

FINAL FEASIBILITY STUDY

**Remedial Investigation/Feasibility Study
Fort Hancock Formerly Used Defense Site
Monmouth County, New Jersey**

Contract: W912QR-12-D-0011, Delivery Order DA01 and DA02

Prepared for:

**U.S. Army Corps of Engineers
Baltimore District**



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FORT HANCOCK FORMERLY USED DEFENSE SITE
MONMOUTH COUNTY, NEW JERSEY

Contract W912QR-12-D-0011
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Prepared for:
U.S. Army Corps of Engineers
Baltimore District

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COMPLETION OF SENIOR TECHNICAL REVIEW

This document has been produced within the framework of the ERT, Inc. (ERT) quality management system. As such, a senior technical review has been conducted. This included review of all elements addressed within the document, proposed or utilized technologies and alternatives and their applications with respect to project objectives and framework of U.S. Army Corps of Engineers regulatory constraints under the current project, within which this work has been completed.



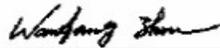
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COMPLETION OF INDEPENDENT TECHNICAL REVIEW

This document has been produced within the framework of ERT's quality management system. As such, an independent technical review, appropriate to the level of risk and complexity inherent in the project, has been conducted. This included a review of assumptions; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the project objectives. Comments and concerns resulting from review of the document have been addressed and corrected as necessary.



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TABLE OF CONTENTS

ACRONYMS and ABBREVIATIONS viii

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1

 1.1 Purpose of the FS 1

 1.2 Report Organization 1

 1.3 Background Information 2

 1.4 Previous Investigation Activities 2

 1.4.1 Engineering Evaluation/Cost Analysis 2

 1.4.2 Site Inspection (SI) 2

 1.4.3 2014 Remedial Investigation 3

 1.4.4 RI Addendum #1 4

 1.4.5 RI Addendum #2 5

 1.4.6 RI Addendum #3 6

 1.5 Nature and Extent of Contamination Summary 7

 1.5.1 Human Health and Ecological Risk Assessment 7

 1.5.2 Explosive Hazards 7

 1.6 MRS Characterization Summary 9

 1.6.1 CSM Elements 9

 1.6.2 MRS Groupings 10

2.0 REMEDIAL ACTION OBJECTIVES 13

 2.1 Remedial Action Objectives 13

 2.1.1 Contaminants and Media of Concern 13

 2.1.2 Receptors and Exposure Pathways 14

 2.1.3 Remediation Goals 14

 2.1.4 Proposed Remedial Action Objectives 14

 2.2 Applicable or Relevant and Appropriate Requirements 15

 2.2.1 Definition of ARARs 15

 2.2.2 Identification of ARARs 16

 2.3 General Response Actions 19

 2.3.1 Potential Explosive Hazards Response Action Areas 19

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES 21

 3.1 LUC Technology Types 21

 3.1.1 Administrative LUCs 21

 3.1.2 Physical LUCs 21

3.2	Detection Technology Types	21
3.2.1	Analog Magnetometers	21
3.2.2	DGM Instruments	22
3.2.3	Advanced Geophysical Classification Technology	23
3.3	Positioning Technology Types	26
3.3.1	Differential GPS	26
3.3.2	Robotic Total Station	26
3.3.3	Fiducial Method	26
3.4	Removal Technology Types	26
3.5	Disposal Technology Types	27
3.6	Summary of Explosive Hazards Technologies and Process Options	27
3.6.1	LUCs	27
3.6.2	Detection	27
3.6.3	Positioning	28
3.6.4	Removal	28
3.6.5	Disposal	29
4.0	DEVELOPMENT AND SCREENING OF ALTERNATIVES	31
4.1	Introduction	31
4.1.1	Effectiveness	31
4.1.2	Implementability	31
4.1.3	Cost	31
4.2	Identification of Remedial Alternatives	31
4.2.1	Explosive Hazards Remedial Alternatives	31
4.3	Screening of Explosive Hazards Remedial Alternatives	32
4.3.1	Alternative 1: No Action	32
4.3.2	Alternative 2: Administrative Land Use Controls	32
4.3.3	Alternative 3: Physical Land Use Controls	33
4.3.4	Alternative 4: MEC Removal to UU/UE	34
4.3.5	Alternative 5: MEC Removal to 2 feet with LUCs	35
5.0	DETAILED ANALYSIS OF ALTERNATIVES	38
5.1	Introduction	38
5.1.1	Threshold Criteria	39
5.1.2	Balancing Criteria	39
5.1.3	Modifying Criteria	41
5.2	Individual Analysis – MRS Group 1 Remedial Alternatives	41
5.2.1	Alternative 1: No Action	42
5.2.2	Alternative 2: Administrative Land Use Controls	42

