable or reliable for the prediction of potential toxicity of aluminum to plants because toxicity is associated with soluble aluminum in soil water. Therefore, the USEPA (USEPA 2003 EcoSSL document) recommends an alternative procedure for screening aluminum in soils that is based on the measured soil pH. The USEPA recommends that aluminum be considered for evaluation as a COPC where the soil pH is less than 5.5. However, studies have shown that when soil pH is 5.0 or higher, the predominant ionic form of aluminum that causes phytotoxicity (i.e., trivalent aluminum) does not occur in soil water and therefore is not expected to be toxic to plants (Delhaize and Ryan 1995; Panda et al. 2009; Zheng 2010; Liang et al. 2013). Mulder et al. (1989) evaluated the relationship between soil solution pH and soluble aluminum concentrations and demonstrated that above a pH of 5.0 soluble aluminum is not measured. This data supports the conclusion that at a soil pH of 5.0 and higher, soluble aluminum does not occur and plant toxicity associated with aluminum in soils is not expected. The site-specific soil pH for the Camp Maxey samples averages 5.2. Based on this information, aluminum is not expected to represent an ecological risk to plants at Camp Maxey.

6.2.3.2.2.3. In accordance with ERA guidance (USEPA 1997; TCEQ 2006) constituents in soil that have concentrations below the ESBs were considered to be of no further ecological concern and were eliminated from additional evaluation in the ERA process. Measured constituents in soil, bioaccumulative or not, that have concentrations below background concentrations were also eliminated.

6.2.3.2.2.4. Constituents that were screened out in this step for surface and subsurface soil were not retained for further evaluation. As discussed in Section 6.2.3.2.1 and as seen in Tables 6-8 and 6-9, the results of the screening demonstrate that no COCs were identified for the Former Camp Maxey.

6.2.4 Consideration of Uncertainty

Risk assessment inherently involves the use of assumptions, judgments and incomplete data to varying degrees that may contribute to decision uncertainty in either direction. Considering the uncertainties associated with components of the risk assessment process provides a meaningful interpretation and thorough understanding of the potential human health risks and adverse effects to ecological receptors. This section identifies some of the major sources of uncertainty in this baseline risk assessment and discusses whether the potential for risk is likely to be under- or over-stated as a result.

6.2.4.1 Sampling and Analysis, and Data Evaluation

6.2.4.1.1. A basic assumption underlying this risk assessment is that the soil data collected during the RI adequately characterize environmental conditions at the Former Camp Maxey. However, there are always some uncertainties associated with environmental sampling and analysis. Uncertainty associated with environmental sampling is generally related to limitations in terms of the number and distribution of samples, while uncertainty associated with the analysis of samples is generally related to systematic or random errors (*i.e.,* false positive or negative results). Efforts to minimize uncertainty were made by collecting and analyzing the RI samples in accordance with the QAPP and by independently validating the analytical data. The effects any unidentified errors in the MC analyses have on the estimated exposure and risk are unknown.

6.2.4.1.2. The risk assessment is based on the analytical results of only 47 surface soil samples and 120 subsurface samples collected across the entire 16,235-acre MRS. As a result, site-related MC concentrations across the Former Camp Maxey may be under-estimated. However, MC sampling locations (*i.e.,* SU) were biased towards medium and high anomaly density grids observed during the RI MEC investigation. As a result of this bias, MC concentrations detected in soil likely over-estimate the potential MC presence across the investigated areas.

6.2.4.1.3. Surface soil samples were collected using the IS methodology approach (ITRC, 2012), rather than a discrete soil sampling approach, in an effort to characterize a greater areal extent and thereby obtain representative estimates of MC concentrations for each SU. Frequently, discrete soil samples are collected in a biased manner (*i.e.,* targeting "hot spots") that likely does not represent the concentrations to which humans and wildlife may be exposed. On the other hand, IS methodology typically captures the broad effects (*i.e.,* proportional representation and thus higher average concentrations) of hot spots due to the improved spatial coverage within the SU, but it does not provide information on the spatial location of smaller volumes of soil containing hot spots of contaminants within the SU, nor does it indicate the magnitude of these areas of elevated concentration if they exist (ITRC, 2012). While the potential presence of hot spots may be over-looked, the selected approach to surface soil sampling provides a better representation of average exposure conditions across the Former Camp Maxey.

6.2.4.2 Risk-Based Screening Levels and Background Concentrations

6.2.4.2.1. Statements about the potential for risk associated with exposure to MC in soil were based on a comparison of detected constituent concentrations to TCEQ PCLs and ESBs, and for metals, to background concentrations in soil. Other basic assumptions therefore underlying this risk assessment are that the TCEQ PCLs and ESBs are adequately protective of adverse effects in potential human and ecological receptors, background concentrations reflect background conditions at the Former Camp Maxey, and background conditions do not pose human health or ecological risks (a reasonable assumption).

6.2.4.2.2. Generally, uncertainties associated with risk-based screening levels are related to the exposure assumptions and toxicity values used to derive them. The TCEQ PCLs and ESBs used in this risk assessment are based on conservative exposure assumptions and toxicity criteria. As a result, the potential for risk is not likely to be under-stated.

6.2.5 Conclusions and Recommendations

6.2.5.1. This baseline risk assessment evaluated the potential for human health and ecological risks associated with exposure to MC in soil at the Former Camp Maxey.

6.2.5.2. The HHRA relied on a comparison of detected MC concentrations in soil to the TRRP Tier 1 PCLs for Residential Soil and, for metals, to background soil concentrations. The Tier 1 PCLs are constituent- and medium-specific concentrations derived to be protective of human health. They are calculated using equations, exposure assumptions, and toxicity data similar to those used in a USEPA Risk Assessment Guidance for Superfund sites baseline risk assessment. As such, use of the Tier 1 PCLs for Residential Soil addresses the risk assessment requirement in the USEPA RI/FS guidelines. No human health COCs were identified in surface or subsurface soil at the Former Camp Maxey, as all detected concentrations were less than risk-based screening values or, for metals (i.e., aluminum), less than background soil concentrations. Additionally, magnesium was eliminated as a COC because it is an essential nutrient and not expected to represent a health concern.

6.2.5.3. The SLERA consisted of a screening analysis to eliminate constituents that do not pose unacceptable ecological risks and to select COCs to evaluate potential effects. The screening analysis for the site was performed using a two-step process: 1) comparison to background and 2) ecological benchmark screening. Constituents that were screened out in this process for surface and subsurface soil were not retained for further evaluation. The results of the screening demonstrate that no ecological COCs were identified for the site. Therefore, adverse impacts are unlikely to occur for ecological receptors potentially exposed, under both current and expected future land use conditions, to constituents in soil at the Former Camp Maxey.

6.2.5.4. In conclusion, the results of this baseline risk assessment demonstrate that adverse health effects from human and ecological exposure to MC in soil at the Former Camp Maxey are not expected, and no further investigation on the basis of potential human health or ecological risk is warranted.

Table 6-6: Selection of Human Health COCs in Surface Soil

Detected Analytes	Soil Type A - Data Summary				Soil Type B - Data Summary				Human Health Risk-Based Screening Level [1]		Site-Specific Background Concentration [2]		Texas-Specific Background Concentration [3]	Soil Type A - Selection of COCs			Soil Type B - Selection of COCs		
	Number of Detections	Number of Samples	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Number of Detections	Number of Samples	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	(mg/kg)	basis	Soil Type A (mg/kg)	Soil Type B (mg/kg)		Maximum Exceeds Risk-Based Screening Level?	Maximum Exceeds Background? [4]	Human Health COPC? [5]	Maximum Exceeds Risk-Based Screening Level?	Maximum Exceeds Background? [4]	Human Health COPC? [5]
Metals																			
Aluminum	33	33	1,200	8,933	14	14	2,000	14,000	6,400	n	2,400	2,500	30,000	Yes	No	No	Yes	No	No
Antimony	0	33	ND	ND	0	14	ND	ND	1.5	n	0.53	ND	1	ND	ND	No	ND	ND	No
Barium	33	33	22	180	14	14	34	130	810	n	51	51	300	No	No	No	No	No	No
Copper	33	33	1.2	15	14	14	1.5	12	55	n	1.9	1.4	15	No	No	No	No	No	No
Magnesium	33	33	150	2,700	14	14	220	1,400	NA		323	228	NA	NA	Yes	No [6]	NA	Yes	No [6]
Lead	33	33	4.3	42	14	14	6.0	19	500	L	7.6	9.0	15	No	Yes	No	No	Yes	No
Nickel	33	33	1.5	13	14	14	2.7	13	84	n	2.6	2.0	10	No	Yes	No	No	Yes	No
Zinc	33	33	5.0	23	14	14	7.2	34	990	n	7.7	6.3	30	No	No	No	No	Yes	No
Explosives																			
1,3,5-Trinitrobenzene (TNB)	0	33	ND	ND	0	14	ND	ND	200	n	N/A	N/A	N/A	ND	N/A	No	ND	N/A	No
1,3-Dinitrobenzene (DNB)	0	33	ND	ND	0	14	ND	ND	0.67	n	N/A	N/A	N/A	ND	N/A	No	ND	N/A	No
2,4-Dinitrotoluene (DNT)	1	33	0.014	0.020	0	14	ND	ND	6.9	c	N/A	N/A	N/A	No	N/A	No	ND	N/A	No
2,6-DNT	19	33	0.018	0.095	5	14	0.020	0.099	6.9	c	N/A	N/A	N/A	No	N/A	No	No	N/A	No
2-Amino-4,6-DNT	0	33	ND	ND	0	14	ND	ND	1.1	n	N/A	N/A	N/A	ND	N/A	No	ND	N/A	No
2,4,6-Trinitrotoluene (TNT)	0	33	ND	ND	0	14	ND	ND	3.3	n	N/A	N/A	N/A	ND	N/A	No	ND	N/A	No
2-Nitrotoluene (NT)	1	33	0.038	0.096	0	14	ND	ND	21	c	N/A	N/A	N/A	No	N/A	No	ND	N/A	No
3-NT	1	33	0.038	0.081	0	14	ND	ND	67	n	N/A	N/A	N/A	No	N/A	No	ND	N/A	No
4-Amino-2,6-DNT	0	33	ND	ND	0	14	ND	ND	1.1	n	N/A	N/A	N/A	ND	N/A	No	ND	N/A	No
4-NT	1	33	0.048	0.054	0	14	ND	ND	27	n	N/A	N/A	N/A	No	N/A	No	ND	N/A	No

