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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 49TH WING (ACC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO

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1 September 2016

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Chief, Installation Management Flight (49 CES/CEI)
49th Civil Engineer Squadron (49 CES)
Holloman Air Force Base, NM

Mr. Chuck Hendrickson, Project Manager
RCRA Corrective Action Section (6MM-RC)
U.S. Environmental Protection Agency
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dear Mr. Hendrickson,

Holloman AFB is pleased to submit the Draft-Final Engineering Evaluation/Cost Analysis for the GR940 Practice Grenade Range Munitions Response Site, Holloman Air Force Base, NM for your review.

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

If you have any questions regarding this submittal, please contact me at (575) 572-6675.

Sincerely,

Digitally signed by KUSMAK.ADAM.M.1263331806
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=KUSMAK.ADAM.M.1263331806
Date: 2016.09.01 15:08:43 -06'00'

ADAM M. KUSMAK, GS-13, USAF

Attachment:
Engineering Evaluation/Cost Analysis for the GR940 Practice Grenade Range Munitions Response Site, Holloman Air Force Base, NM.

cc:

(w/Atch)	(w/Atch)	(w/o Atch)
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DRAFT-FINAL

ENGINEERING EVALUATION/COST ANALYSIS

GR940 PRACTICE GRENADE RANGE MUNITIONS RESPONSE SITE (MRS)

HOLLOMAN AIR FORCE BASE
NEW MEXICO

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland, Texas 78236-9853

September 2016

Prepared by:

FPM Remediations, Inc.

181 Kenwood Avenue
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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by FPM Remediations, Inc. (FPM) under FPM's Air Force Civil Engineer Center Contract FA8903-13-C-0008, to support the United States Air Force (USAF) Military Munitions Response Program. The purpose of the EE/CA is to develop and evaluate Remedial Action (RA) alternatives for reduction of Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) risks to human health potentially present at the GR940 Practice Grenade Range Munitions Response Site (MRS) located at Holloman Air Force Base (AFB), near Alamogordo, New Mexico. The MEC/MPPEH may be present on the surface and in the subsurface of the ground due to past military munitions use of the property.

Holloman AFB is located in south-central New Mexico, seven miles west of the city of Alamogordo in Otero County. The 3.16-acre GR940 MRS is located northwest of the Flying "H" horse stables and just west of Lethal Road. The site was identified during the Comprehensive Site Evaluation (CSE) Phase II as an area containing the potential for MEC/MPPEH in the form of surface Munitions Debris just north of the Former Small Arms Range (SR858) MRS. Based on the CSE Phase II results, munitions that may be found at this site include practice 40 millimeter grenades and pistol flares.

The following four RA alternatives were evaluated for GR940 as part of this EE/CA:

1. Alternative 1 - No Action,
2. Alternative 2 - LUCs,
3. Alternative 3 - Surface Removal of MEC/MPPEH Combined with LUCs.
4. Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH

Alternative 1, the No Action alternative, involves no active response or land use restrictions to locate, remove, dispose of, or limit the exposure to any potential MEC/MPPEH present within the MRSs. The No Action approach is routinely retained in the EE/CA evaluation of alternatives in accordance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide a baseline for comparison of other response technologies and alternatives.

Alternative 2, the LUCs alternative includes engineering controls (e.g., fencing and warning signs) and institutional controls (e.g., administrative controls preventing access to the MRSs). As part of this alternative, fencing would be placed along the perimeter of the site and along the road crossing through the MRS and frequent signage would be put in place.

Alternative 3, the Surface Removal of MEC/MPPEH Combined with LUCs alternative includes instrument-aided (electromagnetic metal detector) removal of any MEC/MPPEH items which may exist on or protruding from the ground surface. The removal activities will be performed by experienced Unexploded Ordnance (UXO)-qualified personnel. MEC/MPPEH items identified during the surface removal will be disposed of by detonation following procedures defined in the Department of Defense Explosives Safety Board (DDESB) approved Explosives Safety Submission (ESS) for the site.

LUCs would be implemented upon completion of surface MEC/MPPEH removal to minimize potential exposure to remaining subsurface MEC/MPPEH. The LUCs will include engineering controls (e.g., warning signs) and institutional controls (e.g., administrative controls preventing

access to the MRSs). As part of this alternative, warning signs would be placed along the perimeter of the site and along the road crossing through the MRS. LUCs will also prohibit digging without dig permits from Holloman AFB which would require construction support by UXO-qualified personnel.

Alternative 4 includes 100 percent (%) surface removal of MEC/MPPEH and removal of the following subsurface anomalies:

- Those that show characteristics of burial pits, and
- All individual geophysical anomalies above the site-specific threshold based on the MRS background noise determined by an Instrument Verification Strip/ Geophysical System Verification.

Removal activities will be performed by experienced UXO-qualified personnel, and in no case will any excavations and removals exceed 10 feet (ft). Following removal of all anomalies identified, the intrusive investigated area will be restored as close as possible to its original state.

These four alternatives were evaluated using the effectiveness, implementability, and cost criteria set forth in the NCP guidance for conducting EE/CAs. Alternative 4 had the best overall ranking and is the recommended alternative for the GR940 MRS.

According to Sections 300.415(m) and 300.820 of the NCP, community relations and administrative record activities will be performed as two forms of public participation necessary for all RAs. The Lead Agency (USAF) will designate a spokesperson to inform the public about the release and actions taken, to respond to questions, and to notify immediately affected citizens, and State and local officials. In addition, the USAF will ensure that documents containing factual information, data and analysis of the factual information, and data that may form a basis for the selection of a response action at this site are placed into the administrative record and make the administrative record available to the public at a central location or near the site, if applicable. Comments from the public on the selection of this RA alternative will be incorporated into the Action Memorandum identifying the preferred alternative for the site.

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Appendix A Remedial Action Alternatives Cost Estimates

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percent
°F	Degrees Fahrenheit
AAAF	Alamogordo Army Air Field
AFB	Air Force Base
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BIP	Blow-in-Place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSE	Comprehensive Site Evaluation
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DID	Data Item Description
DoD (DD)	Department of Defense
DMM	Discarded Military Munitions
EE/CA	Engineering Evaluation/Cost Analysis
EM	Engineering Manual
EM61	Geonics EM61-MK2
EOD	Explosive Ordnance Disposal
ESS	Explosives Safety Submission
FPM	FPM Remediations, Inc.
ft	feet
G-858	Geometrics G-858 Cesium Vapor Magnetometer
GIS	Geographic Information System
GRA	General Response Action
GSV	Geophysical System Verification
HASP	Health and Safety Plan
HDR	HDR Environmental, Operations and Construction, Inc.
HSTT	High Speed Test Track
IAW	in accordance with
IVS	Instrument Verification Strip
LUC	Land Use Control
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
mg/kg	milligram per kilogram
MHAT	MEC Hazard Assessment Tool
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area

LIST OF ABBREVIATIONS AND ACRONYMS (concluded)

MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
N/A	Not Applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NTCRA	Non-Time-Critical Removal Action
ppm	parts per million
PRSC	Post Removal Site Control
RA	Remedial Action
RACER	Remedial Action Cost Engineering and Requirements
RAO	Remedial Action Objective
SARA	Superfund Amendments and Reauthorization Act
SDA	Safe Disposal Area
Shaw	Shaw Environmental, Inc.
SKY	Sky Research, Inc.
TBC	To Be Considered
TDS	Total Dissolved Solids
TMV	Toxicity, Mobility or Volume
U.S.	United States
USAF	U.S. Air Force
USACE	U. S. Army Corp of Engineers
U.S.C.	U.S. Code
USEPA	U.S. Environmental Protection Agency
UXO	Unexploded Ordnance
WP	Work Plan
WSMR	White Sands Missile Range
WWII	World War II
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) is being performed in support of the United States (U.S.) Air Force (USAF) Military Munitions Response Program (MMRP) at Holloman Air Force Base (AFB) near Alamogordo, New Mexico. The purpose of this EE/CA is to develop and evaluate Remedial Action (RA) alternatives and associated costs to mitigate hazards associated with surface and subsurface Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) suspected to be present within the GR940 (formerly SR858a) Practice Grenade Range Munitions Response Site (MRS). This hazard was identified during the Comprehensive Site Evaluation (CSE) Phase II investigation at the SR858 Former Small Arms Range Munitions Response Area (MRA), MRA 858. The EE/CA assumes that no additional site assessment activities will be necessary to determine the appropriate RA alternative.

This document follows the U.S. Environmental Protection Agency's (USEPA's) guidance provided in document 540/R93/057 Guidance on Conducting NTCRAs under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA, 1993).

1.1 Project Authorization

The Department of Defense (DoD) MMRP falls under the authority of the Defense Environmental Restoration Program (DERP) and is in accordance with (IAW) the CERCLA of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and is part of the overall RA process. The MMRP was created by Congress in 2001 under the DERP as established by Section 211 of the SARA and is codified in Sections 2701-2710 of Title 10 of the United States Code (U.S.C.). The MMRP addresses Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), and Munitions Constituents (MC) at "other than operational" ranges at locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The USAF is the Lead Agency for this EE/CA.

The EE/CA is being completed by the FPM Remediations, Inc. (FPM) Team, under FPM's Air Force Civil Engineer Center Contract FA8903-13-C-0008, to support the USAF MMRP.

1.2 Purpose and Scope

The purpose of this EE/CA is to evaluate alternatives to reduce risks associated with suspected surface and subsurface explosive hazards at the GR940 Practice Grenade Range MRS to support a NTCRA. The CSE Phase II (HDR Environmental, Operations and Construction, Inc. [HDR], 2013) found physical evidence of Munitions Debris (MD) at the surface of the MRS indicating the potential presence of surface and subsurface MEC. The EE/CA documents existing site characterization data, provides an analysis of alternatives, and identifies the preferred action to protect human health and the environment.

1.3 Report Organization

The EE/CA has been organized as follows:

Section 1: Introduction – describes the project authorization and purpose and scope.

Section 2: MRS Characterization – presents Holloman AFB location and operational history, GR940 MRS description, previous investigations performed at the MRS, and streamlined risk evaluation.

Section 3: Development of RA Objectives (RAOs) – describes the regulatory requirements for the RA, including Applicable or Relevant and Appropriate Requirements (ARARs) and the RAOs.

Section 4: Identification and Analysis of RA Alternatives – provides detailed description and analysis of RA alternatives.

Section 5: Comparative Analysis of RA Alternatives – provides a comparative analysis of alternatives.

Section 6: Recommendations – summarizes the recommended RA alternative and provides the RA schedule.

Section 7: References – provides a list of references used to develop this EE/CA.

2.0 MRS CHARACTERIZATION

2.1 Installation Location and Background

Holloman AFB is located in south-central New Mexico, seven miles west of the city of Alamogordo in Otero County (**Figure 2-1**). It is adjacent to the White Sands Missile Range (WSMR). A portion of the Base to the south is bordered by Route 70, which also runs roughly north-south and parallel to the eastern boundary of the Base. Holloman AFB occupies approximately 50,763 acres of land. It is contiguous to the much larger (2.2 million acre) WSMR, and is located to the east of the WSMR. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the installation, where Route 70 borders the installation. The Main Base contains housing and administrative buildings. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). The High Speed Test Track (HSTT) runs north-south and is located northwest of the airfield. The track is the world's longest of its kind at 9.5 miles and has been used for an array of missile testing for decades and is still in use today. Access to Holloman AFB requires admittance through the security gate and there is a fence around the installation.

Holloman AFB began nine months after the U.S. entered World War II (WWII), and was an integral facility in the early stages of the U.S. space program throughout the Cold War. On 6 February 1942, construction began on an extensive bombing and gunnery range later known as the Alamogordo Bombing and Gunnery Range. On 10 August 1942, the Alamogordo Army Air Field (AAAF) was officially established. Because the facility was initially intended to be used by Great Britain as part of their WWII British Training Program for bomber crews, the Base was designed after Royal Air Force bases. The first atomic bomb was detonated at the Trinity Site in the northwest corner of the Alamogordo Bombing and Gunnery Range (now the WSMR) on 16 July 1945. In 1946, as more lands became available within the Tularosa Basin, the AAAF was reassigned to be a missile development facility. With the creation of the USAF as a separate service, the facility came under the direction of the Air Materiel Command, which decided that the facility would be used to conduct guided missile programs. On 13 January 1948, the Base was renamed Holloman AFB, after Col. George V. Holloman, an early pioneer in guided missile development.

To support the Holloman mission of developing guided missiles, the Army Ordnance Corps built White Sands Proving Grounds at about this time. The combination of the White Sands Proving Grounds and Alamogordo Bombing Range was 100 miles long and 40 miles wide. On 1 September 1952, the two ranges were combined to form the Integrated White Sands Range. From 1952 to 1970, missile development and testing at White Sands included the Snark, Matador, Mace, Falcon, Aerobee, JB-2 Loon, and Firebee missiles. High speed sled tests, high altitude balloon projects, and Aeromedical Field Laboratory experiments were also conducted. Testing activities included the Central Inertial Guidance Test Facility and the Radar Target Scatter Test Facility.

In 1972, the Base was taken over by Tactical Air Command and became primarily a fighter base with some continued developmental testing. On 15 November 1991, command responsibility passed from the 833rd Air Division to the 49th Wing. Today, the 49th Wing provides leadership

to the installation. Two projects begun during the Cold War era continue on the Base: the HSTT and the Primate Research Lab (both considered tenant organizations).

2.2 Site Description and Operational History of GR940 MRS

The GR940 Practice Grenade Range MRS (3.16 acres) is located northwest of the Flying "H" horse stables and just west of Lethal Road (**Figure 2-2**). The site was identified during expanded CSE Phase II visual surveys north of the SR858 Former Small Arms Range MRS (**Figure 2-2**). An area of practice grenade debris was observed during this survey and a new MRS (GR940) was created based on this area of MD.