5.2.3	Alternative 3: Physical Land Use Controls.....	44
5.2.4	Alternative 5: MEC Removal to 2 feet with LUCs.....	45
5.3	Comparative Analysis – MRS Group 1 Remedial Alternatives.....	47
5.4	Individual Analysis – MRS Group 2 Remedial Alternatives.....	50
5.4.1	Alternative 1: No Action.....	50
5.4.2	Alternative 2: Administrative Land Use Controls	50
5.4.3	Alternative 3: Physical Land Use Controls.....	52
5.4.4	Alternative 5: MEC Removal to 2 feet with LUCs.....	53
5.5	Comparative Analysis – MRS Group 2 Remedial Alternatives.....	55
5.6	Individual Analysis – MRS Group 3 Remedial Alternatives.....	58
5.6.1	Alternative 1: No Action.....	58
5.6.2	Alternative 2: Administrative Land Use Controls	58
5.6.3	Alternative 5: MEC Removal to 2 feet with LUCs.....	60
5.7	Comparative Analysis – MRS Group 3 Remedial Alternatives.....	61
5.8	Conclusions	65
5.8.1	MRS Group 1 Remedial Alternatives.....	65
5.8.2	MRS Group 2 Remedial Alternatives.....	65
5.8.3	MRS Group 3 Remedial Alternatives.....	65
6.0	REFERENCES	67

List of Tables

Table ES.1: MRS Groupings	4
Table 1.1: Summary of MEC RMM Matrix Analysis	8
Table 1.2: Summary of MRS Characterization.....	11
Table 1.3: MRS Groupings.....	12
Table 2.1: Summary of MEC Items by MRS	13
Table 2.2: Summary of ARARs.....	17
Table 3.1: Technology Types and Process Options Screen.....	24
Table 5.1: Summary of Detailed Analysis of Explosive Hazards Remedial Alternatives – MRS Group 1	49
Table 5.2: Summary of Detailed Analysis of Explosive Hazards Remedial Alternatives – MRS Group 2	57
Table 5.3: Summary of Detailed Analysis of Explosive Hazards Remedial Alternatives – MRS Group 3	64

List of Appendices

Appendix A: Site Figures

Appendix B: Post-Remedy Risk Management Methodology (RMM) Matrices

Appendix C: Costing Backup

ACRONYMS and ABBREVIATIONS

AGC	Advanced Geophysical Classification
ARARS	Applicable or Relevant and Appropriate Requirements
ASR	Archive Search Report
BGS	below ground surface
BIP	blow-in-place
CENAB	U.S. Army Corps of Engineers, Baltimore District
CENAN	U.S. Army Corps of Engineers, New York District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	conceptual site model
DA	Department of the Army
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DMM	Discarded Military Munitions
DoD	Department of Defense
ECRPP	Environmental and Cultural Resources Protection Plan
EE/CA	Engineering Evaluation/Cost Analysis
EOD	Explosive Ordnance Disposal
ESP	Explosives Site Plan
FS	Feasibility Study
FUDS	Formerly Used Defense Site
GIS	Geographic Information System
HHRA	Human Health Risk Assessment
HTW	Hazardous and Toxic Waste
LUCs	Land Use Controls
MAMMS	Multiple-Award Military Munitions Services
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MEC HA	MEC Hazard Assessment
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
NPS	National Park Service
NWS	Naval Weapons Station
O&M	operation and maintenance
QA	quality assurance
QC	quality control
RACER	Remedial Action Cost Engineering Requirements
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation

RI/FS	Remedial Investigation/Feasibility Study
RMM	Risk Management Methodology
SI	Site Inspection
TBD	To be determined
TPP	Technical Project Planning
TBC	To Be Considered
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UU/UE	Unlimited use/Unrestricted exposure
UXO	Unexploded Ordnance

EXECUTIVE SUMMARY

Introduction

ERT, Inc., (ERT) was tasked with drafting a Feasibility Study (FS) for the U.S. Army Corps of Engineers (USACE), for the Fort Hancock Formerly Used Defense Site (FUDS), located in Monmouth County, New Jersey. The work was performed under Environmental and Restoration Services Contract W912QR-12-D-0011, Delivery Order DA01 and DA02, and falls under the Department of Defense (DoD) Military Munitions Response Program (MMRP), which was established under the Defense Environmental Restoration Program (DERP). The MMRP addresses munitions constituents (MC), and munitions and explosives of concern (MEC) (comprising unexploded ordnance [UXO], discarded military munitions [DMM], and MC in high enough concentrations to pose an explosive threat) that are located on certain properties, including FUDS, and that may be present at Fort Hancock. USACE Baltimore District (CENAB) administers this work and provides technical oversight, while the USACE New York District (CENAN) is the overall life cycle manager for the project.