Notes:

1 - Human health risk-based screening levels are Texas Risk Reduction Program (TRRP) Tier 1 Residential Soil Protective Concentration Levels (PCL) for a 30-acre source area (June 29, 2012). Tier 1 PCLs for combined soil exposures (TotSoilComb) were used and are protective of incidental ingestion of soil, dermal contact with soil, inhalation of volatiles and particulates, and ingestion of above-ground and below-ground vegetables grown in soil. Depending on the toxic effect, PCLs are based on either a cancer risk of 1x10-5 or a non-cancer hazard quotient (HQ) of 1. PCLs based on adverse, non-cancer health effects were reduced by a factor of 10 (to represent a target HQ of 0.1) to address potential non-cancer health effects from exposure to multiple constituents.

2 - Site-specific background concentrations represent the average of concentrations detected in four soil samples from each of two soil types: A (Course Alluvial) and B (Fine Alluvial).

3 - Texas-specific median background concentrations are from 30 TAC §350.51(m).

4 - Background values used for screening were selected as the greater of average site-specific background concentrations for soil type A or B and Texas-specific background concentrations.

5 - Detected analytes are identified as chemicals of potential concern where maximum detected concentrations are greater than human health risk-based screening values, and for metals, where maximum concentrations are also greater than background concentrations.

6 - No human health risk-based screening value is available; however, magnesium was eliminated as a Chemical of Potential Concern because it is an essential nutrient.

c - Tier 1 PCL is based on a target cancer risk of 1x10-5.

L - Tier 1 PCL was derived using USEPA lead models.

n - Tier 1 PCL is based on a target non-cancer hazard quotient of 0.1.

NA - Not available.

N/A - Not applicable.

ND - Analyte was not detected.

Table 6-7: Selection of Human Health COCs in Subsurface Soil

Analyte	Soil Type A - Data Summary				Soil Type B - Data Summary				Human Health Risk-Based Screening Level [1]		Site-Specific Background Concentration [2]		Texas-Specific Background Concentration [3]	Soil Type A - Selection of COPCs			Soil Type B - Selection of COPCs		
	Number of Detections	Number of Samples	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Number of Detections	Number of Samples	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	(mg/kg)	basis	Soil Type A (mg/kg)	Soil Type B (mg/kg)		Maximum Exceeds Risk-Based Screening Level?	Maximum Exceeds Background? [4]	Human Health COPC? [5]	Maximum Exceeds Risk-Based Screening Level?	Maximum Exceeds Background? [4]	Human Health COPC? [5]
Metals																			
Lead	23	23	3.9	29	7	7	6.2	13	500	L	5.9	11	15	No	Yes	No	No	No	No

Notes:

1 - Human health risk-based screening levels are Texas Risk Reduction Program (TRRP) Tier 1 Residential Soil Protective Concentration Levels (PCL) for a 30-acre source area (June 29, 2012). Tier 1 PCLs for combined soil exposures (TotSoilComb) were used and are protective of incidental ingestion of soil, dermal contact with soil, inhalation of volatiles and particulates, and ingestion of above-ground and below-ground vegetables grown in soil.

2 - Site-specific background concentrations represent the average of concentrations detected in four soil samples from each of two soil types: A (Course Alluvial) and B (Fine Alluvial).

3 - Texas-specific median background concentrations are from 30 TAC §350.51(m).

4 - Background values used for screening were selected as the greater of average site-specific background concentrations for soil type A or B and Texas-specific background concentrations.

5 - Detected analytes are identified as chemicals of concern (COC) where maximum detected concentrations are greater than human health risk-based screening values, and for metals, where maximum concentrations are also greater than background concentrations.

L - Tier 1 PCL was derived using USEPA lead models.

Table 6-8: Selection of Ecological COCs in Surface Soil

Analyte	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	Ecological Benchmark [a,b]	COC? [c]
Surface Soil						
Metals						
Aluminum	100%	1,200	14,000	3,744	soil pH<5.5[d]	No
Antimony	0%	ND	ND	ND	5	No
Barium	100%	22	180	68	330	No
Copper	100%	1.2	15	3.4	70	No
Magnesium	100%	150	2,700	495	--	No (ES)
Lead	100%	4.3	42	10	120	No
Nickel	100%	1.5	13	4.3	38	No
Zinc	100%	5.0	34	12	120	No
Explosives						
1,3,5-Trinitrobenzene (TNB)	0%	ND	ND	ND	6.6	No
1,3-Dinitrobenzene (DNB)	0%	ND	ND	ND	0.07	No
2,4-Dinitrotoluene (DNT)	2%	0.014	0.014	0.019	2.5	No
2,6-DNT	40%	0.018	0.099	0.047	1.8	No
2-Amino-4,6-DNT	0%	ND	ND	ND	10	No
2,4,6-Trinitrotoluene (TNT)	0%	ND	ND	ND	6.4	No
2-Nitrotoluene (NT)	2%	0.096	0.096	0.047	9.9	No
3-NT	2%	0.081	0.081	0.045	12	No
4-Amino-2,6-DNT	0%	ND	ND	ND	3.6	No
4-NT	2%	0.054	0.054	0.049	22	No
2,4,6-Trinitrophenyl-N-methylnitramine (Tetryl)	0%	ND	ND	ND	0.99	No
1,3,5,7-Tetranitro-1,3,5,7-tetrazocane (HMX)	0%	ND	ND	ND	27	No
3,5-Dinitroaniline (DNA)	0%	ND	ND	ND	--	No
Cyclotimethylenetrinitramine (RDX)	0%	ND	ND	ND	7.5	No
Nitroglycerine (NG)	0%	ND	ND	ND	71	No
Pentaerythrite Tetranitrate (PETN)	0%	ND	ND	ND	100	No

Notes:

COC- Constituent of concern.
ES - Essential nutrient.
mg/kg - milligrams per kilogram.
ND - Analyte was not detected.
LANL - Los Alamos National Laboratory.

-- Not available/Not applicable
[a] For metals, the Texas Commission on Environmental Quality (TCEQ) ecological benchmarks for soil were used. If more recent USEPA EcoSSLs are available, those values were used. (Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (Revised) January 2006 Version).
[b] For explosives, the minimum no observed adverse effect level screening level available for soil, from the LANL database (LANL 2013) was used.
[c] Constituent is identified as a COC if the maximum detected concentration exceeds the ecological benchmark.
[d] The USEPA (2003) recommends that aluminum be considered for evaluation as a COC where the soil pH is less than 5.5. As discussed in Section 6.2.3.2.2.2, aluminum is not retained as a COC for evaluation at the Former Camp Maxey site based on the measured soil pH.

Table 6-9: Selection of Ecological COCs in Subsurface Soil

Analyte	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	Ecological Benchmark [a]	COC? [b]
Subsurface Soil						
Metals						
Lead	100%	3.1	86	10	120	No

Notes:

COC- Constituent of concern.

mg/kg - milligrams per kilogram.

% - Percent.

[a] The Texas Commission on Environmental Quality (TCEQ) ecological benchmark for soil was used. If a more recent USEPA EcoSSL is available, that value was used. (Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (Revised) January 2006 Version).

[b] Constituent is identified as a COC if the maximum detected concentration exceeds the ecological benchmark.

7 IDENTIFICATION AND SCREENING OF ALTERNATIVES

The purpose of the FS (Sections 7 through 9) is to identify, screen, and analyze potential remedial alternatives for MRSs investigated during the RI at the Former Camp Maxey. The FS incorporates historical data and information gathered during the RI and compares remedial alternatives against the nine criteria identified in Title 40, CFR, Parts 300 to 399, the NCP 300.430. The purpose of the FS is to provide stakeholders with the information necessary to select the optimal remedial alternative(s) for each of the MRSs evaluated.

7.1 Remedial Action Objectives

7.1.1. The RI supported the characterization, defined as the nature and extent of MEC and MC, of the Former Camp Maxey for the purpose of developing and evaluating effective remedial alternatives. Details concerning the characterization of MEC and MC are provided in Section 3 of the RI and include information related to any data gaps that exist following the investigation. The results of the baseline risk assessment demonstrate that adverse health effects from human and ecological exposure to MC in soil at the Former Camp Maxey are not expected; therefore, MC remedial alternatives are not evaluated within the FS.

7.1.2. Based on the results of the RI fieldwork and review of existing data from previous investigations, it is recommended that 12 separate MRSs be delineated from the original Former Camp Maxey MRS. Of these 12 MRSs, eight are addressed in the FS to develop and evaluate remedial alternatives and four MRSs require additional investigation to adequately characterize the nature and extent of MEC potentially at the site. The four MRSs requiring additional investigation are not addressed further in the FS.