2.3 Physical Description

2.3.1 Climate

Holloman AFB is located in a semi-arid region within the northern portion of the Chihuahuan Desert. Its climate resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters. Monthly mean high temperatures range from 55 degrees Fahrenheit (°F) in January to 93.6°F in August. Monthly mean low temperatures range from 29°F in January to 66°F in July. Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. Seasonal fluctuation in precipitation rates is a result of prevailing wind directions, which can bring in frontal storms from the north or the Pacific or Caribbean cyclonic systems. Holloman averages 13.20 inches of annual rainfall. Nearly half of this amount falls within the months of July through September, known as the summer monsoons. Monsoon thunderstorms are generally short in duration and high in intensity. Occurrences are highly variable from year to year and one or two short-term events may contain a large percentage of the net annual precipitation. Average annual snowfall is approximately 4.5 inches.

2.3.2 Topography

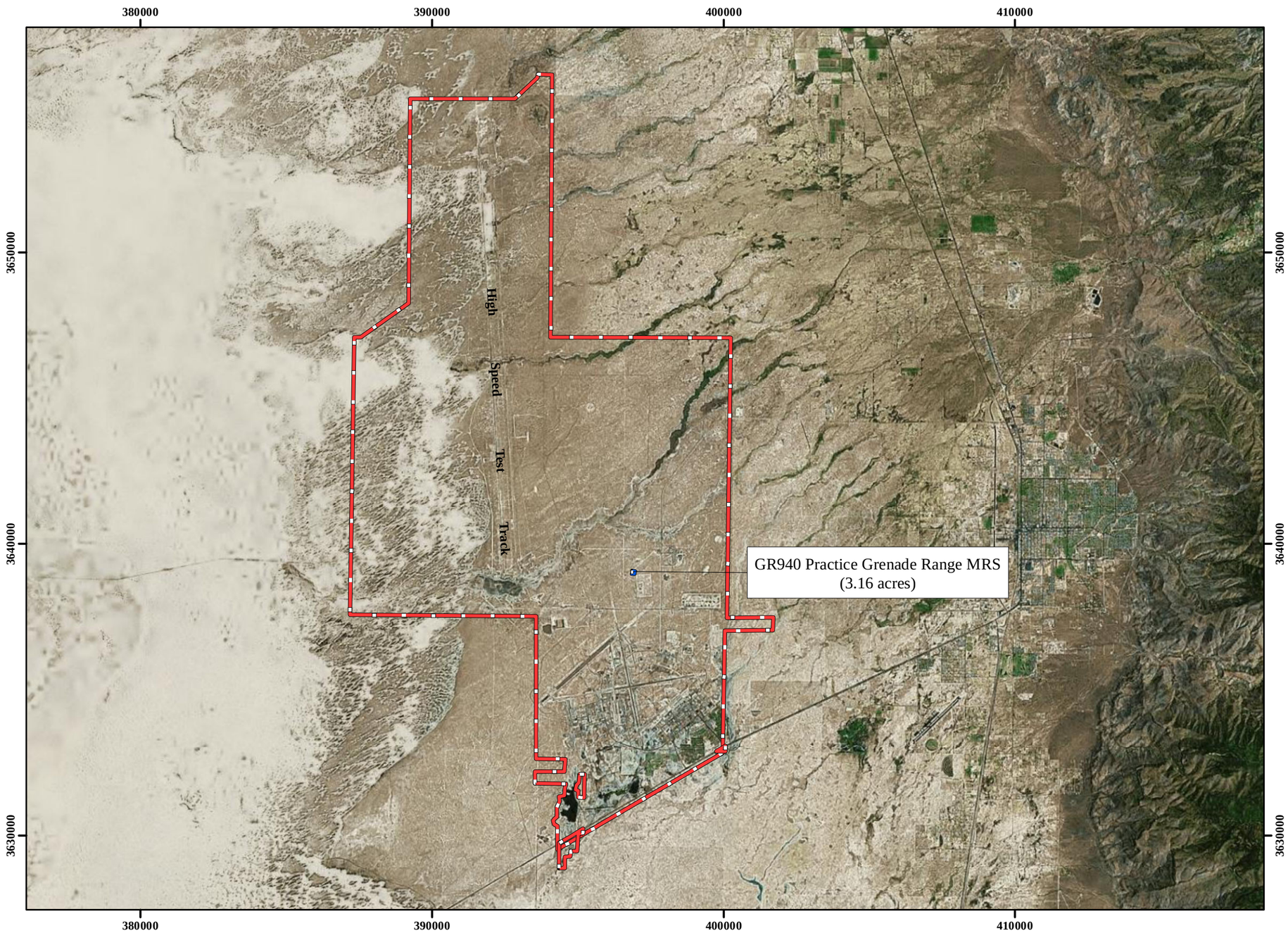
Holloman AFB lies within the Tularosa basin of south-central New Mexico. This area is part of the Mexican Highland section of the Basin and Range physiographic province and is characterized by fault block mountains interspersed with low desert plains and basins. The Base lies on relatively flat alluvial plains below the Sacramento Mountains. These plains are bordered to the west by the White Sands dune field. Elevations range from 4,000 to 4,250 feet (ft) above mean sea level (Sky Research, Inc. [SKY], 2011)

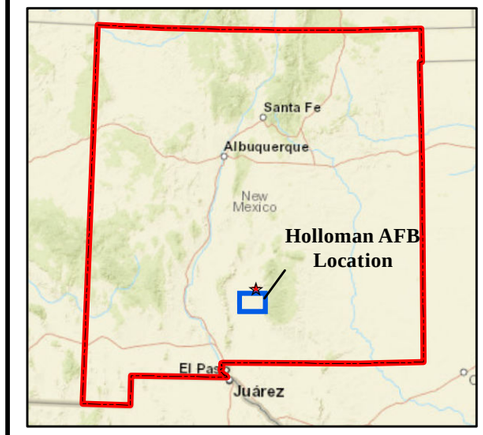
The GR940 MRS exhibits relatively flat topography.

2.3.3 Soils

The soils on Holloman AFB are basin fill deposits formed primarily from alluvial and aeolian processes. All soils have a high gypsum and salt content, primarily due to the eastern migration of gypsum sands from WSMR and White Sands National Monument. Holloman AFB has three primary soil types: several associations and complexes of Holloman, Gypsum Land, and Yesum soils, located in the flats; Dune Land, found in the White Sands dunes; and Mead silty clay loam soil, found in the alluvial floodplains (including most jurisdictional wetlands). None of the soil types are very productive, due to high gypsum and salt content, and all are highly subject to both wind and water erosion when the vegetation is sparse or the soil is exposed.

Soils at the GR940 MRS consist of the Yesum-Nasa complex.





Legend

Installation Boundary

NOTES:

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-1

Holloman AFB Location

FPM Remediations, Inc.

2016

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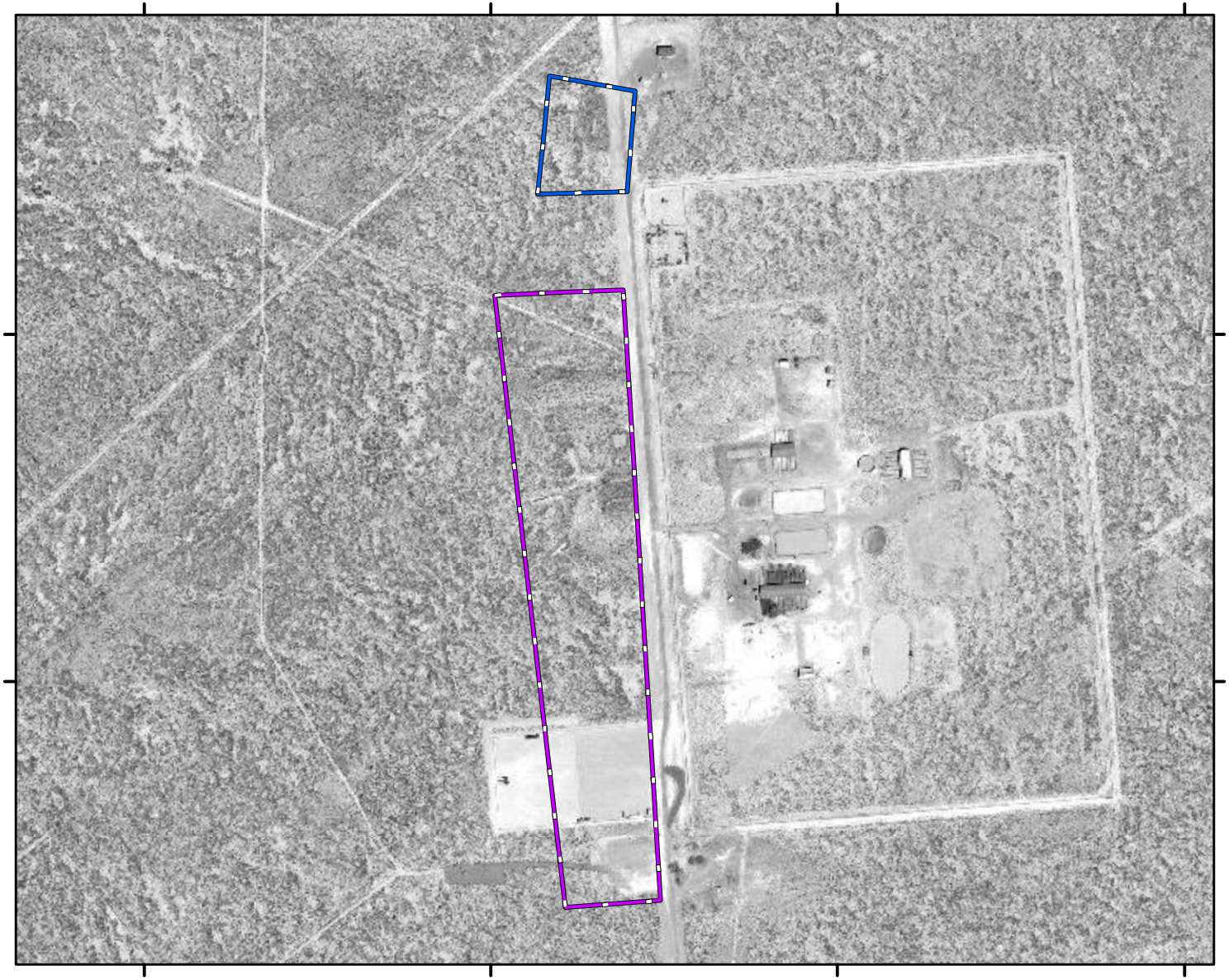

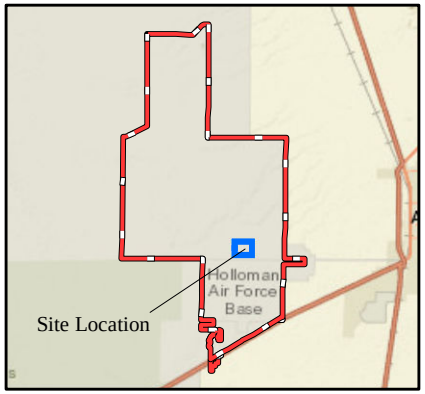

Legend

- GR940 Practice Grenade Range MRS (3.16 acres)
- SR858 Former Small Arms Range (22.60 acres)

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 2-2

GR940 Practice Grenade Range MRS Location

FPM Remediations, Inc.

2016

NOTES:
Revision Date: 6/23/2016

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 600 feet

0 100 200 Meters

0 300 600 Feet

N W E S

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2.3.4 Geology and Hydrogeology

Holloman AFB is located in the Tularosa Basin, a downfaulted, closed, intermountain basin located in the southern portion of the Rio Grande Rift. The Tularosa Basin is a bolson, which is a basin with no surface drainage outlet, in which sediments are carried by surface water into the closed basin and deposited (Bhate Environmental Associates, Inc., 2007). Basin fill of the Tularosa Basin is derived from the erosion of the uplifted material and fluvial deposits from the Rio Grande River. The Basin fill consists of unconsolidated coarse- to fine-grained alluvial fan deposits along the rims of the basin that are gradational toward the basin into finer-grained alluvial, fluvial, and lacustrine deposits. Evaporite materials, such as selenite, are present.

Prominent local physiographic features include the Sacramento Mountains to the east, San Andres Mountains, and White Sands National Monument to the west (49th Fighter Wing, 2009). The Tularosa Basin was formed as a structural trough during the Middle to Late Cenozoic era. Alluvial fill deposition includes; sand, gravel, and clay in alluvial fans along the basin margins and extensive lake, alluvial, and evaporate deposits within the interior basin. Streams sustained by groundwater discharge within the basin include Salt Creek and Malpais Spring. It is estimated that the groundwater resources of the Tularosa Basin contain over 100 million-acre ft of brackish groundwater. A wide range of water chemistries including sodium chloride, carbonate, and sulfate-based brine waters exist in the basin and water with salinity from 1,000 parts per million (ppm) Total Dissolved Solids (TDS), approximate to fresh water, to over 20,000 ppm TDS, approximate to sea water, can be found within the basin. No monitoring wells are located at the site discussed in this EE/CA, and therefore, the TDS levels exactly below the sites are not known. However, the majority (over 70 percent) of the Installation Restoration Program sites located across Holloman AFB have groundwater monitoring wells containing water with an average TDS concentration greater than 10,000 mg/L. TDS concentrations greater than 10,000 mg/L exceed the New Mexico Water Quality Control Commission (NMWQCC) limit for potable water, and therefore, the groundwater beneath Holloman AFB has been designated as unfit for human consumption. Likewise, the USEPA guidelines have identified the groundwater as a Class IIIB water source, characterized by TDS concentrations exceeding 10,000 mg/L and a low degree of interconnection with adjacent surface water or groundwater of a higher class. The primary source of groundwater recharge is percolation of rainwater and a minor contribution from stream run-off along the western edge of the Sacramento Mountains.