Purpose

The purpose of this FS is to develop, screen, and provide a detailed analysis of remedial alternatives to mitigate potential unacceptable explosive hazards that may remain within the Fort Hancock FUDS. It is based on historical information, site characterization, analytical data, and potential risks or hazards to human health or the environment as determined by the Remedial Investigation (RI), and the conclusions and recommendations documented in the *Final Remedial Investigation Report, Fort Hancock Formerly Used Defense Site, January 2014* (USACE, 2014). There have also been three Addenda to the 2014 RI Report.

Background and Site History

Fort Hancock is located on the Sandy Hook peninsula in Monmouth County, New Jersey. The peninsula, which encompasses approximately 1,700 acres, is known as the Sandy Hook Unit of the Gateway National Recreation Area and is a National Historic Landmark. It is currently managed by the Department of the Interior's National Park Service (NPS) and the U.S. Coast Guard, and is used for a variety of recreational purposes year-round.

Multiple investigations have taken place at Fort Hancock and Munitions Response Site (MRS) footprints have evolved as successive investigations have provided new characterization information. MRS boundary changes are associated with the primary investigation phases: the 2007 Site Inspection (SI) and the 2014 RI (and its three Addenda). The 2007 SI was conducted on six MRSs. However, upon further research, it became apparent that many of the MRSs did not accurately reflect areas suspected of containing MEC. Consequently, the presence of some of the SI MRSs was considered speculative, and as a result, the SI MRSs were significantly revised for purposes of conducting the 2014 RI.

ERT completed the 2014 RI that characterized the nature and extent of MEC, munitions debris (MD) and MC in six of seven land-based MRSs (one MRS was excluded from investigation by NPS), and one water-based MRS. The 2014 RI Report included human health and ecological risk assessments. With regard to the nature and extent of MC, the 2014 RI Report recommended that additional soil sampling be conducted to determine the extent and source of metals contamination posed by MC found in the soil of an area known as the B003 Area.

With regard to the nature and extent of MEC/MD, areas of focus (MEC/MD Hazard Areas) were delineated based on MEC/MD densities. The 2014 RI Report further recommended that the portion of the Livens Discovery Area MRS that had been excluded from the Remedial

Investigation by NPS, be further investigated.

RI Addendum #1 was completed to further characterize the B003 area for MC; based on additional soil sampling, the human health and ecological risk assessments were updated and it was concluded that the nature and extent of MC contamination at the B003 Area had been characterized and no unacceptable MC risk to human health or the environment was present. These results are documented in the *RI Addendum #1 Report* (Final, September 2016).

RI Addendum #2 was completed to further characterize the Livens Discovery Area (MRS 06), providing additional information about the locations and potential locations of MEC and MD. The area known or suspected to contain MEC or MD was developed into a smaller MEC/MD Hazard Area, and the MRS 06 boundary was reduced accordingly. These results are documented in the *RI Addendum #2 Report* (Final, June 2017).

In 2017, ERT conducted a third RI phase with the objective of investigating MRS 08. The footprint of MRS 08 was developed as a function of acreage NPS had excluded from all previous investigations based on concerns about potential impacts to plant communities from the vegetation clearance/cutting required to conduct geophysical surveys. NPS ultimately approved a modified, species-protective investigation approach, and the field effort was completed in December 2017. The results of this investigation are documented in the *Final RI Addendum #3 Report* (USACE, 2018).

A secondary purpose of RI Addendum #3 was to present the final configurations of MRSs for the Fort Hancock FUDS as they evolved over the multiple investigations. Thus, the RI Addendum #3 Report describes adjustments to MRS configurations and acreages, including: renumbering of the MRS 05 sub-areas to better associate them with MRS 05; the MRS 08 footprint reduction recommendations; and development of new MRS 10 (Eastern Shoreline), which is intended to address munitions that have historically been found on the beaches after storm events.

Risk Assessment – Human Health and Ecological

The human health risk assessment (HHRA) and screening level ecological risk assessment (SLERA) presented in the 2014 RI Report concluded that there was no unacceptable MC risk to either human or ecological receptors, with the exception of the B003 Area. The RI Addendum #1 effort documented additional MC soil sampling, updated the baseline risk assessments, and concluded that no unacceptable risk to human health or the environment was present at the B003 Area, and therefore, No Action is required for MC at the Fort Hancock FUDS.