7.1.3. The following is a list of the delineated MRSs which are identified as either being addressed in the FS or needing further investigation.

1. Western Range Area A (Further Investigation)
2. Western Range Area B (Feasibility Study)
3. Western Range Area C (Feasibility Study)
4. Western Range Area D (Feasibility Study)
5. Western Range Area E (Further Investigation)
6. Eastern Range Area A (Feasibility Study)
7. Eastern Range Area B (Feasibility Study)
8. Eastern Range Area C (Feasibility Study)
9. Grenade Range Area (Feasibility Study)
10. Cave Training Area (Further Investigation)
11. Mine and Booby Trap Training Area (Feasibility Study)
12. Bivouac Area (Further Investigation)

7.1.4. The following areas within the Former Camp Maxey MRS were not investigated as part of the RI and are not addressed in the FS.

1. Pat Mayse Lake (Not included in project scope. Further investigation required.)
2. Texas National Guard (Not FUDS program eligible.)

7.1.5. The MEC remedial action objective (RAO) for all of the MRSs is to limit interaction between residual MEC and persons accessing the MRSs. Methods by which interaction between potential receptors and MEC can be limited include, but are not limited to, LUCs (e.g., signage, restrictive use, fencing, etc.), education, and surface and subsurface MEC removals. Table 7-1 identifies the preliminary remediation goals for each MRS being addressed in the FS.

Table 7-1: Remedial Action Objectives

MRS	Preliminary Remediation Goals
Western Range Area B	Reduce potential human interaction with MEC while engaged in intrusive and non-intrusive recreational activities on the ground surface and to a maximum anticipated receptor intrusive depth of 12 inches (i.e., hunting, camping, equestrian, fishing, hiking, wildlife viewing, and lake boating access). MEC has not been located in this MRS and therefore the probability of encountering surface or subsurface MEC is low.
Western Range Area C	Reduce potential human interaction with MEC while engaged in intrusive and non-intrusive recreational activities on the ground surface and to a maximum anticipated receptor intrusive depth of 12 inches (i.e., hunting, camping, equestrian, fishing, hiking, lake boating access, and wildlife viewing). Based on the depth of MD and MEC located in the MRS, it is anticipated that MEC may be located to a depth of 12 inches below the ground surface.
Western Range Area D	Reduce potential human interaction with MEC while engaged in intrusive and non-intrusive recreational activities on the ground surface and to a maximum anticipated receptor intrusive depth of 12 inches (i.e., hunting, camping, equestrian, fishing, hiking, and wildlife viewing). Based on the depth of MD and MEC located in the MRS, it is anticipated that MEC may be located to a depth of 12 inches below the ground surface.
Eastern Range Area A	Reduce potential human interaction with MEC while engaged in intrusive and non-intrusive recreational activities on the ground surface and to a maximum anticipated receptor intrusive

MRS	Preliminary Remediation Goals
	depth of 12 inches (i.e., hunting, camping, equestrian, fishing, hiking, wildlife viewing, swimming, and lake boating access). Based on the depth of MD and MEC located in the MRS, it is anticipated that MEC may be located to a depth of 12 inches below the ground surface.
Eastern Range Area B	Reduce potential human interaction with MEC while engaged in intrusive and non-intrusive recreational activities on the ground surface and to a maximum anticipated receptor intrusive depth of 12 inches (i.e., hunting, camping, equestrian, fishing, hiking, and wildlife viewing). Based on the depth of MD and MEC located in the MRS, it is anticipated that MEC may be located to a depth of 12 inches below the ground surface.
Eastern Range Area C	Reduce potential human interaction with MEC while engaged in non-intrusive recreational activities on the ground surface (i.e., hunting, equestrian, fishing, hiking, wildlife viewing, and lake boating access). Based on the depth of MD located in the MRS, it is anticipated that MEC may be located to a depth of 12 inches below the ground surface.
Grenade Range Area	Reduce potential human interaction with MEC while engaged in non-intrusive recreational activities on the ground surface (i.e., hunting, equestrian, hiking, and wildlife viewing). Based on the depth of MD located in the MRS, it is anticipated that MEC may be located to a depth of 12 inches below the ground surface.
Mine and Booby Trap Training Area	Reduce potential human interaction with MEC while engaged in intrusive and non-intrusive residential related activities on the ground surface and to a depth of six inches. Based on historical use, MEC is expected at depths between zero and six inches.

7.2 General Response Actions

A limited number of MEC response actions are available to address MEC contaminated sites. The following four actions have been identified and will be used in combination with one another to develop remedial alternatives, which will be evaluated for potential implementation at each of the sites at the Former Camp Maxey covered under this FS. The MEC-only remedial actions below are typically evaluated for MMRP sites and are considered for the Former Camp Maxey. Alternatives may also be a combination of individual remedial actions.

1. No Action
2. LUCs
3. Surface Removal
4. Subsurface Removal

7.2.1 No Action

The No Action response involves taking no action at an MRS. No additional MEC would be removed from the site and no institutional controls would be implemented. The no action response serves as the baseline against which the effectiveness of other alternatives is judged.

7.2.2 Land Use Controls

LUCs are used to reduce and prevent explosive hazard exposure to potential human and ecological receptors. LUCs for MEC generally include physical and/or administrative/legal mechanisms that minimize the potential for exposure by limiting land use. LUC strategies can include engineering or non-engineering measures that are designed based on the remaining hazard. Institutional controls consist of legal or administrative mechanisms. Legal mechanisms, or institutional control, as used in the NCP, consist of enforcing property restriction through ownership (e.g., deed notices, restrictive covenants, negative easements). Administrative mechanisms are essentially regulatory in nature and include notices, local land use plans and ordinances, construction permits, and land use management systems to ensure compliance with use restrictions. Education (e.g., pamphlets, videos, meetings) is commonly used to reduce the risk to property owners or the public from unexpected exposure to hazards. Engineering controls include physical mechanisms, such as placing fencing or signage to protect property owners and the public from hazards by limiting access or preventing public access to areas. Physical mechanisms are a useful deterrent to prevent unintentional access to a hazardous site and commonly work in conjunction with non-engineering controls to provide the best protection to human health and the environment. The enforcement of LUCs on a property is often complicated. At the Former Camp Maxey, some of the property is owned by the federal government. On these properties land use restrictions can be enforced and maintained and engineering controls (e.g., signs and fences) replaced relatively easily. Separately, some properties are privately owned making any enforcement of LUCS problematic and often difficult. This process does not prevent exposure to MEC in all cases; however, it can effectively prevent exposure by restricting access to these items. LUCS are often used in conjunction with other response actions.

7.2.3 Surface Removal

A surface removal is the removal of any MEC/MPPEH visible in part or whole on the surface. No subsurface removal of MEC/MPPEH would be completed under this action. The surface removal would be conducted by qualified UXO technicians using handheld analog metal detectors. If MEC or MPPEH is discovered, it would be disposed of using explosive demolition procedures. The general components for a surface removal include:

- Vegetation removal (to expose the ground surface only as necessary)
  - Limited to grass and underbrush, trees three inches in diameter or greater should be left in place.

  - Removal of low lying branches is allowable but not the cutting of the main trunk.
  - Areas in which vegetation had been previously cut should be targeted for additional investigations.
- Physical surface removal of MEC/MPPEH in designated areas or across the entire site
- Demolition and disposal operations
  - Demolition activities will be coordinated with all appropriate stakeholders, specifically USACE and TPWD, to ensure standard operating procedurs are followed to prevent fires.
- Re-vegetation and erosion control measures (as necessary)

7.2.4 Subsurface Removal

7.2.4.1. Subsurface anomalies may be identified using handheld analog magnetometer or DGM instruments (e.g., EM-61). Subsurface removal consists of employing geophysical instruments (analog or DGM) to identify subsurface anomalies followed by an intrusive investigation (hand dig and inspect). Surface anomalies are also identified, investigated, and removed as necessary during a subsurface removal. The components of a subsurface removal include:

- Vegetation removal (to expose the ground surface)
  - Limited to grass and underbrush, trees three inches in diameter or greater should be left in place.
  - Removal of low lying branches is allowable but not the cutting of the main trunk.
  - Areas in which vegetation had been previously cut should be targeted for additional investigations.
- Surface removal of MEC/MPPEH in designated areas or across the entire site
- Subsurface investigations
- Demolition and disposal operations
  - Demolition activities will be coordinated with all appropriate stakeholders, specifically USACE and TPWD, to ensure standard operating procedures are followed to prevent fires.
- Re-vegetation and erosion control measures (as necessary)

7.2.4.2. Investigation and removal techniques include hand digging, mechanical digging with conventional earth moving equipment in conjunction with hand digging; mechanical digging using armored equipment; and mechanical digging using remotely operated equipment.

7.3 Identification and Screening of Technologies

As presented in RI/FS guidance section of Engineer Pamphlet (EP) 1110-1-18 (USACE, 2006), the natural characteristics of a particular site may limit the technologies that may be used. Due to the limited number of appropriate technology types and alternatives for MEC only remedial actions, a limited number of remedial alternatives and technologies can be developed to meet the project objectives, as outlined above. A limited screening of technologies, specific for MEC identification and removal as related to the Former Camp Maxey, is included below.

7.3.1 Identification and Screening of MEC Technologies

MEC technologies were divided into three categories for discussion to include detection, recovery, and disposal. The following technologies were identified as being viable options for the general response actions. Although these technologies are industry proven for detection and removal of MEC, there are technology limitations and surface/subsurface residual hazards may remain even following a remedial action. Therefore, LUCs are most often necessary for any site where MEC has been previously identified even if a removal action has occurred.