Beneath Holloman AFB, groundwater ranges from 5 to 50 ft below ground surface (bgs), with shallower groundwater found on the southern end of the Base. Groundwater flow is generally toward the southwest with localized influences from the variations in Base topography with shallower groundwater found on the southern end of the Base (SKY, 2011).

Groundwater at the GR940 MRS is estimated at 5-10 ft bgs.

2.3.5 Hydrology

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the Base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. There are at least nine prominent east-west drainages that receive intermittent flows during seasonal thunderstorms. The largest of these drainages is the Lost River drainage system, including

Malone Draw, Carter Draw, and Ritas Draw. Prior to extensive management of the surface topography and construction of U.S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011).

There are no wetlands or surface water associated with the GR940 MRS.

2.3.6 Vegetation

The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur (SKY, 2011).

Vegetation at the Gr940 MRS is consistent with desert scrubland.

2.3.7 Ecological Profile

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the Base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman. Five other sensitive species currently receive no federal protection: a lichen (*A. clauzadeana*), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the White Sands pupfish, a state-endangered species (New Mexico Department of Game and Fish [NMDGF], 2014); the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

According to Integrated Natural Resources Management Plan (INRMP) (Holloman AFB, 2015), no rare, threatened or endangered species are expected to inhabit the GR940 MRS.

2.3.8 Structures and Utilities

The remains of a concrete foundation including partial walls are located in the eastern portion of the MRS. A junkyard of aircraft parts is located across Lethal Road to the southeast and unidentified buildings on asphalt are located across the road to the northeast. The Flying "H" horse stables complex is located across the road and ~1,000 ft to the south of the MRS. There are 200 buildings located within a 2-mile radius of the GR940 MRS. Operational mission support, recreational, and buildings that support the flight line are located to the south of the MRS within a 3-mile radius (SKY, 2011). Utilities associated with suspected former buildings/structures may be present in the eastern portion of the MRS (Shaw Environmental, Inc. [Shaw], 2010). Prior to any intrusive work at GR940, the location of underground utilities will be designated as a part of a standard procedure for obtaining a Dig Permit at Holloman AFB.

2.3.9 Current and Future Land Uses

According to Installation Development and Design Holloman AFB (HAFB, 2011), the location of the GR940 MRS is currently unused open space and no known changes to the future land use have been indicated.

Holloman AFB is fenced and gated on all roads into and out of the installation. The main entry points are gates manned by security personnel, and security patrols the base roads 24 hours/day.

No additional access controls, other than the base-wide controls, are present at the MRS. Therefore, access to the MRS is restricted for the general public, but is open to Base personnel, contractors, Base residents, and visitors.

2.4 Previous Investigations – CSE Phase II

The only MMRP investigation conducted at the GR940 MRS was CSE Phase II (HDR, 2013) when the MRS was identified. The CSE Phase II field activities included the visual survey and surface soil sampling to evaluate the potential presence of lead contamination.

MD items documented at site during the visual survey included expended practice 40 millimeter (mm) pistol flare (M74A1) casings, grenade pins, spoons, and fuzes (expended), and the body weight from a M781 40mm practice grenade. The remnants of a concrete foundation (including partial walls) were also observed in the same area as the grenade fuzes and pins.

Five surface soil samples were collected and analyzed using X-Ray Fluorescence (XRF) to evaluate for potential lead contamination within the site. The XRF results ranged from below the Limit of Detection (12 milligram per kilogram [mg/kg]) to 17 mg/kg, way below the New Mexico Environment Department (NMED) Residential Soil Screening Level of 400 mg/kg. In addition, at the conclusion of the XRF sampling at MMRP sites during the CSE Phase II, twelve correlation samples were selected and sent to the analytical laboratory to determine whether XRF results can be considered definitive and can be used for decision making purposes. The results of the linear regression analysis for Holloman AFB yield a correlation coefficient of 0.99, indicating that the XRF data may be considered to be definitive and as a result may be used for remedial decision-making. Therefore, XRF analysis have shown that lead was not a concern for human health or the environment at the GR940 MRS. However, the presence of MC contamination associated with the potential presence of surface and subsurface MEC is still possible.

The site was also prioritized for further munitions response actions, based on relative risk, using the Munitions Response Site Prioritization Protocol (MRSPP) scoring system. The MRS Priority is determined by selecting the highest rating from the Explosives Hazard Evaluation, Chemical Hazard Evaluation, and Human Health Hazard Evaluation modules and ranges from 1 to 8. Priority 1 and 8 indicate the highest and the lowest potential hazards, respectively. Only a site with a chemical warfare hazard can receive an MRS Priority of 1. Based on CSE Phase II results, the GR940 MRS received a priority of 5 (moderate risk) due to potential presence of surface and subsurface MEC.

The GR940 MRS was recommended for further munitions response actions at the conclusion of the CSE Phase II based on the presence of surface MD within the MRS.

2.5 Streamlined Risk Evaluation

2.5.1 MEC Exposure Pathway Analysis

The MEC Exposure Pathway Analysis for the GR940 MRS is shown in **Figure 2-3**. Based on the CSE Phase II results the potential for MEC/MPPEH at the MRS was found in the form of surface MD including expended practice 40 millimeter (mm) pistol flare (M74A1) casings, grenade pins, spoons, and fuzes (expended), and the body weight from a M781 40mm practice grenade.

A variety of naturally occurring processes may alter the condition of the land at the site resulting in a potentially explosive subsurface item being exposed at the surface and becoming more accessible to contact with people or the environment. These processes may include frost heave, flooding and erosion. A variety of intrusive activities by people also may alter the condition of the land at the site in a manner that a subsurface MEC item may become exposed at the surface. These may include construction activities that involve excavation.

The GR940 MRS is accessible by human receptors, including Base personnel, Base residents, authorized contractors, visitors, recreational users and trespassers. Exposure pathways are shown to be potentially complete for all of these receptor categories for MEC on the soil surface and in the subsurface.

Biota are generally not considered when evaluating MEC risk because, with the exception of threatened and endangered species, risk to biotic receptors is usually evaluated at the population level. Though an individual ecological receptor may experience a negative affect from encountering MEC, MEC does not pose risk to biotic populations unless a large area of habitat were to be destroyed, for example, by a large detonation. Sandbag mitigation, in accordance with Use of Sandbags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions (HNC-ED-CS-S-98-7) (USACE, 2011) will be employed to reduce any possibility of a fragmentation hazard. The chosen thickness of sandbags will be larger than the minimum required to prevent potential destruction of a large area and any impact on ecological receptors. Since rare, threatened or endangered species are not expected to inhabit the GR940 MRS, MEC exposure pathways to biota are shown as incomplete.

2.5.2 MC Exposure Pathway Analysis

The MC Exposure Pathway Analysis for the GR940 MRS is shown in **Figure 2-4**.

In general, migration pathways involve movement via air, water, soil, and the interfaces between these media. Based on the types of releases and the characteristics of MC, the fate and transport of contaminants at Holloman AFB is expected to occur mainly in the terrestrial environment, but there is potential for migration by aquatic and atmospheric pathways as well.

In the terrestrial environment, if the contaminant is released to soil, it may volatilize, adhere to the soil by sorption, leach into the groundwater with precipitation, or degrade due to chemical (abiotic) or biological (biotic) processes. If the contaminant is volatilized from soil, it may be released to the atmosphere or migrate to groundwater. Constituents that are dissolved in groundwater may eventually be transported to a surface aquatic environment. There are no known aquatic environments present within the GR940 MRS. Therefore, this pathway is believed to be incomplete.

In the atmospheric environment, contaminants may exist as vapors or as suspended particulate matter. The transport of contaminants relies mostly on wind currents, and continues until the contaminants are returned to the earth by wet or dry deposition. Degradation of organic compounds in the atmosphere can occur due to direct photolysis, reaction with other chemicals, or reaction with photochemically generated hydroxyl radicals. Based upon the data collected during the CSE Phase II activities, transport of MC via the atmospheric environment is unlikely at Holloman AFB and therefore at GR940 as well.

Human receptors at GR940 include Base personnel, Base residents, authorized contractors, visitors, recreational users, and trespassers. The exposure pathways include direct (or incidental)

ingestion of soil, dermal contact with soil, and inhalation of volatiles and fugitive dusts from contaminated soil. The exposure pathways are shown to be complete for all of these receptor categories for MC in surface soil based on the presence of lead above the basewide background value. The exposure pathways are shown to be potentially complete for MC in subsurface soil for all human scenarios.

Ecological receptors at the site include terrestrial invertebrates, plants, and terrestrial birds, mammals, and reptiles. MC exposure pathways to biota are shown as incomplete for surface soil, potentially complete for subsurface soil, potentially complete for the food chain (vegetation and wildlife) for the GR940 MRS and incomplete for the food chain (domestic animals).

There is no present-day human exposure to groundwater at Holloman AFB. The aquifer below Holloman AFB is an unconfined sole source brackish aquifer, with an average depth to groundwater of 5 to 50 ft bgs. Groundwater flow beneath the installation generally occurs from the northeast to the southwest, and depths to groundwater tend to be shallowest toward the main installation. Depending on future land use, there is a possibility that groundwater supply wells could be put in place for domestic and/or industrial uses, though the high total dissolved solids in the aquifer indicates that the water would likely need pretreatment before it was considered potable. Therefore, exposure pathways are shown to be incomplete for MC in ground water for all receptors at the GR940 MRS.

Figure 2-3 GR940 MRS MEC Pathway Analysis

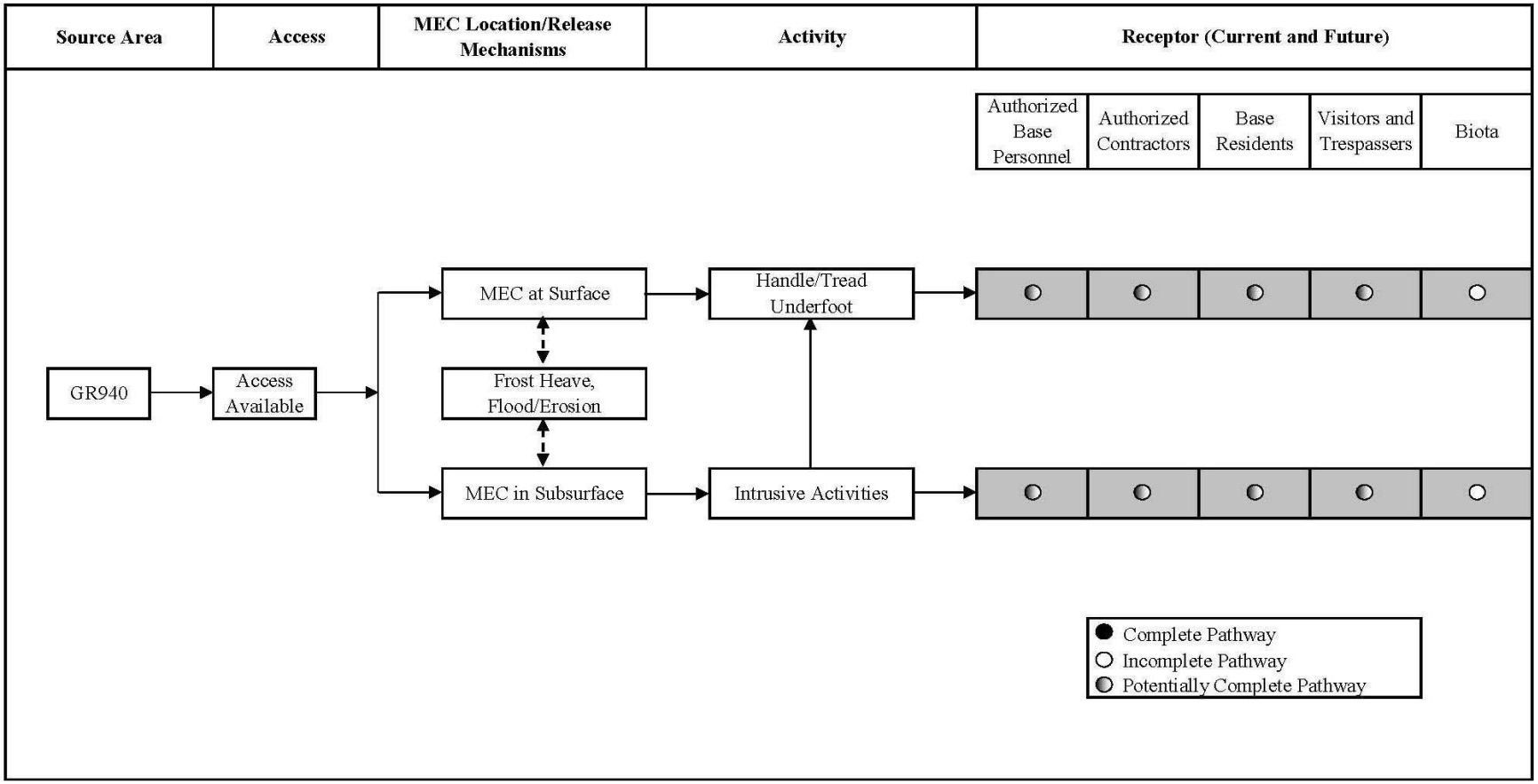
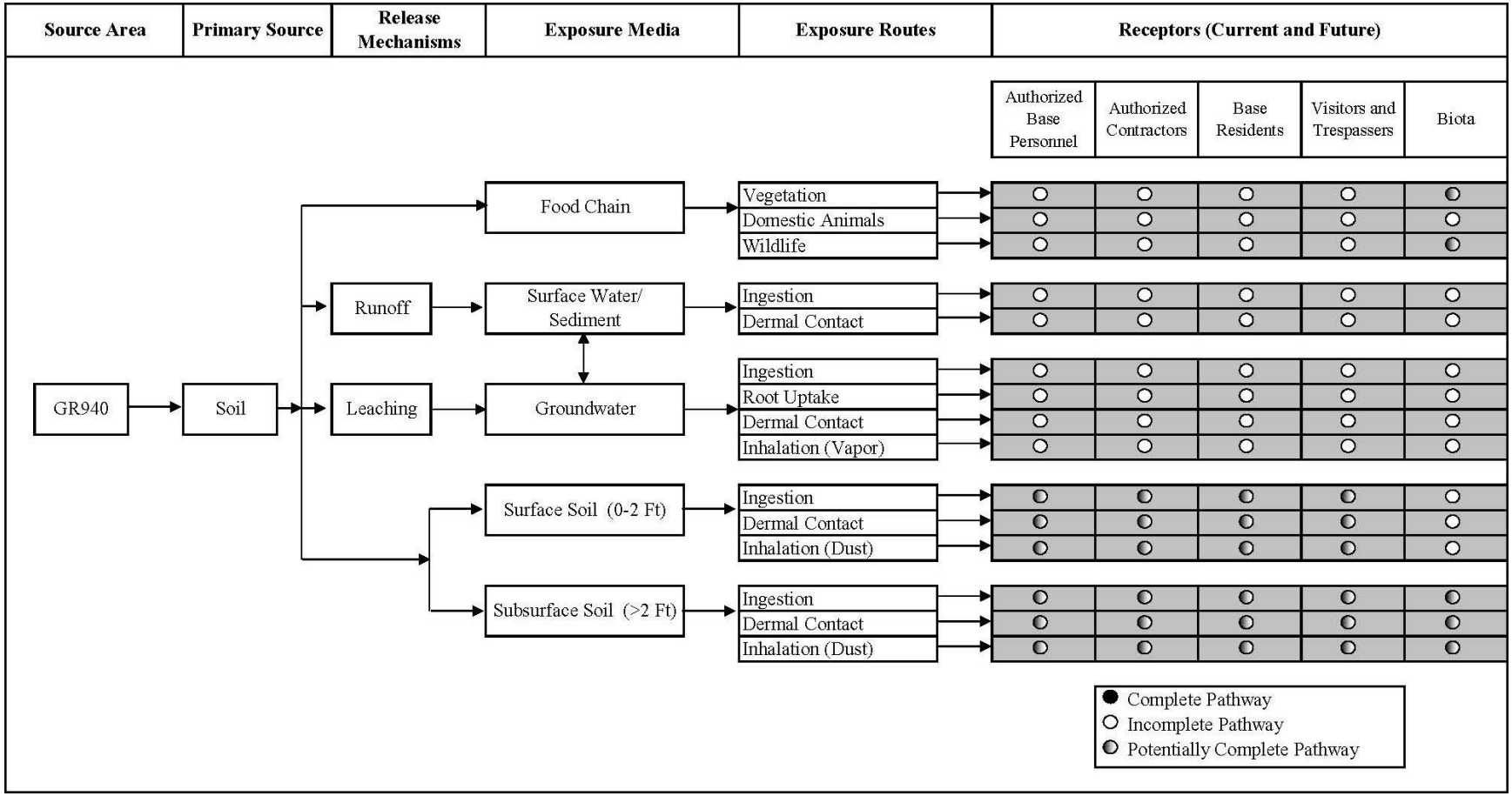