Risk Assessment – Explosive Hazards

With regard to potential explosive hazards that may remain at the Fort Hancock FUDS, in the 2014 RI Report, MEC/MD Hazard Areas were identified as areas of focus within an MRS representing a “moderate to high” probability of encountering MEC/MD. Those MRSs so designated were considered to require further remedial actions. However, as a means of standardization across the multiple RI efforts, RI Addendum #3 updated MEC risk evaluations for all previously existing MRSs using the December 2016 USACE risk management matrix methodology (RMM) to assess risk posed by explosive hazards (USACE, 2017a). Following this updated MEC risk evaluation, those MRSs that were determined to pose an unacceptable MEC risk were considered to require remedial actions to mitigate the potential explosive hazards they represent, and they are therefore addressed in this FS.

MRS Characterization

Following the MEC risk evaluations of RI Addendum #3, five MRSs were found to represent unacceptable conditions (03, 05, 06, 08, and 10). Two of them, MRS 05 and MRS 08, were configured into smaller MRSs as described in the respective RI Addenda Reports (and as shown in Figure A-1), resulting in a total of eight MRSs representing unacceptable site conditions. These MRSs are further evaluated in this FS:

- MRS 03
- MRS 05B, 05E, 05G
- MRS 06
- MRS 08A, 08B
- MRS 10

For several areas of the Fort Hancock FUDS, the 1998 EE/CA recommended complete MEC removals that were not conducted; it is believed there may be munition items that were left in place at that time, in anticipation of a future removal action. These include the B003 area (which is part of current MRS 03), the Livens Discovery Area (current MRS 06), and MRS 05B (the southern portion only) where two 12-inch unfired projectiles, encountered during the EE/CA investigation, were left in the ground.

Special situations were identified for two of the MRSs: MRS 10 (Eastern Shoreline) where unacceptable conditions were determined based on historical observations of munitions washing onto the shore or being exposed via erosion during storm events in the Atlantic Ocean, and MRS 05G, approximately 2 acres of dynamic shoreline area where a single MEC item was found during the RI. The area of MRS 05G was significantly impacted/alterd by Storm Sandy (2012) following the RI investigation such that more than 5 feet of the sandy terrain was removed. Since no munitions deeper than 1 foot were found at Fort Hancock, and the storm removed approximately 5 feet of cover, it is unlikely that any MEC hazard remains in this small 2 acre area.

As a means of further organizing the eight MRSs to facilitate analysis in this FS, the MRSs were categorized using conceptual site model (CSM) elements such as whether they represent high pedestrian traffic areas or low pedestrian traffic areas, whether they were considered to contain MEC such that a previous MEC removal was recommended, or whether they represent the special situations described above.

Based on defined CSM scenarios, three MRS Groups were developed that include all of the MRSs determined to pose unacceptable explosive hazards. The CSM scenarios are described in Table ES.1. These groups require follow-on actions, the specific nature of which will be determined through the alternatives analysis presented in this FS. Each group contains MRSs with attributes similar enough that the FS analysis can be conducted at the MRS Group level.

Remedial Action Objectives (RAOs)

The media of concern at the MRSs are surface and subsurface soil that may potentially contain MEC. Potential explosive hazards may remain in the surface and subsurface soil at the Fort Hancock FUDS, and areas categorized as having unacceptable site conditions with regard to potential explosive hazards require remedial actions to mitigate them.

Table ES.1: MRS Groupings

MRS Group	CSM Scenario	MRSs Included
Group 1	Scenario 1: MEC found, high pedestrian traffic, or areas of existing munitions, or where previous MEC removal recommendations have been made (EE/CA)	MRS 03 (30.2 acres), MRS 05B South (1.0 acres), MRS 06 (5.0 acres)
Group 2	Scenario 2: MEC found, low/no pedestrian traffic area	MRS 05B North (38 acres), MRS 05E (5.1 acres), MRS 08A (11.8 acres), MRS 08B (59.2 acres)
Group 3	Scenario 3: Special situations where MEC has been found in high pedestrian traffic, but where Storm Sandy significantly impacted/altere the investigated area, or munitions washing onto the shore or being exposed via erosion, has historically been observed	MRS 05G (2.1 acres), MRS 10 (179 acres)

The proposed RAOs for the remedial actions are based on site-specific information, including MEC as the contaminant of interest that may occur in the surface and subsurface soil, the depths for potential exposure of receptors (surface to 2 feet bgs), and the receptors most likely to be exposed (park workers and recreational users). Combining the affected media, the exposure pathways, and the project goals, the proposed RAOs include:

- To reduce the unacceptable risk due to the presence of MEC on the surface or in the subsurface to a depth of 2 feet bgs to address direct contact by park workers and recreational users, and direct contact of MEC in the subsurface to depths greater than 2 feet bgs by authorized park workers, such that an acceptable condition (as defined by RMM Matrix 4) is achieved.