7.3.2 Evaluation of Technologies

7.3.2.1 Detection Technologies

The objective of MEC detection is to determine the presence and location of potential MEC items during investigation and removal. For the Former Camp Maxey, ground based magnetic and electromagnetic sensors are available and could be used. Magnetic sensors often have a greater detection depth but can also be less effective in certain geological conditions. The two types of geophysical sensors can be applied to either analog or digital systems. Both digital and analog geophysical equipment can be used to detect MEC at Former Camp Maxey. DGM has a higher level of quality control and provides the ability for advanced processing to limit the number of intrusive investigations. The digital data collected provides a record that can be used to document and evaluate the coverage and quality of the clearance. Analog instruments rely on an operator’s ability to detect geophysical anomalies potentially caused by MEC based on the real-time response of the instrument. QC plans must include a method of ensuring proper coverage and detection. Analog procedures are often more effective in areas with steep, rocky terrain and in areas with limits on clearing vegetation. In areas with sensitive habitats, analog methods may be preferable because vegetation clearing can be more selective. Analog instruments may increase production rates in difficult environments because removal is conducted simultaneously with detection, and because of rapid vegetation re-growth, which may make reacquisition difficult. The depths for a subsurface removal action would be based on site use and depth of munitions. For this effort, it is assumed a combination of analog and digital electromagnetic equipment will be used to locate subsurface anomalies. The selection of specific instruments will need to consider the presence of “hot rock” (i.e., rock with a magnetic signature). Digital EMI systems, such as EM-61, and analog sensors that have ground balancing have been shown to work well in hot rock environments.

7.3.2.2 Recovery Technologies

7.3.2.2.1. Removal or recovery technologies generally include hand excavation or mechanized equipment. Hand excavation consists of digging individual anomalies using commonly available hand tools. This is the industry standard method for performing MEC removals and investigations. The individual UXO Technicians dig an anomaly that was either located using hand held instruments or DGM instrument. The method involves using the hand tools (shovels, picks, trowels, etc.) to excavate the selected item using only human power to do the work. Depending on a number of criteria (e.g., expected MEC and operating environment), actual techniques can vary from removal in shallow layers of the covering surfaces to use of pick and shovel for deeper items.

7.3.2.2.2. Mechanical equipment can also be used to excavate and remove anomalies from the surface and/or subsurface, such as with a backhoe or excavator. Advantages of mechanical equipment include increased production rates.

7.3.2.3 Disposal Technologies

7.3.2.2.1. The objective of a removal action is to eliminate or reduce receptor exposure to MEC hazards. Blow-in-Place is the destruction of any MEC by detonating the item without moving it from the location where it was found. Normally, this is accomplished by placing an explosive charge alongside the item. MEC is dealt with individually in this approach, requiring direct exposure of personnel to each individual item.

7.3.2.2.2. Consolidate and Blow operations are defined as the collection, configuration, and subsequent destruction by explosive detonation of MEC. This process can be used either “in grid” (i.e., within a current working sector) or at a consolidation point, but can only be employed for munitions that have been inspected and deemed acceptable to move. This determination should be made by senior UXO-qualified personnel in accordance with appropriate regulations and guidance.

7.3.3 Evaluation of Technologies

The evaluation of screened detection, recovery, and disposal remedial technologies and process options is illustrated on Figure 7-1.

Figure 7-1: Technology Screening Matrix

General Response Actions	Remedial Technology	Process Option	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	**N/A** - No remedial action technologies are necessary for the no action alternative.	**N/A** - No remedial action technologies are necessary for the no action alternative.	**N/A** - No remedial action technologies are necessary for the no action alternative.
Surface Removal	Detection	Analog	**Medium/High** - Some technologies only detect ferrous anomalies. Appropriate sensors would be necessary for hot rock environments.	**High** - Analog sensors can be easily used in any terrain and easier in thick vegetation.	**Medium** - Manpower intensive. Dependent on vegetation and terrain. Additional seeding for QC required.
	Removal	Manual	**High** - Industry standard for MEC recovery.	**High** - Can be accomplished in almost any terrain and climate. Limited only by the number of people available.	**Low/Medium** - Standard by which all others are measured. Typically this is low cost option.
		Mechanized	**High** - Increases production rate but may not be as effective on steep terrain or with limited access areas	**Medium** - May be limited by steep terrain and inaccessiable areas for equipment (islands).	**Medium/High** - Costs for equipment may be balanced by increased production in accessible areas. Cost may be high to bring in equipment to remote areas.
	Disposal	Blow-in-Place	**High** - Each MEC item is individually destroyed with subsequent results individually verified. Post-detonation sampling may be required to evaluate any residual MC.	**High** - Techniques, transportable tools, and equipment, suited to most environments. Public exposure can limit viability. Engineering controls improve implementation.	**Medium** - Manpower intensive. Costs increase in areas of higher population densities or where public access must be monitored/controlled. Also may increase costs for explosives (multiple shots).
		Consolidate and Blow	**High** - Techniques recently developed and refined are providing documented successes. Donor munitions also proving effective. Limited in use to munitions that are "safe to move". Post-detonation sampling may be required to evaluate any residual MC.	**Medium/High** - Generally employs same techniques, tools and equipment as BIP. Requires larger area and greater controls. Most engineering controls not completely effective/applicable for these operations.	**Low/Medium** - Manpower intensive, may require material handling equipment for large scale operations.
Subsurface Removal	Detection	Analog	**Medium/High** - Some technologies only detect ferrous anomalies. Appropriate sensors would be necessary for hot rock environments.	**High** - Analog sensors can be easily used in any terrain and easier in thick vegetation.	**Medium** - Manpower intensive. Dependent on vegetation and terrain. Additional seeding for QC required.
		Digital Geophysical Mapping	**High** - Data is digital and provides a record of detections. Reduces number of digs.	**Medium** - Equipment can be cumbersome and may not be suitable to all terrain and climates. Thick vegetation may have to removed to complete mapping.	**High** - Additional manpower required. Lower production rates.
	Removal	Hand Excavation	**High** - Industry standard for MEC recovery.	**High** - Can be accomplished in almost any terrain and climate. Limited only by the number of people available.	**Low/Medium** - Standard by which all others are measured. Typically this is low cost option.
		Mechanized	**High** - Increases production rate but may not be as effective on steep terrain or with limited access areas	**Medium** - May be limited by steep terrain and inaccessiable areas for equipment (islands).	**Medium/High** - Costs for equipment may be balanced by increased production in accessible areas. Cost may be high to bring in equipment to remote areas.
	Disposal	Blow-in-Place	**High** - Each MEC item is individually destroyed with subsequent results individually verified. Post-detonation sampling may be required to evaluate any residual MC.	**High** - Techniques, transportable tools, and equipment, suited to most environments. Public exposure can limit viability. Engineering controls improve implementation.	**Medium** - Manpower intensive. Costs increase in areas of higher population densities or where public access must be monitored/controlled. Also may increase costs for explosives (multiple shots).
		Consolidate and Blow	**High** - Techniques recently developed and refined are providing documented successes. Donor munitions also proving effective. Limited in use to munitions that are "safe to move". Post-detonation sampling may be required to evaluate any residual MC.	**Medium/High** - Generally employs same techniques, tools and equipment as BIP. Requires larger area and greater controls. Most engineering controls not completely effective/applicable for these operations.	**Low/Medium** - Manpower intensive, may require material handling equipment for large scale operations.

8 DEVELOPMENT AND SCREENING OF ALTERNATIVES

8.1 DEVELOPMENT OF ALTERNATIVES

8.1.1. This section presents the remedial alternatives developed for the following sites at the Former Camp Maxey based upon data collected during the RI/FS field activities. Based on varying property use and potential receptors on separate portions of the site and to properly develop and screen alternatives, the MRSs have been divided into the following subareas for evaluation.

1. Western Range Area B
2. Western Range Area C
3. Western Range Area D
4. Eastern Range Area A
5. Eastern Range Area B
6. Eastern Range Area C
7. Grenade Range Area
8. Mine and Booby Trap Area

8.1.2. Data generated were used to assess the potential safety hazards and/or risks to enable selection of a cost effective and efficient response action (if required). During the RI Report, a MEC HA was conducted for the MEC and MPPEH issues.

8.1.3. Based on the results of the RI and MEC HA, safety hazards associated with MEC and MPPEH exist at all of the MRSs investigated during this RI/FS. The acute nature of the hazard warrants consideration of a munitions response action.

8.1.4. MEC remedial alternatives were developed for potential implementation at each of the MRSs based on the results of the RI and are evaluated for each MRS where sufficient data is available (Table 8-1). A general description of each response action is included in the developed remedial alternatives in Section 7.2. The alternatives represent a reasonable range of alternatives that meet the requirements of EP-1110-1-18 (USACE, 2006).