Figure 2-4 GR940 MRS MC Pathway Analysis



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3.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

The following sections discuss the justification for the NTCRA, the ARARs, and the specific RAOs developed for the NTCRA at the GR940 MRS.

3.1 Justification for the Proposed Removal Action

The MEC/MPPEH potentially present on the surface and in the subsurface of the ground poses a potential and avoidable threat to human health and welfare. The removal of these items would reduce risk/hazards suspected to be present due to historic use of the property. Threats to human health or the environment, though not time-critical, are sufficiently serious that conditions at the GR940 MRS meet the USEPA 40 Code of Federal Regulations (CFR) § 300.415(b)(2)(vi) - threat of fire or explosion - criterion for initiating a removal action.

3.2 Applicable or Relevant and Appropriate Requirements

The ARARs addressing contaminated environmental media are identified in this section. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.5) defines "applicable" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstance found at a CERCLA site." Only those promulgated state standards identified by a state in a timely manner that are substantive and equally or more stringent than federal requirements may be applicable.

The NCP (40 CFR 300.5) further defines "relevant and appropriate" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, RA, location, or other circumstances 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." Like "applicable" requirements, the NCP also provides that only those promulgated state requirements identified in a timely manner and are more stringent than corresponding federal requirements may be relevant and appropriate.

USEPA identifies three basic types of ARARs. They include the following: chemical-specific, location-specific, and action-specific.

- Chemical-specific ARARs are generally health- or risk-based values that, when applied to site-specific conditions, result in numerical values. These values establish the acceptable concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-specific ARARs are restrictions placed upon removal activities of hazardous substances solely because they are occurring in a particular place.
- Action-specific ARARs are generally technology or activity-based requirements on actions taken with respect to hazardous substances. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Thus, action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. The MEC/MPPEH removal action

will be conducted in compliance with DoD, USAF, and U.S. Army Corp of Engineers (USACE) explosive safety standards and munitions response procedures.

3.2.1 Chemical Specific ARARs

There are no chemical-specific ARARs associated with MEC.

3.2.2 Location-Specific ARARs

Location-specific ARARs set restrictions on the types of activities that can be performed based on site-specific characteristics or location. Alternative actions may be restricted or precluded based on proximity to wetlands or floodplains, presence of natural or cultural resources, or to man-made features such as existing disposal areas and local historic buildings. No location-specific ARARs were identified. Final location-specific ARARs (statutes and regulations) will be determined in consultation with the USEPA, NMED, and other appropriate federal and/or state agencies. These agencies are responsible for administration of programs that implement the potential location-specific ARARs.

3.2.3 Action-Specific ARARs

Based on the RA alternatives developed to address MEC at the GR940 site, certain action-specific ARARs will be considered. The action-specific ARARs are presented in **Table 3-1**. At present, New Mexico regulates military munitions through CERCLA. In addition, an RA plan must incorporate all substantive requirements of state and federal law, including public participation and review, compliance with state and federal laws and regulations, and all other technical elements to ensure protection of public health and the environment.

3.3 Remedial Action Objective

Based on the NCP requirements and the applicable ARARs previously discussed, the following RAO was developed for the RA at the GR940 MRS:

- Implement measures within GR940 that will minimize explosives hazards associated with subsurface MEC/MPPEH that pose a potential explosives safety risk to human health and ecological receptors.

Table 3-1 List of Potential Action-Specific ARARs

Standard, Requirement, or Criteria	Description	Comment
FEDERAL		
Resource Conservation and Recovery Act of 1976 (RCRA) (40 CFR Part 261.1 and 261.2)	Defines whether a material is a "solid waste."	Applicable if RA involves the identification of and treatment or off-site disposal of hazardous waste.
RCRA (40 CFR Parts 261.3 thru 261.41)	Provides guidance to determine if a “solid waste” is a “hazardous waste,” provides the criteria for identifying the characteristics of and for the listing of hazardous wastes	
RCRA (40 CFR 262, Subparts A-C)	Provides guidance regarding the management of hazardous waste with regards to record keeping, packaging, labeling, marking, and placarding requirements before transporting hazardous waste.	
Approval and promulgation of Implementation Plans 40 CFR 52, Subpart GG, New Mexico, [52.1620(c)]	Establishes Air Quality Control Regions and attainment dates for national standards in those regions.	Applicable for remedial activities that involve air emissions (including dust particulates) e.g., excavation.
Hazardous Materials Regulations (49 CFR Subchapter C, Part 171 Subpart A, Parts 172 -173, and Part 177) Relevant and appropriate.	Establishes regulations for the transportation of hazardous materials by private, common, or contract carriers by motor vehicle. Includes regulations on hazard communications, and the preparation, packaging, labeling, loading and unloading of hazardous materials.	Applicable if the remedial action involves transportation of hazardous materials.
Occupational Safety and Health Administration	Establishes safety and health requirements for personnel working in operations	Applicable to on-site remedial activities involving hazardous waste (e.g., MEC)

Standard, Requirement, or Criteria	Description	Comment
(29 CFR Part 1910.120) Hazardous Waste Operations and Emergency Response	involving hazardous waste and hazardous waste clean-up.	removal.
Hazard Communication Standard (29 CFR 1910.1200)	Addresses classifying the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees. Includes developing and maintaining a written hazard communication program, preparation and distribution of safety data sheets to employees, and development and implementation of employee training programs regarding hazards of chemicals and protective measures.	Applicable if the RA involves handling hazardous substances (e.g., MEC).
Work Plans MMRP-09-001 (USACE, 2009a)	WPs will be used to describe the goals, methods, procedures, and personnel used for field activities for all munitions response remedial or removal responses and other munitions related actions.	To be Considered (TBC) for all alternatives that will require potential interaction with MEC/MDEH or MD.
Explosives Management Plan MMRP-09-002 (USACE, 2009b)	The Explosives Management Plan will be used to provide details for management of explosives for a specific munitions response or other munitions related project in accordance with applicable regulations. This Data Item Description contains the instructions for preparing WP chapters addressing explosives management for specific MR or other munitions related projects.	TBC to those alternatives that may encounter MPPEH as part of remedial process.

Standard, Requirement, or Criteria	Description	Comment
Safety Submissions MMRP-09-003 (USACE, 2009c)	The ESS is used to provide the appropriate safety criteria for planning and siting of operations for munitions response, Recovered Chemical Warfare Material and other related projects that are in an investigative or characterization phase where there will be intentional physical contact with MPPEH, or presenting a chemical hazard.	TBC to those alternatives that will require removal of MEC/MPPEH as part of the remedial process.
Accident Prevention Plan MMRP-09-005 (USACE, 2009d)	Instructions for preparing an Accident Prevention Plan for conventional ordnance and explosives projects.	TBC to those alternatives that will require removal of MEC/MPPEH as part of the remedial process.
EE/CA, Remedial Investigation and Feasibility Study Reports MMRP-09-010 (USACE, 2009e)	The EE/CA Report, the Remedial Investigation Report and the Feasibility Study Report are used to document the methods employed during site characterization and present the results of the site characterization, an analysis of response action alternatives, and the recommended response alternative. This DID provides the requirements for preparing these reports as part of the MMRP response process and other munitions related actions.	Portions of this guidance are TBC to the completion of this EE/CA.
Accident / Incident Reports MMRP-09-011 (USACE, 2009f)	The Accident/Incident Reports will be used for reporting accidents/ incidents that occur on the work site or in connection with the stated work of this contract.	TBC. Any accidents or incidents that occur during the implementation of remedial alternatives will need to be reported accordingly.
Personnel Qualifications Certification Letter MMRP-09-012 (USACE, 2009g)	The Personnel Qualifications Certification Letter is submitted by the contractor certifying that key personnel and personnel filling core labor categories meet the training and	TBC. Proof of training would be maintained for all UXO personnel that would work on the site in various capacities in accordance with the work required for the alternatives presented

Standard, Requirement, or Criteria	Description	Comment
	experience requirements for the position held. Resumes will be used to document personnel qualifications and experience.	in this EE/CA. Use of properly trained personnel is required by MMRP guidelines.
Implementation of DDESB Guidance on Minimum Separation Distances for Unintentional Detonations (DDESB, 2013)	The USACE has endorsed the use of the Hazard Fragmentation Distance for determining the minimum separation distance for unintentional detonations for MMRP responses/ projects for all MEC/MDEH	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
USAF, MEC Hazard Assessment Tool (MHAT) Methodology (USAF, 2011)	This document describes the MHAT methodology for assessing potential explosive hazards to human receptors at MRS. The MHAT allows a project team to evaluate the potential explosive hazard associated with an MRS, given current or reasonably anticipated future conditions, and under various cleanup, land use activities, and Land Use Control (LUC) alternatives.	TBC for all alternatives that will involve LUCs, surface clearances, and/or subsurface clearances.
USACE Engineering and Design Military Munitions Response Actions; Engineer Manual (EM) 1110-1-4009 (USACE, 2010)	This manual provides USACE procedures to be used to perform engineering and design activities for all phases of the MMRP.	TBC for engineering and design activities under the MMRP.
USACE Safety and Health Requirements Manual; EM 385-1-1 (USACE, 2011)	This manual prescribes the safety and health requirements for all USACE activities and operations.	TBC for all on-site remedial activities.
USACE Explosives Safety and Health Requirements Manual; EM 385-1-97 (USACE, 2013)	This manual prescribes the safety and health requirements for all USACE activities and operations that involve explosives related work.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.

Standard, Requirement, or Criteria	Description	Comment
Air Force Manual 91-201; Explosives Safety Standards (USAF, 2011)	These standards establish a central source for explosive safety criteria. It identifies hazards and states safety precautions and rules when working with explosives.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
DoD Ammunition and Explosives Safety Standards; 6055.09-M (DoD, 2009)	These standards are designed to manage risks associated with DoD-titled ammunition and explosives by providing protection criteria to minimize serious injury, loss of life, and damage to property.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
Department of Defense Instruction 4140.62, Material Potentially Presenting an Explosive Hazard (DoD, 2015)	This instruction provides policy and responsibilities for the management and disposition of MPPEH.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD
STATE		
NMED New Mexico Administrative Code Title 20 Chapter 9, Part 2	Applies to the transportation, storage, transfer, processing, recycling, composting, nuisance abatement and disposal of solid waste.	Applicable for remedial actions that involve recycling of solid waste or disposal of solid waste at an approved off-site landfill.
NMED New Mexico Administrative Code Title 20 Chapter 2 Part 7	General Provisions Emission of an air contaminant, including a fugitive emission, in excess of the quantity, rate, opacity or concentration specified by an air quality regulation or permit condition.	Potentially applicable to fugitive dust emissions during excavation, backfilling and landscaping activities.