Identification and Screening of Technologies

To develop remedial alternatives, Applicable or Relevant and Appropriate Requirements (ARARs) were identified. General response actions to satisfy the RAOs were developed for each medium of interest. For MMRP sites, these typically include Land Use Controls (LUCs) such as fencing or institutional controls, and MEC Removal (geophysical investigation of anomalies followed by removal/disposal).

Review of detection process options for MEC Removal included analog magnetometers, Digital Geophysical Mapping (DGM), and Advanced Geophysical Classification (AGC). For the FS analysis, where MEC Removal was evaluated, it was concluded that the analog magnetometer approach, wherein UXO technicians immediately dig metallic anomalies encountered (a procedure known as “mag & dig”) may be the most viable MEC detection and removal technology for the Fort Hancock FUDS because this approach requires minimal vegetation removal and NPS has imposed cutting limitations to minimize disturbance to sensitive plant communities. However, it was concluded that the best available geophysical technology detection process option, based on

access and vegetation clearance requirements for specific site areas, would be utilized for the development of remedial alternatives.

A MEC removal depth component was also developed, with 2 feet bgs a practical maximum for park visitor activities, while an educational and notification LUC would be required for authorized park workers (utility or construction contractors) who may need to achieve depths greater than 2 feet (e.g., notifications of the intent to safely conduct such activities). The LUCs would include advising the NPS to exercise anomaly avoidance procedures for areas that may be developed in the future.

Development and Screening of Alternatives

Based on the explosive hazards mitigation technologies reviewed, five remedial alternatives were identified to mitigate the potential unacceptable explosive hazards that may remain:

- Alternative 1: No Action
- Alternative 2: Administrative LUCs
- Alternative 3: Physical LUCs
- Alternative 4: MEC Removal to Unlimited Use/Unrestricted Exposure (UU/UE)
- Alternative 5: MEC Removal to 2 feet with LUCs

These alternatives were screened against effectiveness, implementability, and cost, and the conclusion was that Alternatives 1, 2, 3, and 5, met key elements of the effectiveness and implementability criteria and they were retained for the detailed comparative analysis. Alternative 4 did not meet these criteria and it was not retained for further analysis.

Analysis of Remedial Alternatives – Explosive Hazards

On an MRS Group level, each of the retained remedial alternatives was first screened against the nine CERCLA evaluation criteria, and then were screened against each other. Final selection of a preferred alternative will be proposed in the Proposed Plan and documented in the Decision Document.

MRS Group 1

Four remedial alternatives were evaluated for MRS Group 1: No Action, Administrative LUCs, Physical LUCs, and MEC Removal to 2 feet with LUCs.

MRS Group 2

Four remedial alternatives were evaluated for MRS Group 2: No Action, Administrative LUCs, Physical LUCs, and MEC Removal to 2 feet with LUCs.

MRS Group 3

Three remedial alternatives were evaluated for MRS Group 3: No Action, Administrative LUCs, and MEC Removal to 2 feet with LUCs. Physical Land Use Controls via fencing was screened out as an alternative as it is impractical for the dynamic shoreline areas of MRS Group 3.

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1.0 INTRODUCTION

ERT, Inc., (ERT) was tasked with drafting a Feasibility Study (FS) report for the U.S. Army Corps of Engineers (USACE), for the Fort Hancock Formerly Used Defense Site (FUDS), located in Monmouth County, New Jersey. The work was performed under Environmental and Restoration Services Contract W912QR-12-D-0011, Delivery Order DA01 and DA02, and falls under the Department of Defense (DoD) Military Munitions Response Program (MMRP), which was established under the Defense Environmental Restoration Program (DERP).

The DoD established the MMRP to address munitions constituents (MC), and munitions and explosives of concern (MEC) (comprising unexploded ordnance [UXO], discarded military munitions [DMM], and MC in high enough concentrations to pose an explosive threat) that are located on certain properties – including FUDS, and that may be present at Fort Hancock. USACE Baltimore District (CENAB) administers this work and provides technical oversight, and the USACE New York District (CENAN) is the overall life cycle manager for the project.

Under the DERP, the U.S. Army is the DoD’s lead Agent for FUDS, and USACE executes FUDS for the Army. USACE performs its response activities in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). FUDS is administered pursuant to the DERP statute, the CERCLA, Executive Orders 12580 and 13016, the NCP, and DoD and Army policies in managing and executing the FUDS program.