Table 8-1: Remedial Alternatives Evaluated for Each MRS

MRS	Alternatives
Western Range Area B	1. No Action 2. LUCs 3. LUCs; 100 percent surface clearance 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 24 inches)
Western Range Area C	1. No Action 2. LUCs; Focused surface clearance for frequented public use areas (i.e. trail, dirt roads, picnic areas, camp grounds, shorelines) 3. LUCs; 100 percent surface clearance and focused 12 inch subsurface clearance for frequented public use areas (i.e. trail, dirt roads, picnic areas, camp grounds, shorelines) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 24 inches)
Western Range Area D	1. No Action 2. LUCs; 100 percent surface clearance 3. LUCs; Focused surface and 12 inch subsurface clearance for frequented public use areas (i.e. trail, dirt roads, picnic areas, camp grounds, shorelines) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 24 inches)
Eastern Range Area A	1. No Action 2. LUCs; 100 percent surface clearance 3. LUCs; Focused surface and 12 inch subsurface clearance for frequented public use areas (i.e. trails, dirt roads, picnic areas, camp grounds, beaches outside of previously cleared areas) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)
Eastern Range Area B	1. No Action 2. LUCs; Focused surface clearance for frequented public use areas (i.e. trails, dirt roads, picnic areas, camp grounds, beaches outside of previously cleared areas) 3. LUCs; 100 percent surface clearance and focused 12 inch subsurface clearance for frequented public use areas (i.e. trails, dirt roads, picnic areas, camp grounds, beaches outside of previously cleared areas) 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)
Eastern Range Area C	1. No Action 2. LUCs 3. LUCs; Focused surface clearance for frequented public use areas (i.e. trails, picnic areas, shorelines) where only surface activities are expected 4. LUCS; 100 percent surface clearance 5. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)

MRS	Alternatives
Grenade Range Area	1. No Action 2. LUCs 3. LUCs; Focused surface clearance for frequented public use areas (i.e. trails, picnic areas) 4. LUCS; 100 percent surface clearance 5. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)
Mine and Booby Trap Area	1. No Action 2. LUCs 3. LUCs; 100 percent surface and six inch subsurface clearance 4. Unlimited Use/Access (100 percent subsurface clearance to a depth of 12 inches)

8.2 Screening of Individual Alternatives

The preliminary screening of individual alternatives is not required for many MEC sites because of the limited number of response actions and resulting remedial alternatives. Each of the remedial alternatives developed for the sites will be individually and comparatively analyzed in the following sections to determine strengths and weaknesses.

9 DETAILED ANALYSIS OF ALTERNATIVES

9.1 INTRODUCTION OF NCP CRITERIA

9.1.1. The NCP (40 CFR 300) states that the primary objective of the FS is to "ensure that appropriate remedial alternatives are developed and evaluated," and that "the number and type of alternatives to be analyzed shall be determined at each site, taking into account the scope, characteristics, and complexity of the site problem that is being addressed." In this section, the remedial action alternatives that were developed are evaluated against the nine criteria identified in the NCP and how well they meet the RAOs. Remedial alternatives have been developed in an effort to distinguish a cost-effective remedial action that is protective of human health and the environment and can be implemented with conventional means. The first seven criteria are addressed in this report. The last two criteria (regulatory and community acceptance) will be addressed during remedy selection. The nine NCP criteria are provided below:

- Protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost
- Regulatory acceptance
- Community acceptance

9.1.2. The NCP evaluation criteria can be separated into three categories: threshold criteria, balancing criteria, and modifying criteria. The threshold criteria judges if the alternative is protective of human health and the environment, and in compliance with the ARARs. The balancing criteria look at both the short- and long-term effectiveness and permanence of the alternative, the reduction of volume, implementability, and cost of the alternative. The modifying criteria include the regulatory and community acceptance, which are evaluated in this report based on interactions to date with the regulatory community and public and will be re-evaluated during remedy selection. The final risk management decision is one that determines which cost-effective remedy offers the best balance of all the NCP factors. These criteria take into account both current and future land uses and are applied with regards to the current, as well as, reasonable future land use at the site.

9.1.3. In addition, the information from the MEC HA input factors and outputs can be used to support the analysis of alternatives. The FS examines three broad criteria: Effectiveness, Implementability, and Cost. For the Effectiveness Criterion, the MEC HA input factors of Energetic Material Type, Location of Additional Human Receptors, Site Accessibility, Amount of MEC, and MEC Classification can provide information to support evaluation of short-term effectiveness, and compliance with ARARs.

9.1.4. An estimated cost for each alternative was developed and is presented in detail in Appendix K.

9.2 NCP Criteria Categories

9.2.1. Section 300.430(e) of the NCP lists nine criteria against which each remedial alternative must be assessed. The first two criteria are threshold criteria that must be met by each Alternative. The next five criteria are the primary balancing criteria upon which the analysis is based. The final two criteria are referred to as modifying criteria and are applied after the subsequent public comment period to evaluate state and community acceptance. The acceptability or performance of each Alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified.

9.2.2. The two threshold criteria are:

- Protection of human health and the environment; and
- Compliance with ARARs

9.2.3. The five primary balancing criteria upon which the analysis is based on are:

- Long-term effectiveness and permanence;
- Reduction of volume, or removal, of MEC;
- Short-term effectiveness;
- Implementability; and
- Cost

9.2.4. The two modifying criteria upon which the analysis is based on are:

- Regulatory acceptance; and
- Community acceptance

9.2.5. Regulatory and community acceptance evaluation included in the FS are based on previous discussions with regulatory agencies and the community during TPP meetings and field activities. These criteria will be re-evaluated during the CERCLA process following receipt of regulatory comments and public review of the Proposed Plan. The final evaluation for both criteria will be addressed in the Decision Document or Record of Decision.

9.2.1 Definitions of NCP Criteria Categories

9.2.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether a remedial alternative will achieve adequate protection of human health and the environment and describes how MEC at the site will be eliminated, reduced, or controlled through treatment, engineering, and/or LUCs. Because there is not an established threshold for MEC hazard, the goal is to effectively minimize or eliminate the exposure pathway between the MEC and receptor.

9.2.1.2 Compliance with ARARs

Addresses whether a remedial alternative meets all applicable, appropriate, or relevant selected federal and state environmental statutes and regulations. To be acceptable, an alternative shall comply with ARARs or be covered by a waiver.

9.2.1.3 Long-Term Effectiveness and Permanence

This criterion addresses the ability of a remedial alternative to maintain reliable protection of human health and the environment over time. This criterion considers the magnitude of residual hazard, the adequacy of the response in limiting the hazard, and whether LUCs and long-term maintenance are required.

9.2.1.4 Reduction of Volume, or Removal, of MEC

This criterion relates to the extent to which the remedial alternatives permanently reduce the volume of MEC and reduces the associated safety hazard. Factors for this criterion for MEC include the degree of permanence of the remedial action, the amount of MEC removed/demolished, and the type and quantity of MEC remaining.

9.2.1.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during implementation. MEC removal poses risks to workers and the public that are not associated with environmental contaminants that must be considered and controlled.

9.2.1.6 Implementability

The technical and administrative feasibility of implementing each Alternative and the availability of services and materials are addressed by this criterion. This criterion also considers the degree of coordination required by the regulatory agencies, successful implementation of the remedial action at similar sites, and research to realistically predict field implementability.

9.2.1.7 Cost

This criterion addresses the capital costs, in addition to annual costs anticipated for implementation of the response action.

9.2.1.8 Regulatory Acceptance

This criterion is used to evaluate the technical and administrative concerns of the regulatory community regarding the alternatives, including an assessment of the regulatory community's position and key concerns regarding the alternative, and comments on ARARs or the proposed use of waivers.

9.2.1.9 Community Acceptance

This criterion includes an evaluation of the concerns of the public regarding the alternatives. It determines which component of the alternatives interested persons in the community support, have reservations about, or oppose.

9.3 INDIVIDUAL ANALYSIS OF ALTERNATIVES

9.3.1 Western Range Area B

9.3.1.1 No Action

The No Action alternative involves taking no action at Western Range Area B. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-1.

9.3.1.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.1.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The "reduction of toxicity, mobility, and volume" generally refers to MC. However, the "volume" or potential hazards associated with MEC would not be reduced with the No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.1.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the Proposed Plan (PP).

9.3.1.2 Land Use Controls

The LUC alternative requires that signs be installed on and around the MRS and that an educational program be implemented to warn of the potential explosive hazards associated with the site. A Long Term Management (LTM) plan would be required to identify LUC enforcement actions, to inspect LUCs during the five-year review period and provide educational material on a periodic basis. In addition, the LTM plan will address the potential for MEC that may become exposed due to natural forces such as erosion along shorelines. An assessment based on the NCP criteria is provided below. The summary of the LUC alternative compared to the NCP criteria is presented in Table 9-1.

9.3.1.2.1 Threshold Criteria

The LUC alternative meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across the site is considered low based on the historic field activities and MEC finds. The site is owned by USACE and managed by TPWD and the reasonably anticipated future land use remains unchanged from the current land use; no development is anticipated to occur at the site.

Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.1.2.2 Balancing Criteria

9.3.1.2.2.1. The LUC alternative can be effective over the short- and long-term because it educates the site users of the potential explosive hazards (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC, the LUC alternative would not reduce the "volume" of MEC but it would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

9.3.1.2.2.2. The LUC alternative can be implemented relatively easily and cost effectively by installing signs on and around the site and by hosting education meetings with residents and by making educational material available for workers and visitors. The majority of the MRS is on public property making the implementation and enforcement of LUCs feasible; however, portions of the MRS are located on private property where the implementation and enforcement of LUCs are much more difficult and require consent from the landowner. ROEs were granted for RI field work for the private parcels within the MRS; therefore, implementation of LUCs may be more practical within the private property at this MRS compared to private parcels where no ROEs have previously been granted. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K. Overall, the LUC alternative is a relatively low cost, easily implementable alternative.

9.3.1.2.3 Modifying Criteria

The LUC alternative may potentially gain regulatory or community acceptance as it would provide notification to potential human receptors (trespassers) through LUCs. However, this alternative does not remove any MEC which may be unacceptable. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.1.3 Land Use Controls; 100 Percent Surface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) and implementation of the same LUCs outlined in the LUC alternative for this MRS without signage. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-1.