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4.0 IDENTIFICATION AND ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

This section identifies and describes the RA alternatives that address the RAO for the GR940 MRS. The RA alternatives were developed by combining the most qualified General Response Actions (GRAs) that have been selected in the past at sites with similar conditions. The main objective of development of different alternatives is to provide decision-makers with an appropriate range of options and sufficient information to adequately compare alternatives against one another.

4.1 General Response Actions

The GRAs are broad classes of medium-specific actions such as no action, LUCs, subsurface removal, or a combination of these that will achieve the RAO. The GRAs can be implemented through different remedial technologies and process options, defined as follows:

- Remedial technologies are the general categories of remedies such as detection, removal, disposal, and access restrictions;
- Process options are specific categories of remedies within each remedial technology, and are used to implement each remedial technology.

4.1.1 Identifications of Technologies and Process Options

The GRAs with corresponding remedial technologies and process options that were used for development of RA alternatives for the GR940 MRS are summarized in **Table 4-1** and described as follows:

- **No Action** – No remedial action would be taken to address the potential MEC/MPPEH, MD, or range related debris hazards.
- **LUCs** – This GRA includes access restrictions and educational programs. In general access restrictions may include installing and maintaining fencing around controlled areas, posting warning signs prohibiting entry, or annotating areas covered by LUCs in the Holloman AFB Installation Development and Design and Geographic Information System (GIS) and implementing a dig permit process to ensure that no excavation occurs without approval from the installation EM. In addition, as part of this alternative, administrative controls (including anomaly avoidance measures and UXO Construction Support) would be implemented that could include stipulation that property could be used only for surface activities. Construction support would include a qualified UXO team, usually consisting of a minimum one UXO Technician III and one UXO Technician I, provides MEC avoidance by escorting site users in high risk areas and observing grading or other construction activities. The UXO team would halt all activities if MEC is encountered. For excavation activities in the MRS, this process option would likely require UXO personnel conducting a removal action to the maximum excavation depth or the maximum penetration depth prior to excavation activities. Educational programs would be tailored to community needs and could include public meetings, distribution of fact sheets, exhibits, videos, and educational signage at the MRS.
- Surface MEC/MPPEH Removal – Removal of MEC/MPPEH from the entire surface of the MRS. Analog metal detectors (e.g., Whites all metal detectors) and magnetometers (e.g., Schonstedt) would be used to provide instrument assistance in identifying metal items exposed at the surface. Recovered MEC/MPPEH would be handled, stored, destroyed, and

Table 4-1 Potentially Applicable MEC Technologies and Process Options at the GR940 MRS

General Response Action	Remedial Technology	Process Option
No Action	None	None
LUCs	Access Restrictions - Administrative Controls	Educational Awareness Program
		UXO Escort/Construction Support
	Access Restrictions - Engineering/Physical Controls	Fencing
		Signage
Surface MEC/MPPEH Removal	Detection	Analog Instruments (metal detectors and magnetic locators)
	Removal	Manual Removal Methods (Shovels, Hand Equipment)
	Disposal	MPPEH Inspections
		Demolition (MEC)
		Manual Demilitarization (If Required)
		MDAS Disposal (recycling)
Subsurface MEC/MPPEH Removal	Detection	Digital Instruments (electromagnetic induction sensors and magnetometers)
		Analog Instruments (metal detectors and magnetic locators)
	Removal	Manual Removal Methods (Shovels, Hand Equipment)
		Mechanical Methods (Earth Moving Machinery)
	Disposal	MPPEH Inspections
		Demolition (MEC/MDEH)
		Manual Demilitarization (If Required)
		MDAS Disposal (recycling)

demilitarized in accordance with the DDESB Guidance for Clearance Plans (DDESB, 1998), and the USACE Technical Guidance for Military Munitions Response Actions, EM 200-1-15

(USACE, 2015). All recovered MD and other metallic cultural debris items would be moved to a central location inspected, certified as Material Documented as Safe (MDAS). MEC/MPPEH (determined as Material Documented as an Explosive Hazard [MDEH]) would be destroyed by detonation using Blow-in-Place (BIP) or consolidated detonation procedures. BIP is the destruction of MEC for which the risk of movement beyond immediate vicinity of discovery is not considered acceptable. Normally, this is accomplished by placing an explosive charge alongside the item. Waste streams generated from BIP operations may fall under further regulatory guidance with respect to treatment and/or final disposition. Consolidated Detonations are defined as the collection, configuration, and subsequent destruction by explosive detonation of MEC for which the risk of movement has been determined to be acceptable for transport to the MRS Safe Disposal Area (SDA). This option has an increased risk associated with handling and transporting live MEC, and requires oversight by specially trained UXO technicians or Explosive Ordnance Disposal (EOD) personnel and restricted access during detonation. EOD and other applicable organizations require notification of detonation activities. All MDAS would be transported from the site to an alternate offsite location for disposal/recycling.

- **Subsurface MEC/MPPEH Removal -** Removal of subsurface anomalies, potentially representing MEC/MPPEH, to a depth based on the anticipated penetration of suspected munitions or technology limitation. The most common digital detection technologies considered for detecting and mapping subsurface anomalies are electromagnetic induction sensors (e.g., Geonics EM61-MK2 [EM61]) and magnetometers (e.g., Geometrics G-858 Cesium Vapor Magnetometer [G-858]). The detection capabilities of magnetometers and electromagnetic induction sensors are not anticipated to be impacted by site geology or anthropogenic sources. This should be confirmed with use of Instrument Verification Strip (IVS)/Geophysical System Verification (GSV). Demolition operations of discovered MEC/MPPEH and disposal operations of MDAS would be performed within this response action as described for Surface MEC/MPPEH Removal.

4.2 Alternative Description

The following four RA alternatives were developed for the GR040 MRS by combining the GRAs summarized in **Section 4.1.1**:

1. Alternative 1 - No Action,
2. Alternative 2 - LUCs,
3. Alternative 3 - Surface Removal of MEC/MPPEH Combined with LUCs.
4. Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH

A description of each of these alternatives is provided below

4.2.1 Alternative 1 - No Action

The No Action alternative involves no action to be performed under current or future land-use scenarios. No RA would be performed at the site, and no institutional controls such as warning signs or land use restrictions are included in the No Action alternative. No cost would be associated with this alternative. This alternative is included as a baseline comparison for other alternatives.

4.2.2 Alternative 2 - Land Use Controls

The LUCs alternative includes engineering controls (e.g., fencing and warning signage) and institutional controls (e.g., administrative controls preventing access to the MRS). Based on the suspected presence of MEC/MPPEH at the MRSs, the sites' proximity to populated areas, and the relative ease of access for Holloman AFB personnel and residents, engineering controls including physical barriers and signage would be required. As part of this alternative, fencing would be placed along the perimeter of the site and along the road crossing through the MRS and frequent signage would be put in place. The fencing would be constructed of 7-ft high chain link topped with barbed wire and would be constructed to restrict access to entire site. Signs identifying the area as having a MEC hazard would be placed every 300 ft along the fence line. Intrusive work would be required during fence installation; therefore, MEC avoidance would be required. An estimated 1,498 linear ft of fence and 5 warning signs would be installed as part of this alternative. If Holloman AFB transfers the land associated with the MRSs to a non-Federal entity, then LUCs including restrictions and a description of hazards present at each MRS would need to be incorporated into any real property documents necessary for transferring ownership from Holloman AFB.

4.2.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs

This alternative includes 100 percent (%) coverage, instrument-aided removal of all visible MEC/MPPEH coupled with LUCs. The hand-held electromagnetic metal detectors would be utilized during this effort. The use of magnetic locators for surface clearance would not be warranted since munitions with nonferrous components are suspected to be present at the site. Some limited brush clearing would likely be required during the MEC/MPPEH surface clearance work; brush clearing would be performed using hand or powered tools such as machetes, brush hooks, or powered circular saw type weed cutters. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the guidance set forth in the DDESB-approved Explosives Safety Submission (ESS) developed for the MRS. Discovered MEC/MPPEH (determined as MDEH) would be detonated onsite, and all remaining MD and other metallic cultural debris items would be moved to a central location, certified as MDAS, and shipped to a recycling facility for disposal.

Composite surface soil samples would be collected at isolated locations of confirmed MEC/MPPEH and in areas of significant amounts of MD to determine the presence or absence of MC (explosives constituents and metals) contamination in site soils. The soil samples would be sent to an accredited laboratory and analyzed for metals and explosive constituents. The soil sampling results would be compared against approved basewide background values (NationView/Bhate JV III, LLC, 2012) and the more conservative of the NMED residential Soil Screening Levels (NMED, 2015) or USEPA residential Regional Screening Levels (USEPA, 2016) to determine whether MC contamination exists. In addition, MC soil sampling would be performed before and after BIPs and consolidated shots. It is estimated that approximately three (3) composite soil samples will be required.

LUCs would be implemented upon completion of surface MEC/MPPEH removal to minimize potential exposure to potential subsurface MEC/MPPEH and to increase public awareness of the historical use and the potential for encountering MEC/MPPEH. LUCs would be comprised of educational and awareness programs for Holloman AFB personnel, residents, and visitors that include but are not limited to:

- Notations of the suspected presence of subsurface MEC/MPPEH in the base Real Property records, in the Installation General Plan, and in the base GIS land management system (Geobase) as well as written materials designed to raise community understanding and awareness of the hazards associated with subsurface MEC.
- Notifications to contractors and utility workers.
- Signs that warn users of the former range they may encounter subsurface MEC in specified areas.
- Dig permits at Holloman AFB prohibiting digging without construction support by UXO personnel would remain in place.
- UXO construction support.

The warning signs would be placed every 300 ft along the perimeter of the MRS and along the road crossing through the MRS. Intrusive work would be required during sign installation; therefore, MEC avoidance would be required. An estimated 5 warning signs would be installed as part of this alternative.

4.2.4 Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH

This alternative includes 100% surface removal of MEC/MPPEH and removal of the following subsurface anomalies:

- Those that show characteristics of burial pits, and
- All individual geophysical anomalies above the site-specific threshold based on the MRS background noise determined by an IVS/GSV.

In no case would any excavations and removals exceed 10 feet. In addition, if perimeter anomalies are found or if intrusive investigation results indicate potential MEC/MPPEH presence beyond the boundaries of the MRS, FPM will extend surface clearance and Digital Geophysical Mapping (DGM) investigation to determine the extent of contamination.

The MRS would undergo a 100% surface clearance as outlined for **Alternative 3** and 100% DGM coverage using electromagnetic induction sensors (e.g., EM61s) coupled with a Real-Time Kinematic Global Positioning System. The suspected munition items at the GR940 MRS are grenades and flares. Grenades and flairs may be composed of or contain significant non-ferrous metal components. The presence of non-ferrous metal components in the items of interest makes electromagnetic induction (e.g., EM61) the most appropriate detection technology for the subsurface clearance.

All DGM anomalies identified for intrusive investigation would be removed using both manual removal techniques (e.g., shovels, hand equipment) and earth moving machinery. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the guidance set forth in the DDESB-approved ESS developed for the GR940 MRS. The excavated MEC for which the risk of movement beyond immediate vicinity of discovery is not considered acceptable would be BIP. MEC for which the risk of movement has been determined to be acceptable would be transported to the MRS SDA for demolition.

Composite surface and/or subsurface soil samples would be collected from isolated locations of confirmed MEC/MPPEH, in areas with significant amounts of MD, and before and after BIPs

and consolidated detonations to determine the presence or absence of MC contamination (metals and explosives constituents) as outlined for **Alternative 3**. It is estimated that approximately four (4) composite soil samples will be required.

In the event that MC contamination is identified, a risk assessment would be performed to determine if further RA is necessary. If the risk assessment determines that the concentrations of explosive constituents and/or metals in soil pose a significant threat to human health and/or the environment, then a removal of the contaminated soil would be conducted. Prior to removal, step-out sampling will be performed to identify the extent of contamination.

4.3 Evaluation Criteria

This section provides evaluation of four alternatives using the effectiveness, implementability, and cost criteria set forth in the NCP and the USEPA guidance for conducting EE/CAs (USEPA, 1993). The following sections provide a discussion of the pertinent evaluation criteria for each alternative.

Effectiveness

The effectiveness of a technology refers to its capability of removing the specific items in the volumes required, the degree to which the technology achieves the RAO, and the reliability and performance of the technology over time, including protection of human health and the environment, compliance with ARARs to the extent practical, long-term effectiveness and permanence, reduction in explosive safety hazard, and short-term effectiveness. As explained in **Section 3.3**, the RAO for the GR940 MRS is to implement measures that will minimize MEC hazards which may contain energetic materials that pose a potential explosive safety hazard to human health and the environment. Levels of effectiveness were assessed based upon the number of effectiveness criteria that would be satisfied by each alternative. Effectiveness criteria include: protection of human health, protection of workers during implementation, compliance with location and action- specific ARARs, short-term effectiveness, long-term effectiveness, and reduction in the toxicity, mobility, or volume (TMV) of contaminants.

Implementability

The ease of implementation of a technology refers to the availability of commercial services to support it, the constructability of the technology under specific site conditions, and the acceptability of the technology to the parties involved (regulators, public, owner, etc.), including technical feasibility, administrative feasibility, availability of services, support agency acceptance, and community acceptance. Levels of implementability were assessed based upon the number of implementability criteria satisfied by each alternative. Implementability criteria include: technical feasibility, administrative feasibility, and community and regulatory acceptance.

Cost

For the detailed cost analysis of alternatives, the expenditures required to complete each alternative were estimated in terms of capital costs and Post Removal Site Control (PRSC) cost. Capital costs include costs to complete initial RA activities. The PRSC costs include annual operation and maintenance for 30 years and periodic costs to perform Five-Year Reviews for 30 years. By combining the different costs associated with each alternative, a present-worth calculation for each alternative can be made for comparison. For the purposes of the cost estimate summaries (**Appendix A**), Remedial Action Cost Engineering and Requirements

(RACER) was utilized to develop alternative costs. RACER is an environmental remediation/corrective action cost-estimating system developed for DoD cost-estimating use.