This FS is based on historical information, site characterization, analytical data, and potential risks or hazards to human health or the environment as determined by the Remedial Investigation (RI), and the conclusions and recommendations documented in the *Final Remedial Investigation Report, Fort Hancock Formerly Used Defense Site, January 2014* (USACE, 2014), hereinafter referenced as the 2014 RI Report. As further described below, there have also been three Addenda to the 2014 RI Report.

1.1 Purpose of the FS

The purpose of an FS, in accordance with U.S. Environmental Protection Agency (USEPA) guidance, is “to provide decision makers with an assessment of the remedial alternatives, including their relative strengths and weaknesses, and trade-offs in selecting one alternative over another.” An FS typically develops, screens, and provides a detailed analysis of remedial alternatives.

The purpose of this FS is to develop, screen, and provide a detailed analysis of the remedial alternatives required to mitigate potential unacceptable explosive hazards that may remain within the Fort Hancock FUDS.

1.2 Report Organization

The organization of this FS follows both the *USEPA’s Guidance for Conducting RI/FS Studies under CERCLA* (USEPA, 1988) and the *US Army Munitions Response RI/FS Guidance* (USACE, 2009). However, it most closely aligns with the suggested FS Report format provided by Table 6-5 of the USEPA Guidance. It is organized into six sections and three appendices:

- Section 1.0: Introduction
- Section 2.0: Remedial Action Objectives
- Section 3.0: Identification and Screening of Technologies

- Section 4.0: Development and Screening of Alternatives
- Section 5.0: Detailed Analysis of Alternatives
- Section 6.0: References
- Appendix A: Site Figures
- Appendix B: Post-Remedy Risk Management Methodology (RMM) Matrices
- Appendix C: Costing Backup

1.3 Background Information

All background and site history presented in this FS is summarized from the 2014 RI Report and the Addenda to it.

Fort Hancock is located on the Sandy Hook peninsula in Monmouth County, New Jersey, in the Lower Bay of the Hudson River. Raritan Bay is north of Fort Hancock, Sandy Hook Bay borders the site on the west, and the Atlantic Ocean is east of the peninsula. The peninsula, which encompasses approximately 1,700 acres, is known as the Sandy Hook Unit of the Gateway National Recreation Area and is a National Historic Landmark. It is currently managed by the Department of the Interior's National Park Service (NPS) and the U.S. Coast Guard, and is used for a variety of recreational purposes year-round. An active U.S. Coast Guard Station is positioned on the northwest corner of the peninsula (approximately 68 acres). The closest city is Highlands, located on the mainland of New Jersey, south of the peninsula.

Figure A-1 presents the project location with the current configuration of Munition Response Sites (MRSs). (All figures are presented in Appendix A).

1.4 Previous Investigation Activities

Multiple investigations have taken place at Fort Hancock and MRS footprints have evolved as successive investigations have provided new characterization information. MRS boundary changes are associated with the primary investigation phases: the 2007 Site Inspection (SI) and the 2014 RI (and its three Addenda). The following discussions are summaries of those investigations that were key to characterizing nature and extent of contamination for the Fort Hancock FUDS.

1.4.1 Engineering Evaluation/Cost Analysis

In 1998, USACE conducted an *Engineering Evaluation/Cost Analysis* (EE/CA) [Draft Final Former Fort Hancock EE/CA, (USACE, 1998)] to more thoroughly investigate ordnance at the Fort Hancock FUDS. Multiple areas of concern were established for investigation, based on the 1993 USACE Archives Search Report (ASR) and an analysis of historical aerial photographs conducted by the U.S. Army Topographic Engineering Center.

An explosive risk assessment was conducted as part of the EE/CA, and one of the areas, the Livens Discovery Area, was recommended for MEC clearance to depth. Although the MEC removals were never undertaken, NPS maintained a protocol for public education through information sheets and signage.

1.4.2 Site Inspection (SI)

In 2007, USACE completed an SI (USACE, 2007) as part of a DoD-wide effort to evaluate the inventoried MRSs for further action. The SI served to inspect each of the MRSs (as defined in the

ASR supplement) for MEC on the surface and to collect environmental samples to determine if there may have been a release of MC. The SI recommended that an RI be conducted.

The 2007 SI was conducted on six MRSs that were based on the 1993 ASR and its 2004 Supplement. However, upon further evaluation and research for scoping of the 2014 RI, it became apparent that many of the MRSs did not accurately reflect areas suspected of containing MEC. USACE researched the six MRSs to determine which should be included in the study. During follow-up discussions with NPS, it was discovered that some of the MRSs were based on anecdotal information obtained during the ASR interviews. Consequently, the presence of some of the SI MRSs was considered speculative, and they were therefore excluded from the 2014 RI. As a result, the SI MRSs were significantly revised for purposes of conducting the 2014 RI.