9.3.1.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require that vegetation be removed from large areas of the MRS. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.1.3.2 Balancing Criteria

9.3.1.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the ground surface, which limits the direct exposure pathway and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the "volume" of MEC on the ground surface. LUCs, with enforcement, would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

9.3.1.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with the LUC alternative. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.1.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.1.4 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 24 inches bgs to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-1.

9.3.1.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.1.4.2 Balancing Criteria

9.3.1.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the “volume” of MEC on the surface and in the subsurface.

9.3.1.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.1.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.2 Western Range Area C

9.3.2.1 No Action

The No Action alternative involves taking no action at Western Range Area C. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-2.

9.3.2.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.2.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The "reduction of toxicity, mobility, and volume" generally refers to MC. However, the "volume" or potential hazards associated with MEC would not be reduced with the No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.2.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the PP.

9.3.2.2 Land Use Controls; Focused Surface Clearance

This alternative consists of conducting a surface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, shorelines). Surface clearances will be conducted in areas frequented by recreational users. LUCs would consist of restrictions placed on public property providing permanent notice of actual and/or potential hazards in the form of a deed notice, restrictive covenant and equivalent zoning or ordinance functionally equivalent to a deed notice. Educational programs will be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-2.

9.3.2.2.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed in areas with frequent current or anticipated human activity, and LUCs would be implemented for risk management. MEC density across the site is considered medium to high based on the historic field activities and MEC finds. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a relatively low level of disturbance as removal activities would be restricted to the surface in areas which have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.2.2.2 Balancing Criteria

9.3.2.2.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface of select areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the "volume" of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

9.3.2.2.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with the LUC alternative but are not substantial. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.2.2.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.2.3 Land Use Controls; 100 Percent Surface and Focused Subsurface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) and a focused subsurface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, shorelines) and implementation of the same LUCs outlined previously for this MRS. Based on the depth of MD and MEC found in the MRS and the anticipated recreational activities occurring at the site, subsurface clearances will be conducted to a depth of 12 inches in areas frequented by recreational users. Educational programs will be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-2.

9.3.2.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed from the entire MRS and MEC in the subsurface would be removed to a depth of 12 inches in areas with frequent current or anticipated human activity. LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require substantial brush and tree removal. In addition, subsurface removal activities would further disturb the environment during excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.2.3.2 Balancing Criteria

9.3.2.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the “volume” of MEC on the surface and in the subsurface.

9.3.2.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.2.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.3 Western Range Area D

9.3.3.1 No Action

The No Action alternative involves taking no action at Western Range Area D. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-3.

9.3.3.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.3.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The “reduction of toxicity, mobility, and volume” generally refers to MC. However, the “volume” or potential hazards associated with MEC would not be reduced with the

No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.3.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the Proposed Plan (PP).

9.3.3.2 Land Use Controls; 100 Percent Surface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) in and implementation LUCs. LUCs would consist of restrictions placed on public property providing permanent notice of actual and/or potential hazards in the form of a deed notice, restrictive covenant and equivalent zoning or ordinance functionally equivalent to a deed notice. Educational programs will be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-3.

9.3.3.2.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed and LUCs would be implemented for risk management. MEC density across the site is considered medium to high based on the historic field activities and MEC finds. There is a residual risk of MEC surfacing through mechanisms such as erosion. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require that vegetation be cleared from large areas of the MRS. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.3.2.2 Balancing Criteria

9.3.3.2.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the ground surface, which limits the direct exposure pathway, and educates the site users of the potential explosive hazards through the LUCs (signs/educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the ground surface. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.3.2.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy substantially when compared with the LUC alternative due to the effort required to complete a surface removal over the entire MRS. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.3.2.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.3.3 Land Use Controls; Focused Surface and Subsurface Clearance

This alternative consists of conducting a focused surface clearance and subsurface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, shorelines) and implementation of the same LUCs outlined previously for this MRS. Based on the depth of MD and MEC found in the MRS and the anticipated recreational activities occurring at the site, surface clearances will be conducted to a depth of 12 inches in areas frequented by recreational users. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-3.

9.3.3.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface and in the subsurface to 12 inches would be removed in areas with frequent current or anticipated human activity, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a moderate level of disturbance as removal activities would be restricted to the areas frequented by the public which typically have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.3.3.2 Balancing Criteria

9.3.3.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and in the top 12 inches of the subsurface in areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards through LUCs (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface and subsurface clearance activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the "volume" of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

9.3.3.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would require substantial time and resources for the remedy because if the increased clearance activities required for the surface and subsurface clearances. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.3.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.3.4 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 24 inches bgs to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-3.

9.3.3.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.3.4.2 Balancing Criteria

9.3.3.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the "volume" of MEC on the surface and in the subsurface.

9.3.3.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.3.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.4 Eastern Range Area A

9.3.4.1 No Action

The No Action alternative involves taking no action at Eastern Range Area A. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-4.

9.3.4.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.4.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The "reduction of toxicity, mobility, and volume" generally refers to MC. However, the "volume" or potential hazards associated with MEC would not be reduced with the No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.4.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the PP.

9.3.4.2 Land Use Controls; 100 Percent Surface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) and the implementation of LUCs. LUCs would consist of restrictions placed on public property providing permanent notice of actual and/or potential hazards in the form of a deed notice, restrictive covenant and equivalent zoning or ordinance functionally equivalent to a deed notice. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-4.

9.3.4.2.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed and LUCs would be implemented for risk management. MEC density across the site is considered low to medium based on the historic field activities and MEC finds. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require that vegetation be cleared from large portions of the MRS. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.4.2.2 Balancing Criteria

9.3.4.2.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface, which limits the direct exposure pathway, and educates the site users of the potential explosive hazards through LUCs (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.4.2.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would substantially increase the amount of time and resources for the remedy when compared with the LUC alternative due the resources required to complete a surface removal over the entire MRS. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.4.2.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.4.3 Land Use Controls; Focused Surface and Subsurface Clearance

This alternative consists of conducting a focused surface clearance and subsurface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, beaches) and implementation of the same LUCs outlined previously for this MRS. Based on the depth of MD and MEC found in the MRS and the anticipated recreational activities occurring at the site, surface clearances will be conducted to a depth of 12 inches in areas frequented by recreational users outside of areas that can be confirmed to have been cleared in previous remedial actions. LUCs would consist of restrictions placed on public property providing permanent notice of actual and/or potential hazards in the form of a deed notice, restrictive covenant and equivalent zoning or ordinance functionally equivalent to a deed notice. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-4.

9.3.4.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface and in the subsurface to 12 inches would be removed in areas with frequent current or anticipated human activity, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a moderate level of disturbance as removal activities would be restricted to the areas frequented by the public which typically have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.4.3.2 Balancing Criteria

9.3.4.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and in the top 12 inches of the subsurface in areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards through LUCs (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface and subsurface clearance activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.4.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would require substantial time and resources for the remedy because if the increased clearance activities required for the surface and subsurface clearances. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.4.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.4.4 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 12 inches bgs outside of areas that can be confirmed to have been cleared in previous remedial actions to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-4.

9.3.4.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.4.4.2 Balancing Criteria

9.3.4.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the “volume” of MEC on the surface and in the subsurface.

9.3.4.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.4.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.5 Eastern Range Area B

9.3.5.1 No Action

The No Action alternative involves taking no action at Eastern Range Area B. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-5.

9.3.5.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.5.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The “reduction of toxicity, mobility, and volume” generally refers to MC. However, the “volume” or potential hazards associated with MEC would not be reduced with the No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.5.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the PP.

9.3.5.2 Land Use Controls; Focused Surface Clearance

This alternative consists of conducting a focused surface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, beaches). Surface clearances will be conducted in areas frequented by recreational users outside of areas that can be confirmed to have been cleared in previous remedial actions. LUCs would consist of restrictions placed on public property providing permanent notice of actual and/or potential hazards in the form of a deed notice, restrictive covenant and equivalent zoning or ordinance functionally equivalent to a deed notice. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-5.

9.3.5.2.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed in areas with frequent current or anticipated human activity, and LUCs would be implemented for risk management. MEC density across the site is considered medium to high based on the historic field activities and MEC finds. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a relatively low level of disturbance as removal activities would be restricted to the surface in areas which have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.5.2.2 Balancing Criteria

9.3.5.2.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface of select areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the "volume" of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

9.3.5.2.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with the LUC alternative but are not substantial. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.5.2.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.5.3 Land Use Controls; 100 Percent Surface and Focused Subsurface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) and a focused subsurface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, beaches). The same LUCS previously outlined for the MRS would be implemented. Based on the depth of MD and MEC found in the MRS and the anticipated recreational activities occurring at the site, subsurface clearances will be conducted to a depth of 12 inches in areas frequented by recreational users outside of areas that can be confirmed to have been cleared in previous remedial actions. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-5.

9.3.5.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed over the entire MRS and MEC in the subsurface would be removed to a depth of 12 inches in areas with frequent current or anticipated human activity. LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require substantial brush and tree removal. In addition, subsurface removal activities would further disturb the environment during excavations in the areas frequented by the public which typically have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.5.3.2 Balancing Criteria

9.3.5.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface of the entire MRS and in the top 12 inches of the subsurface in areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards through LUCs (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface and subsurface clearance activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.5.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would require substantial time and resources for the remedy because if the increased clearance activities required for the surface and subsurface clearances. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.5.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.5.4 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 12 inches bgs outside of areas that can be confirmed to have been cleared in previous remedial actions to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-5.

9.3.5.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.5.4.2 Balancing Criteria

9.3.5.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the “volume” of MEC on the surface and in the subsurface.