4.4 Individual Analysis of Alternatives

4.4.1 Alternative 1 – No Action

Effectiveness

Alternative 1 provides no additional protection to human health and the environment. Potential MEC/MPPEH would remain onsite, which would potentially expose authorized personnel/workers, Base residents, and visitors to explosive safety hazards associated with MEC/MPPEH. In addition, this alternative would not protect the environment from future releases of explosive-related contaminants. No risk reduction will be accomplished through this alternative.

Action-specific ARARs do not apply to this alternative. Alternative 1 does not provide any short term effectiveness at the GR940 MRS as it does not limit or eliminate risks to human health and the environment. Alternative 1 does not provide any long-term effectiveness. Since no RA is performed for Alternative 1, there is no reduction in the TMV of contaminants.

Implementability

Alternative 1 is the No Action alternative; therefore, implementability does not apply. Alternative 1 is not protective of human and ecological receptors; therefore, it would not be accepted by regulators.

Cost

The total estimated cost for Alternative 1 is $0. There are no capital or PRSC costs, contingencies, or professional or technical services associated with this alternative.

4.4.2 Alternative 2 – Land Use Controls

Effectiveness

Alternative 2 provides a moderate level of protection to human health and the environment at the MRS. This alternative would reduce the explosive safety risk to humans by inhibiting access to MEC/MPPEH that would remain in place; however, engineering controls cannot eliminate the potential for human exposure because of intended or unintended breeches of the installed barrier. No potential environmental benefits are realized from this alternative because munitions items would remain in place.

As with any MEC site, Alternative 2 does have worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working in areas potentially containing live munitions. In this limited instances in which personnel obtain approval for a dig permit, any intrusive work performed at this site will be led by UXO personnel who will provide MEC avoidance support. Establishing the engineering controls (fencing and signage) would involve intrusive activities during installation, therefore the immediate area must be verified free of subsurface MEC/MPPEH by qualified UXO personnel prior to installation. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities.

MEC left in place does not conflict with the ability to comply with potential action- specific ARARs; therefore, Alternative 2 is in compliance with ARARs.

Alternative 2 is effective in the short term by providing physical barriers and signage for receptor access to restricted areas. Alternative 2 provides limited long-term effectiveness. Engineering controls cannot eliminate the long term risks to human health. Fencing and signage can be compromised by trespassers, and weather and the receptors would in turn have access to restricted areas. Alternative 2 does not include the removal of on-site MEC/MPPEH; therefore, the risk to human health is high if engineering controls are compromised. Long term and extensive operation and maintenance would be required to maintain fencing and signs in good repair.

Since no RA will be performed for Alternative 2, there will be no reduction in the TMV of contaminants.

Implementability

This alternative is technically feasible, administratively feasible, and services and materials necessary to implement the LUCs are readily available in the local community. This alternative is considered technically feasible because the action is achievable using readily available MEC avoidance support services and tools. This alternative is considered administratively feasible because there are no foreseeable obstacles to implement LUCs. There are no permits, waivers, easements, or right-of-way agreements necessary to install fence and warning signage for the MRS. All equipment, personnel, and services necessary to implement Alternative 2 are available in the vicinity of Holloman AFB.

Alternative 2 provides an adequate level of protection to human health as long as LUCs are enforced. Since this alternative will not address the removal of the hazard it is less likely that the regulators will accept this alternative.

Cost

The total estimated cost for Alternative 2 is $417,349 (**Appendix A**). Alternative 2 includes capital costs ($104,387) for developing and implementing LUCs including institutional restrictions and engineering controls. Engineering controls include installation of fencing and warning signs. PRSC costs associated with this alternative ($312,962) include annual operation and maintenance for 30 years and periodic costs to perform Five-Year Reviews for 30 years.

4.4.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs

Effectiveness

Alternative 3 provides the moderate level of protection to human health and the environment within the MRSs. Authorized and unauthorized personnel accessing the site would be protected from potential MEC/MPPEH items currently on the surface and the potential release of explosive related contamination will be reduced because the surface MEC/MPPEH items will be removed and disposed of, as necessary. An explosive hazard that may still exist in this area due to the potential presence of subsurface MEC/MPPEH would be addressed through LUCs.

Alternative 3 has worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with/around potentially live munitions. All personnel involved with the surface MEC/MPPEH removal would be qualified to work on a site contaminated with MEC/MPPEH and must have

documented proof of qualifications. All applicable safety requirements would be followed for handling, storage, and demolition/demilitarization. To protect both the site workers and visitors to the site (authorized and unauthorized), areas where the removal would take place would have exclusion zones established for explosive safety purposes. Only authorized personnel would be allowed in the exclusion zone during working hours, however, authorized visitors would be allowed in the exclusion zone under conditions specified in the DDESB-approved ESS. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities. The methodologies to safely perform these activities would be described in the Site-Specific NTCRA WP and the Health and Safety Plan (HASP).

For Alternative 3, surface MEC/MPPEH would be removed and destroyed and all activities conducted in a manner consistent with applicable ARARs.

Alternative 3 is effective in the short term by minimizing the explosive safety risk of MEC/MPPEH by permanently removing the items from the ground surface. The removal of MEC/MPPEH from the ground surface would eliminate exposure to potential receptors along that pathway. Long-term operation and maintenance would be required and periodic site inspections would need to be performed to identify and mitigate subsurface MEC/MPPEH that become exposed at the surface.

Alternative 3 provides reduction of TMV since the MEC/MPPEH that are encountered during the NTCRA will be detonated (thermal treatment) either at MEC find locations (BIP) if it is not safe to move the MEC, or at SDA if MEC items can be moved safely. Additional residuals include trace amounts of metals and potential residual explosive constituents that may remain in the soil. An evaluation of the concentrations of these residuals following a MEC detonation would be performed.

Implementability

Alternative 3 employs technologies that have been used in full-scale applications; therefore, it is technically and administratively feasible. MEC/MPPEH removal support services and tools are readily available through a number of commercial contractors.

Alternative 3 provides the moderate level of protection to human health and the environment among the four alternatives. MEC/MPPEH currently on the surface would be removed and disposed of, as necessary, and the remaining subsurface MEC/MPPEH would be addressed through LUCs. However, since this MRS is fairly small (3.16 acres), a subsurface clearance of the site would be cost-effective and would remove the need for LUCs and their maintenance for 30 years. Therefore, it is less likely that the regulators will accept this alternative.

Cost

The total estimated cost for Alternative 3 is $393,976 (**Appendix A**). Alternative 2 includes capital costs ($81,014) for demolition of surface MEC/MPPEH, and offsite disposal of MDAS, developing and implementing LUCs including institutional restrictions and engineering controls. Engineering controls include installation of warning signs. PRSC costs associated with this alternative ($312,962) include annual operation and maintenance for 30 years and periodic costs to perform surface sweeps of the 10% of the MRS every five years, and Five-Year Reviews for 30 years.

4.4.4 Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH

Effectiveness

Alternative 4 provides the highest level of protection to human health and the environment within the GR940 MRS. Authorized and unauthorized personnel accessing the site would be protected from MEC/MPPEH items currently on the surface/subsurface and the potential release of explosive related contamination will be minimized because the surface and subsurface MEC/MPPEH items will be removed and disposed of.

Alternative 4 has worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with/around potentially live munitions. All personnel involved with the MEC/MPPEH removal would be qualified to work on a site contaminated with MEC/MPPEH and would have documented proof of qualifications. All applicable safety requirements would be followed for handling, storage, and demolition/demilitarization. To protect both the site workers and visitors to the site (authorized and unauthorized), areas where the removal is taking place would have exclusion zones established for explosive safety purposes. Only authorized personnel would be allowed in the exclusion zone during the working hours, however, authorized visitors would be allowed in the exclusion zone under conditions specified in the DDESB-approved ESS. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities. The methodologies to safely perform these activities would be described in the Site-Specific NTCRA WP and the HASP.

For Alternative 4, surface and subsurface MEC/MPPEH would be removed and destroyed and all activities conducted in a manner consistent with applicable ARARs.

Alternative 4 is effective in both the short and long term by minimizing the explosive safety risk of MEC/MPPEH by permanently removing the items from the ground surface and subsurface.

Alternative 4 provides reduction of TMV since the MEC/MPPEH that are encountered during the NTCRA will be either BIP or transported to the MRS SDA for demolition. Additional residuals include trace amounts of metals and potential residual explosives. An evaluation of the concentrations of these residuals will be performed.

Implementability

The removal of surface and subsurface MEC/MPPEH from the GR940 MRS is technically and administratively implementable. MEC removal support services and tools are readily available through a number of commercial contractors.

Alternative 4 provides the highest level of protection to human health and the environment among the four alternatives and will result in the site closeout and unrestricted land use at GR940. Therefore, the regulatory agencies are likely to consider the Alternative 4 as the most acceptable alternative at the GR940 MRS.

Cost

The total estimated cost for Alternative 4 is $237,144 (**Appendix A**). Alternative 4 includes capital costs ($237,144) for performing surface clearance across 3.16 acres, 100% DGM coverage of the site, excavation of all anomalies above the established threshold, demolition of MEC, and offsite disposal of MDAS. Since this alternative will result in site closeout, no PRSC costs are associated with this alternative.

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

This section presents a comparative analysis of RA alternatives for the GR940 MRS. In order to rank the alternatives, each alternative was ranked numerically from 1 to 3 for each criterion. The No Action alternative was rated as Not Protective, and therefore, was not carried forward for comparison purposes. The alternative that was determined to be the best alternative when assessed with the criterion, received a numerical ranking of 1. The second best alternative received a numerical ranking of 2, and so forth. Once the numerical ranking was determined for the three criteria (effectiveness, implementability, and cost) the overall score was determined by adding up the individual numerical rankings for each alternative. An alternative ranked "3" for effectiveness, "1" for implementability, and "3" for cost would have an overall score of "7". The overall scores were used to arrange the alternatives in rank order, with the lowest score being ranked the highest.

5.1 Effectiveness

Table 5-1 provides the ranking of effectiveness criteria of the four alternatives. Alternative 1 does not achieve the RAO. Alternatives 2, 3, and 4 have been developed because they were able to achieve RAO identified in **Section 3.3**. If the RAO is achieved, then human health and the environment are protected. Workers can be protected during implementation of Alternatives 2, 3, and 4 using standard personal protective equipment and MEC detecting devices and procedures. The explosive safety risk to the human health will be minimized through the removal of MEC contamination, which, if left in place, could also potentially serve as a source of chemical environmental contamination. Alternative 2 is less protective of human health and the environment than Alternatives 3 and 4 because no MEC/MPPEH is removed from the site. Alternative 3 is protective of human health and the environment than Alternatives 2 because it directly addresses the explosive hazard through removing MEC/MPPEH from the surface of the site but Alternative 3 does not address subsurface MEC/MPPEH. Alternative 4 is more protective of the human health and the environment than Alternatives 2 and 3 because it directly addresses the explosive hazard through removing MEC/MPPEH from both the surface and subsurface of the site.

All three alternatives can comply with the action-specific ARARs, which apply to the implementation of the alternatives. The surface and subsurface RA will adhere to all applicable regulations regarding environmentally sensitive locations, excavations, detonations, and explosives transportation, use, and storage. Therefore, surface and subsurface removal meets more ARARs than a surface removal or LUCs. Surface removal meets more ARARs than LUCs.

For the short term effectiveness, the LUCs alternative is ranked best because it reduces risk upon implementation, requires little time to implement, and has minimal adverse effects on the public and the environment. The surface removal alternative is ranked second best as it reduces risk upon implementation, requires less time and effort to implement than surface and subsurface removal, and results in few public and environmental impacts. The surface and subsurface removal alternative is ranked third because it requires more planning and has more of an impact on the environment.

For the long-term effectiveness, the surface and subsurface removal alternative is ranked best because it would eliminate any buried MEC/MPPEH in the area. For the same reason Alternative 4 is ranked best for the reduction of TMV.

As shown in **Table 5-1**, Alternative 4 is ranked best in terms of effectiveness.

Table 5-1 Effectiveness Criteria Evaluation GR940 MRS

Alternative	Protection of Human Health	Protection of Workers	Compliance with ARARs	Short-Term	Long-Term	Reduction of TMV	Overall Score	Rank
Alternative 1 No Action	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 2 LUCs	3	1	3	1	3	3	14	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	2	2	2	2	2	12	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	3	1	3	1	1	10	**1**

5.2 Implementability

All of the alternatives are technically and administratively feasible. Implementing Alternative 2 would be easier than implementing Alternative 3, from both an administrative and a technical feasibility perspective. In addition, Alternative 2 could be accomplished in a relatively shorter length of time than that required to implement Alternative 3.

From technical and administrative perspectives, implementation of a subsurface removal is the least feasible. Unlike surface removal, a subsurface removal requires excavation equipment (in addition to specially trained and qualified personnel and a means of MEC disposal, which is required for all RAs). WPs and removal reports are more difficult to document. The subsurface removal alternative generally requires more logistical and management support than the surface removal alternative and it would take more time and effort to implement than surface removal.

Considering the high MEC/MPPEH risk level, it was determined that the regulatory agencies and community are likely to consider Alternative 4 – Surface and Subsurface removal of MEC/MPPEH as the most acceptable alternative for this MRS. Therefore, the subsurface removal alternative is ranked best in terms of state agency and community acceptance. Surface removal is ranked second, as state agencies and community are likely to be less enthusiastic about a clearance that does not address subsurface risks. LUCs are ranked third, as state agencies and community are likely to prefer a response action that addresses removal of the hazards.

As shown in **Table 5-2,** all three alternatives have the same rank in terms of implementability.

Table 5-2 Implementability Criteria Evaluation GR940 MRS

Alternative	Technical Feasibility	Admin Feasibility	Regulatory Acceptance	Community Acceptance	Overall Score	Rank
Alternative 1 No Action	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 2 LUCs	1	1	3	3	8	**1**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	2	2	2	8	**1**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	3	3	1	1	8	**1**

5.3 Cost

The costs to perform each of the alternatives are summarized in **Table 5-3**. The detailed cost breakdown for each alternative is provided in **Appendix A**.

5.4 Overall Ranking of Alternatives

The overall ranking of the different alternatives in terms of their effectiveness, implementability, and cost for the GR940 MRS is presented as **Table 5-4**. Alternative 4 has the best overall ranking and is the recommended alternative for the MRS.

Table 5-3 Cost Criteria Evaluation GR940 MRS

Alternative	Total Project Duration (Years)	Capital Cost	Total O&M Cost	Total Present Cost of Alternative	Rank
Alternative 1 No Action	N/A	N/A	N/A	N/A	N/A
Alternative 2 LUCs	30	$104,387	$312,962	$417,349	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	30	$81,014	$312,962	$393,976	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	$237,144	$0	$237,144	**1**

Table 5-4 Alternatives Evaluation GR940 MRS

Alternative	Effectiveness Rank	Implementability Rank	Cost Rank	Overall Score	Overall Rank
Alternative 1 No Action	N/A	N/A	N/A	N/A	N/A
Alternative 2 LUCs	3	1	3	6	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	1	2	6	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	1	1	3	**1**

6.0 RECOMMENDATIONS

This EE/CA presents the selected RA alternative for the MEC/MPPEH hazards at the GR940 MRS at Holloman AFB in Otero County, New Mexico, developed IAW CERCLA as amended and consistent with the NCP. This recommendation is based on the information gathered during the previous investigations completed at the site and included in the Administrative Record for the site. The action recommended for this site is Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH, which will achieve the RAO with a higher certainty of success and is consistent with what is anticipated to be the overall final remedy for the site. This alternative addresses the explosive safety issues associated with MEC/MPPEH, while the other alternatives leave them in place with no means to mitigate the hazard. Additionally, Alternative 4 provides the greatest protection of human health and the environment and long term effectiveness. Implementation of this alternative will allow for site closeout which means that no restrictions on future land use are needed at the site and no further restoration funds are required to be expended at the MRS. Conditions at the site meet the USEPA 40 CFR § 300.415(b)(2)(vi) - threat of fire or explosion - criterion for initiating a removal action. The total project cost for the MRS, if approved, is estimated to be $237,144 with no PRSC costs.

6.1 Public Participation

Following completion of the EE/CA, community relations and administrative record activities necessary for all RAs will be performed.

According to Section 300.415(m) of the NCP, the Lead Agency (USAF) will conduct the following community relations activities:

- Designate a community relations spokesperson,
- Place all site documents that are available to the public in the information repository at Holloman AFB,
- Conduct community interviews,
- Prepare Community Relations Plan, and
- Issue public notice in the Alamogordo Daily News of availability of the EE/CA.

According to Section 300.820 of the NCP, the Lead Agency will conduct the following administrative record requirements:

- Place the following documents in the administrative record file: documents containing factual information, data and analysis of the factual information, and data that may form a basis for the selection of a response action an at this site are placed into the administrative record for Holloman AFB,
- Publish public notice of the availability of the administrative record file,
- Hold a public comment period,
- Develop written responses to significant public comments, and
- Complete the administrative record file after selecting the response.

Written responses to significant comments will be summarized in an Action Memorandum and will be included in the Administrative Record.

6.2 Removal Action Schedule

The general completion time frames for activities associated with the NTCRA at the GR940 MRS are summarized in **Table 6-1**.

Table 6-1 Removal Action Schedule

EE/CA (preparation, review, and approval)	June 2015 to July 2016
Action Memorandum (with public comment period)	July 2016 to November 2016
ESS	Final DDESB approved ESS currently in place
NTCRA WP (preparation, review, and approval)	November 2017 to April 2017
Fieldwork	May 2017
After Action Report	June 2017 to October 2017

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Appendix A
Remedial Action Alternatives Cost Estimates

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Alternative 1
No Action

There is no cost associated with Alternative 1.

Alternative 2
Land Use Controls

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

Phase Cost Detail Report
(with Markups)

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: FPM
Estimator Title: FPM
Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com

Phase Cost Detail Report
(with Markups)

Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Cost Detail Report
(with Markups)

Phase Documentation:

Phase Type: Long Term Monitoring
Phase Name: Alt 2
Description: LUC/ICs and engineering controls

Approach: Ex Situ
Start Date: June, 2016
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	True	100	0
MEC Institutional Controls	True	100	0

Total Marked-up Cost: $336,481.35

Technologies:

Phase (Markup Template)	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
Alt 2	$162,249							$174,232	$336,481
(System Defaults)		$0	$0	$118,432	$22,455	$0	$33,345		

Phase Cost Detail Report
(with Markups)

Total Phase Cost	$162,249	$0	$0	$118,432	$22,455	$0	$33,345	$174,232	$336,481
						Escalation			$80,867
						Total Phase Cost			$417,349

	Direct Cost	Markups	Escalation	Total
Total Phase Cost	$162,249	$174,232	$80,867	$417,349

Markup Templates

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

Phase Cost Over Time Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

Phase Cost Over Time Report
(with Markups)

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: FPM
Estimator Title: FPM
Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com

Phase Cost Over Time Report
(with Markups)

Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2016	2017	2018	2019	2020	2021
MEC Institutional Controls	1	$104,387	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$112,123	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.0000	1.0180	1.0373	1.0581	1.0793	1.1008
Escalated Site Cost		$112,123	$7,876	$8,025	$8,186	$8,350	$8,516

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2022	2023	2024	2025	2026	2027
MEC Institutional Controls	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.1229	1.1453	1.1682	1.1916	1.2154	1.2397
Escalated Site Cost		$8,687	$8,861	$9,038	$9,219	$9,403	$9,591

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2028	2029	2030	2031	2032	2033
MEC Institutional Controls	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.2645	1.2898	1.3156	1.3419	1.3688	1.3961
Escalated Site Cost		$9,783	$9,979	$10,178	$10,382	$10,590	$10,801

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2034	2035	2036	2037	2038	2039
MEC Institutional Controls	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.4240	1.4525	1.4816	1.5112	1.5414	1.5723
Escalated Site Cost		$11,017	$11,237	$11,462	$11,691	$11,925	$12,164

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2040	2041	2042	2043	2044	2045
MEC Institutional Controls	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.6037	1.6358	1.6685	1.7019	1.7359	1.7706
Escalated Site Cost		$12,407	$12,655	$12,908	$13,167	$13,430	$13,698

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	Total
MEC Institutional Controls	1	$104,387
ADMINISTRATIVE LAND USE CONTROLS	2	$232,095
Total Phase Cost		$336,481
Escalation Factor		
Escalated Site Cost		$417,349

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: FPM
Estimator Title: FPM

Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Documentation:

Phase Type: Long Term Monitoring
Phase Name: Alt 2
Description: LUC/ICs and engineering controls

Approach: Ex Situ
Start Date: June, 2016
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	True	100	0
MEC Institutional Controls	True	100	0

Total Marked-up Cost: $336,481.35

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010104	Sample collection, vehicle mileage charge, car or van	0.00	MI	0.00	0.00	0.00	0.56	$0.00	True

Technology: ADMINISTRATIVE LAND USE CONTROLS

33010202	Per Diem (per person)	0.00	DAY	0.00	0.00	0.00	129.00	$0.00	True
33022038	Overnight delivery service, 1 lb package	0.00	LB	0.00	0.00	0.00	62.19	$0.00	False
33040934	UXO Technician II	8.00	HR	0.00	89.03	0.00	0.00	$712.23	False
33220102	Project Manager	1.00	HR	0.00	258.21	0.00	0.00	$258.21	False
33220106	Staff Engineer	24.00	HR	0.00	234.80	0.00	0.00	$5,635.16	False
33220110	QA/QC Officer	2.00	HR	0.00	150.99	0.00	0.00	$301.98	False
33220114	Word Processing/Clerical	2.00	HR	0.00	120.83	0.00	0.00	$241.67	False
33220115	Draftsman/CADD	2.00	HR	0.00	154.91	0.00	0.00	$309.82	False
33220119	Health and Safety Officer	0.00	HR	0.00	194.72	0.00	0.00	$0.00	False
33240101	Other Direct Costs	1.00	LS	277.43	0.00	0.00	0.00	$277.43	True

Total Element Cost: $7,736.49

Total 1st Year Tech Cost: $7,736.49

Technology: MEC Institutional Controls

Element: Engineering Controls

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
18040108	7' Galvanized Chain-link Fence	1,497.00	LF	63.79	4.04	0.96	0.00	$102,980.04	False
18040501	Hazardous Waste Signing	15.00	EA	51.18	42.59	0.00	0.00	$1,406.62	False

Total Element Cost: $104,386.65

Total 1st Year Tech Cost:	$104,386.65
Total Phase Element Cost	**$112,123.14**

Alternative 3
Surface Removal of MEC/MPPEH with LUCs

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

Phase Cost Detail Report
(with Markups)

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: FPM
Estimator Title: FPM
Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com

Phase Cost Detail Report
(with Markups)

Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Cost Detail Report
(with Markups)

Phase Documentation:

Phase Type: Remedial Action
Phase Name: Alt 3
Description: FPM

Approach: Ex Situ
Start Date: June, 2016
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	True	100	0
MEC Removal Action	True	100	0

Total Marked-up Cost: $313,108.74

Technologies:

Phase (Markup Template)	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
Alt 3	$153,442							$159,666	$313,109
(System Defaults)		$0	$0	$110,461	$19,801	$0	$29,404		

Phase Cost Detail Report
(with Markups)

Total Phase Cost	$153,442	$0	$0	$110,461	$19,801	$0	$29,404	$159,666	$313,109
						Escalation			$80,867
						Total Phase Cost			$393,976

	Direct Cost	Markups	Escalation	Total
Total Phase Cost	$153,442	$159,666	$80,867	$393,976

Markup Templates

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

Phase Cost Over Time Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

Phase Cost Over Time Report
(with Markups)

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

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Estimator Title: FPM
Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com

Phase Cost Over Time Report
(with Markups)

Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2016	2017	2018	2019	2020	2021
MEC Removal Action	1	$81,014	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$88,751	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.0000	1.0180	1.0373	1.0581	1.0793	1.1008
Escalated Site Cost		$88,751	$7,876	$8,025	$8,186	$8,350	$8,516

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2022	2023	2024	2025	2026	2027
MEC Removal Action	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.1229	1.1453	1.1682	1.1916	1.2154	1.2397
Escalated Site Cost		$8,687	$8,861	$9,038	$9,219	$9,403	$9,591

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2028	2029	2030	2031	2032	2033
MEC Removal Action	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.2645	1.2898	1.3156	1.3419	1.3688	1.3961
Escalated Site Cost		$9,783	$9,979	$10,178	$10,382	$10,590	$10,801

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2034	2035	2036	2037	2038	2039
MEC Removal Action	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.4240	1.4525	1.4816	1.5112	1.5414	1.5723
Escalated Site Cost		$11,017	$11,237	$11,462	$11,691	$11,925	$12,164

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2040	2041	2042	2043	2044	2045
MEC Removal Action	1	$0	$0	$0	$0	$0	$0
ADMINISTRATIVE LAND USE CONTROLS	2	$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Total Phase Cost		$7,736	$7,736	$7,736	$7,736	$7,736	$7,736
Escalation Factor		1.6037	1.6358	1.6685	1.7019	1.7359	1.7706
Escalated Site Cost		$12,407	$12,655	$12,908	$13,167	$13,430	$13,698

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	Total
MEC Removal Action	1	$81,014
ADMINISTRATIVE LAND USE CONTROLS	2	$232,095
Total Phase Cost		$313,109
Escalation Factor		
Escalated Site Cost		$393,976

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- ☐ **Pre-Study**
- ☑ **Study**
- ☐ **Design**
- ☐ **Removal/Interim Action**
- ☑ **Remedial Action**
- ☑ **Operations & Maintenance**
- ☑ **Long Term Monitoring**
- ☐ **Site Closeout**

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

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Estimator Title: FPM

Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Documentation:

Phase Type: Remedial Action
Phase Name: Alt 3
Description: FPM

Approach: Ex Situ
Start Date: June, 2016
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	True	100	0
MEC Removal Action	True	100	0

Total Marked-up Cost: $313,108.74

Technologies:

Technology: ADMINISTRATIVE LAND USE CONTROLS

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010104	Sample collection, vehicle mileage charge, car or van	0.00	MI	0.00	0.00	0.00	0.56	$0.00	True

Technology: ADMINISTRATIVE LAND USE CONTROLS

33010202	Per Diem (per person)	0.00	DAY	0.00	0.00	0.00	129.00	$0.00	True
33022038	Overnight delivery service, 1 lb package	0.00	LB	0.00	0.00	0.00	62.19	$0.00	False
33040934	UXO Technician II	8.00	HR	0.00	89.03	0.00	0.00	$712.23	False
33220102	Project Manager	1.00	HR	0.00	258.21	0.00	0.00	$258.21	False
33220106	Staff Engineer	24.00	HR	0.00	234.80	0.00	0.00	$5,635.16	False
33220110	QA/QC Officer	2.00	HR	0.00	150.99	0.00	0.00	$301.98	False
33220114	Word Processing/Clerical	2.00	HR	0.00	120.83	0.00	0.00	$241.67	False
33220115	Draftsman/CADD	2.00	HR	0.00	154.91	0.00	0.00	$309.82	False
33220119	Health and Safety Officer	0.00	HR	0.00	194.72	0.00	0.00	$0.00	False
33240101	Other Direct Costs	1.00	LS	277.43	0.00	0.00	0.00	$277.43	True