9.3.5.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and

LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.5.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.6 Eastern Range Area C

9.3.6.1 No Action

The No Action alternative involves taking no action at Eastern Range Area C. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-6.

9.3.6.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.6.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The “reduction of toxicity, mobility, and volume” generally refers to MC. However, the “volume” or potential hazards associated with MEC would not be reduced with the No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.6.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the PP.

9.3.6.2 Land Use Controls

The LUC alternative requires that signs be installed on and around the MRS and that an educational program be implemented to warn of the potential explosive hazards associated with the site. A LTM plan would be required to identify LUC enforcement actions, to inspect LUCs during the five-year review period and provide educational material on a periodic basis. In addition, the LTM plan will address the potential for MEC that may become exposed due to natural forces such as erosion along shorelines. An assessment based on the NCP criteria is provided below. The summary of the LUC alternative compared to the NCP criteria is presented in Table 9-6.

9.3.6.2.1 Threshold Criteria

The LUC alternative meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across the site is considered medium to high based on the historic field activities and MEC finds. The site is owned by USACE and the reasonably anticipated future land use remains unchanged from the current land use; no development is anticipated to occur at the site. Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.6.2.2 Balancing Criteria

9.3.6.2.2.1. The LUC alternative can be effective over the short- and long-term because it educates the site users of the potential explosive hazards (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC, the LUC alternative would not reduce the “volume” of MEC but it would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

9.3.6.2.2.2. The LUC alternative can be implemented relatively easily and cost effectively by installing signs on and around the site and by hosting education meetings with residents and by making educational material available for workers and visitors. Costs for the remedial action and LTM (30 years) are presented in Tables 9-9. Data supporting the cost estimates are presented in Appendix K. Overall, the LUC alternative is a relatively low cost, easily implementable alternative.

9.3.6.2.3 Modifying Criteria

The LUC alternative may potentially gain regulatory or community acceptance as it would provide notification to potential human receptors (trespassers) through LUCs. However, this alternative does not remove any MEC, which may be unacceptable. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.6.3 Land Use Controls; Focused Surface Clearance

This alternative consists of conducting a focused surface clearance in frequented public use areas at the site (e.g., trails, dirt roads, picnic areas, camp grounds, shorelines) and implementation of the same LUCs outlined in the LUC alternative except no signage. Surface clearances will be conducted in areas frequented by recreational users where subsurface activities are not anticipated. Educational programs will be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-6.

9.3.6.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed in areas with frequent current or anticipated human activity, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a relatively low level of disturbance as removal activities would be restricted to the surface in areas, which have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.6.3.2 Balancing Criteria

9.3.6.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface of select areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.6.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with the LUC alternative. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.6.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.6.4 Land Use Controls; 100 Percent Surface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) and implementation of the same LUCs outlined in the LUC alternative except no signage. Educational programs will be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-6.

9.3.6.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require that vegetation be cleared over large portions of the MRS. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.6.4.2 Balancing Criteria

9.3.6.3.2.3. This alternative would be effective over the short- and long-term because it would remove MEC from the ground surface, which limits the direct exposure pathway, and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.6.3.2.4. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with previously discussed alternatives due to the resources required to complete a surface removal over the entire MRS. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.6.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.6.5 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 12 inches bgs to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-6.

9.3.6.5.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.6.5.2 Balancing Criteria

9.3.6.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the “volume” of MEC on the surface and in the subsurface.

9.3.6.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.6.5.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.7 Grenade Range Area

9.3.7.1 No Action

The No Action alternative involves taking no action at Grenade Range Area. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the

NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-7.

9.3.7.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.7.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The “reduction of toxicity, mobility, and volume” generally refers to MC. However, the “volume” or potential hazards associated with MEC would not be reduced with the No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.7.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the PP.

9.3.7.2 Land Use Controls

The LUC alternative requires that signs be installed on and around the MRS and that an educational program be implemented to warn of the potential explosive hazards associated with the site. A LTM plan would be required to identify LUC enforcement actions, to inspect LUCs during the five-year review period and provide educational material on a periodic basis. In addition, the LTM plan will address the potential for MEC that may become exposed due to natural forces such as erosion. An assessment based on the NCP criteria is provided below. The summary of the LUC alternative compared to the NCP criteria is presented in Table 9-7.

9.3.7.2.1 Threshold Criteria

The LUC alternative meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across the site is considered medium to high based on the historic field activities and MEC finds. The site is owned by USACE and the reasonably anticipated future land use remains unchanged from the current land use; no development is anticipated to occur at the site. Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.7.2.2 Balancing Criteria

9.3.7.2.2.1. The LUC alternative can be effective over the short- and long-term because it educates the site users of the potential explosive hazards (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC, the LUC alternative would not reduce the "volume" of MEC but it would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

9.3.7.2.2.2. The LUC alternative can be implemented relatively easily and cost effectively by installing signs on and around the site and by hosting education meetings with residents and by making educational material available for workers and visitors. Costs for the remedial action and LTM (30 years) are presented in Tables 9-9. Data supporting the cost estimates are presented in Appendix K. Overall, the LUC alternative is a relatively low cost, easily implementable alternative.

9.3.7.2.3 Modifying Criteria

The LUC alternative may potentially gain regulatory or community acceptance as it would provide notification to potential human receptors (trespassers) through LUCs. However, this alternative does not remove any MEC which may be unacceptable. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.7.3 Land Use Controls; Focused Surface Clearance

This alternative consists of conducting a focused surface clearance in frequented public use areas at the site (e.g., trails, dirt roads) and implementation of the same LUCs outlined in the LUC alternative except signage. Surface clearances will be conducted in areas frequented by recreational users where subsurface activities are not anticipated. Educational programs will also be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-7.

9.3.7.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed in areas with frequent current or anticipated human activity, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a relatively low level of disturbance as removal activities would be restricted to the surface in areas which have little to no vegetation. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.7.3.2 Balancing Criteria

9.3.7.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface of select areas of the site frequented by the public, which limits the direct exposure pathway and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the "volume" of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

9.3.7.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with the LUC alternative. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.7.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.7.4 Land Use Controls; 100 Percent Surface Clearance

This alternative consists of conducting a surface clearance over the entire MRS (100 percent) and implementation of the same LUCs outlined in the LUC alternative except no signage. Educational programs will be put in place to notify and educate people who use the area for recreational purposes. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-6.

9.3.7.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface would be removed and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach and/or shoreline areas. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur an extremely high level of disturbance as surface removal activities would require that vegetation be cleared over large portions of the MRS. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.7.4.2 Balancing Criteria

9.3.6.3.2.5. This alternative would be effective over the short- and long-term because it would remove MEC from the ground surface, which limits the direct exposure pathway, and educates the site users of the potential explosive hazards (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the "volume" of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

9.3.6.3.2.6. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would increase the amount of time and resources for the remedy when compared with previously discussed alternatives due to the resources required to complete a surface removal over the entire MRS. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.7.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.7.5 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 12 inches bgs to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-7.

9.3.7.5.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.7.5.2 Balancing Criteria

9.3.7.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the “volume” of MEC on the surface and in the subsurface.

9.3.7.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.7.5.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.8 Mine and Booby Trap Area

9.3.8.1 No Action

The No Action alternative involves taking no action at the Mine and Booby Trap Area. Under this alternative, no further effort or resources would be expended. An analysis of the No Action alternative based on the NCP criteria is provided below. A summary of this alternative compared to the NCP criteria is presented in Table 9-8.

9.3.8.1.1 Threshold Criteria

The No Action alternative does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC and does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, this alternative does not meet RAOs for the MRS.

9.3.8.1.2 Balancing Criteria

The No Action alternative is not effective in the short or long-term because no actions would be taken to reduce potential contact with MEC nor does this alternative employ an action that will result in a permanent solution for the site. The “reduction of toxicity, mobility, and volume” generally refers to MC. However, the “volume” or potential hazards associated with MEC would not be reduced with the

No Action alternative since no action would be taken. This alternative is easily implementable as no actions would be taken and is also the lowest cost alternative since there would be no associated cost.

9.3.8.1.3 Modifying Criteria

The No Action alternative will most likely not gain regulatory or community acceptance as there would be no change to the risk of potential receptor exposure to MEC. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS and during the PP.

9.3.8.2 Land Use Controls

The LUC alternative requires that signs be installed on and around the MRS and that an educational program be implemented to warn of the potential explosive hazards associated with the site. A LTM plan would be required to identify LUC enforcement actions, to inspect LUCs during the five-year review period and provide educational material on a periodic basis. In addition, the LTM plan will address the potential for MEC that may become exposed due to natural forces such as erosion. An assessment based on the NCP criteria is provided below. The summary of the LUC alternative compared to the NCP criteria is presented in Table 9-8.

9.3.8.2.1 Threshold Criteria

The LUC alternative meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across the site is considered low to medium based on the historic field activities and MEC finds. The site is privately owned and the reasonably anticipated future land use remains unchanged from the current land use as a residential property. Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.8.2.2 Balancing Criteria

9.3.8.2.2.1. The LUC alternative can be effective over the short- and long-term because it educates the site users of the potential explosive hazards (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC, the LUC alternative would not reduce the “volume” of MEC but it would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand-alone or in part with other remedial alternatives).