Total Element Cost: $7,736.49

Total 1st Year Tech Cost: $7,736.49

Technology: MEC Removal Action

Element: Site Visit

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33041301	Munitions Response Workplan (Low Complexity)	1.00	EA	119.88	14,331.29	0.00	0.00	$14,451.17	False

Total Element Cost: $14,451.17

Technology: MEC Removal Action

Element: Surveying

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	129.00	$387.00	True
33040673	GPS, Real Time Kinematic Survey Grade, Weekly Rental	1.00	WK	0.00	0.00	0.00	2,335.05	$2,335.05	False
33040934	UXO Technician II	20.00	HR	0.00	89.03	0.00	0.00	$1,780.57	False
33041101	Airfare	2.00	LS	0.00	0.00	0.00	500.00	$1,000.00	True
33220213	Surveying - 3-man Crew	1.00	DAY	0.00	1,592.82	19.94	0.00	$1,612.76	False
33240101	Other Direct Costs	1.00	LS	0.00	0.00	0.00	201.37	$201.37	True

Total Element Cost: $7,316.75

Element: Vegetation Removal

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
17010401	Chipping brush, light brush	1.20	ACR	0.00	1,417.01	500.24	0.00	$2,300.70	False
33010114	Mobilization Equipment (Soils)	1.00	LS	0.00	2,330.72	2,760.92	0.00	$5,091.64	False
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	129.00	$387.00	True
33040934	UXO Technician II	10.00	HR	0.00	89.03	0.00	0.00	$890.28	False
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	104.33	0.00	0.00	$1,043.29	False
33041101	Airfare	2.00	LS	0.00	0.00	0.00	500.00	$1,000.00	True

Total Element Cost: $10,712.92

Element: UXO Mapping - Land

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010108	Sedan, Automobile, Rental	6.00	DAY	0.00	0.00	0.00	56.69	$340.16	False
33010202	Per Diem (per person)	30.00	DAY	0.00	0.00	0.00	129.00	$3,870.00	True
33021620	Testing, TAL metals (6010/7000s)	4.00	EA	0.00	0.00	0.00	204.43	$817.71	False
33040149	Nonsparking UXO Shovels	2.00	EA	118.27	0.00	0.00	0.00	$236.53	False
33040210	Geonics EM-61 Metal Locator, Towed (Weekly Rental)	1.00	WK	0.00	0.00	0.00	1,040.82	$1,040.82	False
33040211	Geonics EM-61 Mark II Metal Locator, Towed Rental Prep Fee	1.00	WK	0.00	0.00	0.00	143.60	$143.60	False
33040230	Geonics EM-61 Metal Locator, Hand Held (Weekly Rental)	1.00	WK	0.00	0.00	0.00	889.63	$889.63	False
33040267	Schonstedt GA-52Cx Daily Rental	6.00	DAY	0.00	0.00	0.00	30.62	$183.72	False
33040651	4 X 4 Truck- Rental/Lease	12.00	DAY	0.00	0.00	121.14	0.00	$1,453.63	False
33040653	All Terrain Vehicle (ATV) - Rental/Lease	2.00	DAY	0.00	0.00	0.00	178.02	$356.04	False
33040672	GPS, Real Time Kinematic Survey Grade, Daily Rental	2.00	DAY	0.00	0.00	0.00	538.52	$1,077.03	False
33040695	GPS, Hand Held Mapping Grade, Weekly Rental with External Antenna	1.00	WK	0.00	0.00	0.00	626.04	$626.04	False
33040933	UXO Technician I	30.00	HR	0.00	75.42	0.00	0.00	$2,262.61	False
33040934	UXO Technician II	76.00	HR	0.00	89.03	0.00	0.00	$6,766.16	False
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	104.33	0.00	0.00	$1,043.29	False

Technology: MEC Removal Action

33040936	Geophysicist (UXO)	64.00	HR	0.00	166.40	0.00	0.00	$10,649.82	False
33040937	Geophysical Instrument Operator (UXO)	10.00	HR	0.00	89.03	0.00	0.00	$890.28	False
33041101	Airfare	13.00	LS	0.00	0.00	0.00	750.00	$9,750.00	True
33220212	Surveying - 2-man Crew	1.00	DAY	0.00	1,055.31	19.94	0.00	$1,075.25	False
33240101	Other Direct Costs	1.00	LS	5,060.85	0.00	0.00	0.00	$5,060.85	True

Total Element Cost:	$48,533.19
Total 1st Year Tech Cost:	$81,014.04
Total Phase Element Cost	**$88,750.53**

Alternative 4
Subsurface Removal of MEC/MPPEH

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

Phase Cost Detail Report
(with Markups)

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: FPM
Estimator Title: FPM
Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com

Phase Cost Detail Report
(with Markups)

Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Cost Detail Report
(with Markups)

Phase Documentation:

Phase Type: Remedial Action
Phase Name: Alt 4
Description: FPM

Approach: Ex Situ
Start Date: June, 2016
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Removal Action	True	100	0
Feasibility Study	True	100	0

Total Marked-up Cost: $200,892.96

Technologies:

Phase (Markup Template)	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
Alt 4	$113,426							$87,467	$200,893
(System Defaults)		$0	$0	$56,871	$12,312	$0	$18,284		

Phase Cost Detail Report
(with Markups)

Total Phase Cost	$113,426	$0	$0	$56,871	$12,312	$0	$18,284	$87,467	$200,893
						Escalation			$0
						Total Phase Cost			$200,893

	Direct Cost	Markups	Escalation	Total
Total Phase Cost	$113,426	$87,467	$0	$200,893

Markup Templates

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

Phase Cost Over Time Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

Phase Cost Over Time Report
(with Markups)

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- **Pre-Study** ☐
- **Study** ☑
- **Design** ☐
- **Removal/Interim Action** ☐
- **Remedial Action** ☑
- **Operations & Maintenance** ☑
- **Long Term Monitoring** ☑
- **Site Closeout** ☐

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: FPM
Estimator Title: FPM
Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com

Phase Cost Over Time Report
(with Markups)

Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Cost Over Time Report
(with Markups)

Technology Name	Technology	2016	Total
Feasibility Study	1	$90,074	$90,074
MEC Removal Action	1	$110,819	$110,819
Total Phase Cost		$200,893	$200,893
Escalation Factor		1.0000	
Escalated Site Cost		$200,893	$200,893

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: RACER® Version 11.3.18.0
Database Location: C:\Users\Daniel\Documents\RACER 11.3\Racer.mdb

Folder:

Folder Name: New Folder

Project:

ID: NM-AZ EECAs and FSs
Name: NM-AZ EECAs and FSs
Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User	Reason for changes
	0.990	0.990	

Options
Database: System Costs
Cost Database Date: 2016
Report Option: Fiscal

Description Cost Estimates to add to NM-AZ EECAs and FSs

Site:

ID: GR940
Name: GR940
Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Metals
Secondary: None

Phase Names

- ☐ **Pre-Study**
- ☑ **Study**
- ☐ **Design**
- ☐ **Removal/Interim Action**
- ☑ **Remedial Action**
- ☑ **Operations & Maintenance**
- ☑ **Long Term Monitoring**
- ☐ **Site Closeout**

Documentation

Description: EE/CA estimates
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
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Estimator Title: FPM

Agency/Org./Office: FPM
Business Address: FPM
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 06/14/2016

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed: 06/14/2016

Reviewer Signature: _____ **Date:** _____

Phase Documentation:

Phase Type: Remedial Action
Phase Name: Alt 4
Description: FPM

Approach: Ex Situ
Start Date: June, 2016
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Removal Action	True	100	0
Feasibility Study	True	100	0

Total Marked-up Cost: $200,892.96

Technologies:

Technology: MEC Removal Action

Element: Site Visit

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33041301	Munitions Response Workplan (Low Complexity)	1.00	EA	119.88	14,331.29	0.00	0.00	$14,451.17	False

Technology: MEC Removal Action

33041304	Explosive Safety Submission (Low Complexity)	1.00	EA	239.76	24,218.89	0.00	0.00	$24,458.65	False

Total Element Cost: $38,909.82

Element: Surveying

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	129.00	$387.00	True
33040673	GPS, Real Time Kinematic Survey Grade, Weekly Rental	1.00	WK	0.00	0.00	0.00	2,335.05	$2,335.05	False
33040934	UXO Technician II	20.00	HR	0.00	89.03	0.00	0.00	$1,780.57	False
33041101	Airfare	2.00	LS	0.00	0.00	0.00	500.00	$1,000.00	True
33220213	Surveying - 3-man Crew	1.00	DAY	0.00	1,592.82	19.94	0.00	$1,612.76	False
33240101	Other Direct Costs	1.00	LS	0.00	0.00	0.00	201.37	$201.37	True

Total Element Cost: $7,316.75

Element: Vegetation Removal

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
17010401	Chipping brush, light brush	1.20	ACR	0.00	1,417.01	500.24	0.00	$2,300.70	False
33010114	Mobilization Equipment (Soils)	1.00	LS	0.00	2,330.72	2,760.92	0.00	$5,091.64	False
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	129.00	$387.00	True
33040934	UXO Technician II	10.00	HR	0.00	89.03	0.00	0.00	$890.28	False

Technology: MEC Removal Action

33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	104.33	0.00	0.00	$1,043.29	False
33041101	Airfare	2.00	LS	0.00	0.00	0.00	500.00	$1,000.00	True

Total Element Cost: $10,712.92

Element: UXO Mapping - Land

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010108	Sedan, Automobile, Rental	6.00	DAY	0.00	0.00	0.00	56.69	$340.16	False
33010202	Per Diem (per person)	30.00	DAY	0.00	0.00	0.00	129.00	$3,870.00	True
33021620	Testing, TAL metals (6010/7000s)	4.00	EA	0.00	0.00	0.00	204.43	$817.71	False
33040149	Nonsparking UXO Shovels	2.00	EA	118.27	0.00	0.00	0.00	$236.53	False
33040210	Geonics EM-61 Metal Locator, Towed (Weekly Rental)	1.00	WK	0.00	0.00	0.00	1,040.82	$1,040.82	False
33040211	Geonics EM-61 Mark II Metal Locator, Towed Rental Prep Fee	1.00	WK	0.00	0.00	0.00	143.60	$143.60	False
33040230	Geonics EM-61 Metal Locator, Hand Held (Weekly Rental)	1.00	WK	0.00	0.00	0.00	889.63	$889.63	False
33040267	Schonstedt GA-52Cx Daily Rental	6.00	DAY	0.00	0.00	0.00	30.62	$183.72	False
33040651	4 X 4 Truck- Rental/Lease	12.00	DAY	0.00	0.00	121.14	0.00	$1,453.63	False
33040653	All Terrain Vehicle (ATV) - Rental/Lease	2.00	DAY	0.00	0.00	0.00	178.02	$356.04	False
33040672	GPS, Real Time Kinematic Survey Grade, Daily Rental	2.00	DAY	0.00	0.00	0.00	538.52	$1,077.03	False
33040695	GPS, Hand Held Mapping Grade, Weekly Rental with External	1.00	WK	0.00	0.00	0.00	626.04	$626.04	False

Technology: MEC Removal Action

	Antenna								
33040933	UXO Technician I	30.00	HR	0.00	75.42	0.00	0.00	$2,262.61	False
33040934	UXO Technician II	76.00	HR	0.00	89.03	0.00	0.00	$6,766.16	False
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	104.33	0.00	0.00	$1,043.29	False
33040936	Geophysicist (UXO)	64.00	HR	0.00	166.40	0.00	0.00	$10,649.82	False
33040937	Geophysical Instrument Operator (UXO)	10.00	HR	0.00	89.03	0.00	0.00	$890.28	False
33041101	Airfare	13.00	LS	0.00	0.00	0.00	750.00	$9,750.00	True
33220212	Surveying - 2-man Crew	1.00	DAY	0.00	1,055.31	19.94	0.00	$1,075.25	False
33240101	Other Direct Costs	1.00	LS	5,060.85	0.00	0.00	0.00	$5,060.85	True

Total Element Cost: $48,533.19

Element: UXO Removal - Land

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33010115	Demobilize Equipment (Soils)	1.00	LS	0.00	2,330.72	2,760.92	0.00	$5,091.64	False
33240101	Other Direct Costs	1.00	LS	254.58	0.00	0.00	0.00	$254.58	True

Total Element Cost: $5,346.22

Total 1st Year Tech Cost: $110,818.91

Technology: Feasibility Study

Technology: Feasibility Study

Element: Feasibility Report / Record of Decision

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Cost	Extended Cost	Cost Override
33220102	Project Manager	35.00	HR	0.00	258.21	0.00	0.00	$9,037.50	False
33220103	Office Manager	21.00	HR	0.00	213.87	0.00	0.00	$4,491.24	False
33220105	Project Engineer	87.00	HR	0.00	278.28	0.00	0.00	$24,209.93	False
33220106	Staff Engineer	109.00	HR	0.00	234.80	0.00	0.00	$25,593.00	False
33220108	Project Scientist	60.00	HR	0.00	280.29	0.00	0.00	$16,817.31	False
33220110	QA/QC Officer	13.00	HR	0.00	184.13	0.00	0.00	$2,393.74	False
33220114	Word Processing/Clerical	45.00	HR	0.00	120.83	0.00	0.00	$5,437.57	False
33220115	Draftsman/CADD	6.00	HR	0.00	188.91	0.00	0.00	$1,133.47	False
33240101	Other Direct Costs	1.00	LS	960.28	0.00	0.00	0.00	$960.28	True

Total Element Cost:	$90,074.05
Total 1st Year Tech Cost:	$90,074.05
Total Phase Element Cost	**$200,892.96**

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