9.3.8.2.2.2. The site is located on private property; therefore, the LUC alternative can be implemented relatively easily if property owners are cooperative. If property owners do not wish participate in the remedial action, the implementability of LUCs would become increasingly more difficult or even impossible. ROEs were granted for portions of the MRS for RI field work; therefore, implementation of LUCs may be practical at these parcels within the MRS compared to private parcels where no ROEs have previously been granted. The alternative is cost effective and involves the installation of signs on and around the site, educational meetings with residents, and making educational material available. Costs for the remedial action and LTM (30 years) are presented in Tables 9-9. Data supporting the cost estimates are presented in Appendix K. Overall, the LUC alternative is a relatively low cost, easily implementable alternative.

9.3.8.2.3 Modifying Criteria

The LUC alternative may potentially gain regulatory or community acceptance as it would provide notification to potential human receptors (trespassers) through LUCs. However, this alternative does not remove any MEC which may be unacceptable. Regulatory and community acceptance of the alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.8.3 Land Use Controls; 100 Percent Surface and Subsurface Clearance to Six Inches

This alternative consists of conducting a surface and subsurface clearance over the entire site and implementation of the same LUCs outlined previously except for signage. Based on the depth of MD and MEC found in the MRS and the anticipated recreational activities occurring at the site, the surface clearance will be conducted to a depth of six inches. Educational programs will also be put in place to notify and educate residents, visitors, and trespassers. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-8.

9.3.8.3.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC at the ground surface and in the subsurface to six inches would be removed, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion. However, LUCs would further reduce and help prevent exposure of human receptors to MEC introduced on the surface by increasing awareness and discouraging contact. Furthermore, LUCs would educate potential human receptors of the possible hazards at the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. Vegetation disturbance would potentially be less than in surrounding areas because much of the property is residential and has less vegetation that would be cleared. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.8.3.2 Balancing Criteria

9.3.8.3.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and in the top six inches of the subsurface and educates the site users of the potential explosive hazards through LUCs (educational programs/dig restrictions). There would be a slight increased short-term risk to workers associated with the surface and subsurface clearance activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially reduce the “volume” of MEC on the surface in areas frequented by human receptors. LUCs, with enforcement, would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

9.3.8.3.2.2. This alternative can be implemented relatively easily using conventional MEC surface removal and disposal techniques and equipment, and installation of LUCs. Implementation of this alternative would require substantial time and resources for the remedy because if the increased clearance activities required for the surface and subsurface clearances. In addition, the cooperation of the property owns would be paramount to determining whether the alternative is implementable. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.8.3.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC in areas most often frequented by the public for recreational purposes and LUCs. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

9.3.8.4 Unlimited Use/Access (100 Percent Subsurface Clearance)

This alternative consists of conducting a surface and subsurface clearance over the entire site allowing unlimited use and access for the property. The subsurface clearance will be completed to a depth of 12 inches bgs to ensure the property is acceptable for unlimited use and access. An assessment based on the NCP criteria is provided below. The summary of this alternative compared to the NCP criteria is presented in Table 9-8.

9.3.8.4.1 Threshold Criteria

This alternative meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC on the surface and in the subsurface would be removed across the entire site allowing unlimited use and access for the site. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal and subsurface excavations. This alternative would comply with the applicable ARARs listed in Section 2.

9.3.8.4.2 Balancing Criteria

9.3.8.4.2.1. This alternative would be effective over the short- and long-term because it would remove MEC from the surface and subsurface at the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to workers associated with the clearance activities. This alternative can be considered a permanent solution because the extensive removal action would greatly reduce the risk associated with MEC as MEC would presumably be removed from the site to the greatest extent possible. As stated in the analysis of the LUC alternative, the reduction of toxicity, mobility, and volume is generally associated with MC. However, this alternative would essentially remove the "volume" of MEC on the surface and in the subsurface.

9.3.8.4.2.2. This alternative would be implemented with moderate difficulty using conventional MEC surface and subsurface removal and disposal techniques and equipment. Implementation of this alternative would require a substantial amount of time and resources. Costs for the remedial action and LTM (30 years) are presented in Table 9-9. Data supporting the cost estimates are presented in Appendix K.

9.3.8.4.3 Modifying Criteria

This alternative may potentially gain regulatory or community acceptance as it would provide reasonable protection to potential human receptors through the surface and subsurface removal of MEC throughout the entire site. Regulatory and community acceptance of alternatives will be further evaluated following the public comment period for the FS Report and during the PP.

Table 9-1: NCP Criteria for Western Range Area B

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate (NPV)	Total cost is $381,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs, 100 Percent Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $4,333,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $19,688,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-2: NCP Criteria for Western Range Area C

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs Focused Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface removal.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $1,419,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; 100 Percent Surface and Focused Subsurface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $11,553,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $11,633,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-3: NCP Criteria for Western Range Area D

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs; 100 Percent Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $8,427,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; Focused Surface and Subsurface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $7,367,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $27,450,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-4: NCP Criteria for Eastern Range Area A

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs; 100 Percent Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $3,791,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; Focused Surface and Subsurface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $4,646,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $11,948,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-5: NCP Criteria for Eastern Range Area B

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs; Focused Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $1,349,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; 100 Percent Surface and Focused Subsurface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $8,216,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $8,156,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-6: NCP Criteria for Eastern Range Area C

Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate (NPV)	Total cost is $298,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; Focused Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $849,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
		Alternative 4: LUCS; 100 Percent Surface Clearance
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability over the entire MRS.
	Cost Estimate (NPV)	Total cost is $2,138,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 5: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation and private camps utilizing the area reduces implementability.
	Cost Estimate (NPV)	Total cost is $6,130,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-7: NCP Criteria for Grenade Range Area

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate (NPV)	Total cost is $273,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; Focused Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. .
	Cost Estimate (NPV)	Total cost is $540,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs; 100 Percent Surface Clearance**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Thick vegetation reduces implementability over the entire MRS.
	Cost Estimate (NPV)	Total cost is $801,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 5: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Thick vegetation reduces implementability.
	Cost Estimate (NPV)	Total cost is $1,286,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-8: NCP Criteria for Mine and Booby Trap Area

Criteria		Alternative 1: No Action
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate (Net Present Value [NPV])	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: LUCs**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate (NPV)	Total cost is $272,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs; 100 Percent Surface Clearance and Subsurface Clearance to Six Inches**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and in the subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface and subsurface clearance techniques. Limited access to cays reduces implementability.
	Cost Estimate (NPV)	Total cost is $566,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: Unlimited Use/Access**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Vegetation and potential private property issues reduce implementability.
	Cost Estimate (NPV)	Total cost is $617,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 9-9: Remedial Action Cost Estimates

MRS	Alternative	Total Capital Costs	Total Annual Costs (Present Worth)	Total Capital and Annual Costs
Western Range Area B	1 - No Action	$0	$0	$0
	2 - LUCs	$221,000	$160,000	$381,000
	3 - LUCs and 100 Percent Surface Clearance	$4,173,000	$160,000	$4,333,000
	4 - 100 Percent Subsurface Clearance (24 inches)	$19,671,000	$17,000	$19,688,000
Western Range Area C	1 - No Action	$0	$0	$0
	2 - LUCs and Focused Surface Clearance	$1,320,000	$160,000	$1,419,000
	3 - LUCs, 100 Percent Surface Clearance and Focused Subsurface Clearance (12 Inches)	$11,393,000	$160,000	$11,553,000
	4 - 100 Percent Subsurface Clearance (24 inches)	$11,616,000	$17,000	$11,633,000
Western Range Area D	1 - No Action	$0	$0	$0
	2 - LUCs and 100 Percent Surface Clearance	$8,267,000	$160,000	$8,427,000
	3 - LUCs and Focused Subsurface Clearance (12 Inches)	$7,310,000	$160,000	$7,367,000
	4 - 100 Percent Subsurface Clearance (24 inches)	$27,433,000	$17,000	$27,450,000
Eastern Range Area A	1 - No Action	$0	$0	$0
	2 - LUCs and 100 Percent Surface Clearance	$3,631,000	$160,000	$3,791,000
	3 - LUCs and Focused Subsurface Clearance (12 Inches)	$4,549,000	$160,000	$4,646,000
	4 - 100 Percent Subsurface Clearance (12 inches)	$11,931,000	$17,000	$11,948,000
Eastern Range Area B	1 - No Action	$0	$0	$0
	2 - LUCs and Focused Surface Clearance	$1,219,000	$160,000	$1,349,000
	3 - LUCs, 100 Percent Surface Clearance, and Focused Subsurface Clearance (12 Inches)	$8,056,000	$160,000	$8,216,000
	4 - 100 Percent Subsurface Clearance (12 inches)	$8,139,000	$17,000	$8,156,000
Eastern Range Area C	1 - No Action	$0	$0	$0
	2 - LUCs	$138,000	$160,000	$298,000
	3 - LUCs and Focused Surface Clearance	$721,000	$160,000	$849,000
	4 - LUCs and 100 Percent Surface Clearance	$1,978,000	$160,000	$2,138,000
	5 - 100 Percent Subsurface Clearance (12 inches)	$6,113,000	$17,000	$6,130,000
Grenade Range Area	1 - No Action	$0	$0	$0
	2 - LUCs	$113,000	$160,000	$273,000
	3 - LUCs and Focused Surface Clearance	$386,000	$160,000	$540,000
	4 - LUCs and 100 Percent Surface Clearance	$641,000	$160,000	$801,000
	5 - 100 Percent Subsurface Clearance (12 inches)	$1,269,000	$17,000	$1,286,000
Mine and Booby Trap Area	1 - No Action	$0	$0	$0
	2 - LUCs	$112,000	$160,000	$272,000
	3 - LUCs and Focused Surface / Subsurface Clearance to 6 inches	$410,000	$160,000	$566,000
	4 - 100 Percent Subsurface Clearance (12 inches)	$600,000	$17,000	$617,000