1.4.3 2014 Remedial Investigation

ERT completed the 2014 RI that characterized the nature and extent of MEC, munitions debris (MD) and MC in six of seven land-based MRSs, and one water-based MRS. The scope included digital geophysical mapping (DGM), intrusive investigations to identify location, density, and types of MEC, and environmental sampling to determine the distribution and concentrations of metals and explosives in soil, sediment, surface water, and groundwater.

1.4.3.1 2014 RI MRS Delineations

To better define areas where MEC and MC may remain from historical military operations on the Fort Hancock FUDS, ERT reviewed historical reports regarding proving ground operations, including NPS historic resource studies, and discovered a summary report containing a map of the locations of six impact areas associated with the historic proving ground. This key document identifies the location of proof firing targets and indicates that guns were fired from north to south along the beach (NPS undated report). No other testing, training, or disposal areas potentially containing MEC were found in the NPS documents reviewed.

The impact areas are the basis for most of the MRSs investigated during the 2014 RI. Buffer zones equal to the radius of the targets were added on all sides of the circular target areas, allowing for under- and over-shots. A revised boundary was drawn for the Livens area, based on newly-discovered documentation of a 1927 fire in a storage bunker. An in-water MRS, parallel to the proving ground and target areas, was established to address areas on the beach where munitions have been found, portions of the former proving ground that may have eroded into the ocean, and off-shore areas to a depth at which recreational users or NPS employees may come into contact with MEC, if present.

The re-configuration of MRSs was discussed during technical project planning (TPP) meetings and presented in the RI Work Plan, which was reviewed and approved by the New Jersey Department of Environmental Protection (NJDEP) and NPS.

Based on the results of the RI, the 2014 RI Report concluded that nature and extent of MC and MEC at Fort Hancock had been characterized, including assessment of human health and ecological risks. As part of the characterization, areas of focus (MEC/MD Hazard Areas) were delineated based on MEC/MD densities.

With regard to MC, the 2014 RI Report recommended that additional soil sampling be conducted to determine the extent and source of metals contamination posed by MC found in the soil of an area known as the B003 Area; this further investigation was the subject of Addendum #1 to the 2014 RI Report.

With regard to MEC/MD, the 2014 RI Report recommended that the portion of the Livens Discovery Area MRS that had been excluded from investigation by NPS, be further investigated to determine the nature and extent of MEC/MD, and to identify possible MEC/MD Hazard Areas. The further investigation of the Livens Discovery Area MRS was the subject of Addendum #2 to the 2014 RI Report.

1.4.4 RI Addendum #1

ERT conducted additional RI field activities as a result of recommendations from the 2014 RI Report. Addendum #1 activities were conducted in July 2014 and the results are documented in the Final RI Addendum #1 Report (USACE, 2016).

The 2014 RI Report concluded that in the B003 Area, arsenic and lead in soil could potentially pose a threat to human health, and that antimony, arsenic, copper, lead, selenium, and thallium could pose a threat to ecological receptors. RI Addendum #1 was completed to further characterize this area; based on additional soil sampling, the human health and ecological risk assessments were updated and it was concluded that the nature and extent of MC contamination at the B003 Area had been characterized and no unacceptable risk to human health or the environment was present.

In addition to addressing the B003 Area MC issue, the Addendum #1 Report formally reconfigured the MRSs based on the 2014 RI findings, as described below.

1.4.4.1 RI Addendum #1 MRS Delineations

In summary: two smaller MRSs were defined based on the MEC/MD Hazard Areas identified in the 2014 RI Report; the Livens Discovery Area was retained for future investigation (later completed as RI Addendum #2); a larger MRS was defined for all remaining land areas; an MRS comprising NPS excluded acreage was defined; and lastly, an MRS was defined for the off-shore range fans emanating from the firing batteries. These adjustments resulted in six MRSs, shown in Figure A-1, and described below:

- **MRS 03, Northern Portion Proving Ground:** This MRS encompasses 30.2 acres and includes the MEC/MD Hazard Area 1A and PAOI 9-Gun Battery.
- **MRS 05, Southern Portion Proving Ground:** This MRS encompasses 51 acres and includes the following seven MEC/MD Hazard Areas (as defined in the 2014 RI Report): 1B, 2A, 3A, 3B, 4A, 5A, and 5B (note: these seven sub-areas were renumbered for RI Addendum #3, as described in Section 1.4.6 and listed in Table 1.2).
- **MRS 06, Livens Discovery Area:** The original Livens Discovery Area footprint was 28.8 acres, of which NPS granted access to only 4.8 acres; those 4.8 acres were included in MRS 07 as the 2014 RI determined that no MEC is suspected in this area. (The remaining 24 acres were ultimately investigated under RI Addendum #2 as described in Section 1.4.5.1 below).
- **MRS 07, Remaining Land Areas:** At 952 acres, this MRS encompasses all remaining land on the eastern side of the Sandy Hook peninsula, where there is a potential MEC hazard from munitions that may wash onto the shore or be exposed via erosion during storm events in the Atlantic Ocean. The MRS extends to the northernmost extent of the Sandy Hook peninsula and to the southernmost boundary of the recreation area (note that the acreage total shown on Figure A-1 is different based on RI Addendum #3 adjustments described in Section 1.4.6).

- **MRS 08, NPS Excluded Area:** This MRS is 140 acres and encompasses portions of the former proving ground to which NPS had excluded access for geophysical investigation due to the presence of the globally rare Maritime Holly Forest plant community. The MRS was named "NPS Excluded Area" because at the time, it was not clear that access to conduct the RI would be obtained. However, further discussions with NPS resulted in an access agreement and MRS 08 was investigated as RI Addendum #3 (note that the acreage total shown on Figure A-1 is different based on RI Addendum #3 adjustments described in Section 1.4.6).
- **MRS 09, Water Ranges:** This MRS is 129,611 acres and encompasses the off-shore portions of the coastal battery range fans. A large portion of the range fans overlaps those of Fort Tilden, another FUDS in New York, and have been excluded (i.e., the overlapping acres are accounted for in the Fort Tilden MMRP project). The MRS encompasses the in-water segment of the SI MRS called the Northern Battery Complex, and the 154-acre area paralleling the eastern shore, which was identified in the 2014 RI Report as MRS 08. This MRS was designated as No DoD Action Indicated, based on the fact that no MEC was found in the water during the RI and that deep water significantly reduces the potential for encounters with MEC, if present, in many of these areas (MRS 10, developed during the RI Addendum #3 phase, addresses the potential for MEC to wash up on shore or be exposed via erosion during storm events).

1.4.5 RI Addendum #2

Permission was ultimately obtained from NPS to investigate the approximately 24 acre Livens Discovery Area (MRS 06), and the results were documented in the RI Addendum #2 Report (USACE, 2017b). MRS 06 encompasses 24 acres surrounding the location of a former munitions storehouse where a fire occurred in 1927. It was determined that there was a potential for MEC to remain in MRS 06, as MD items and a potentially live Stokes mortar fuze were found during the 1998 EE/CA investigation. Most of the munitions-related items were found in EE/CA investigation Grid E004 (the assumed location of the 1927 storehouse fire). The EE/CA recommended a UXO clearance to depth for Grid E004 and vicinity, but it was never conducted.

The RI Addendum #2 investigation found material potentially presenting an explosive hazard (MPPEH) on transects and investigation grids. The MPPEH items included two apparently intact Livens projectiles, a partial Livens projectile, 5 Stokes Mortar MK1 fuzes, 4 Livens burster tubes, an MK1 detonator, an M-1 smoke canister, and a brass base fuze. MD was somewhat common in the inner transects and in the grids, consisting of unidentified munitions fragments or Livens projectile fragments. Some of the items were found on the surface and some were found in the subsurface.

1.4.5.1 *RI Addendum #2 MRS Delineations*

The RI Addendum #2 effort provided additional information about the locations and potential locations of MEC, MPPEH, and MD within MRS 06. The area known or suspected to contain MEC or MD was developed into a smaller MEC/MD Hazard Area. Consequently, the MRS 06 boundary was reduced accordingly, and the acreage for MRS 06 was revised from 24 acres to 5.0 acres. The revised MRS 06 boundary is shown in Figure A-1. The 19 acres removed from MRS 06 were included as part of MRS 07.

1.4.6 RI Addendum #3

NPS would not allow investigation of significant portions (140 acres) of the land-based MRSs during the RI and RI Addenda #1 and #2 phases because of vegetation cutting restrictions associated with the globally-rare Maritime Holly Forest. However, NPS accommodate a modified, species-protective investigation approach, and access was eventually allowed. Consequently, ERT conducted a third RI phase to investigate this acreage, now developed into MRS 08 (acreage NPS excluded from all previous investigations based on its concerns about potential impacts to plant communities from vegetation cutting required to conduct geophysical surveys). The field effort was completed in December 2017. The results of this investigation are documented in the Final RI Addendum #3 Report (USACE, 2018).

A secondary purpose of RI Addendum #3 was to present the final configurations of MRSs for the Fort Hancock FUDS as they evolved over the multiple investigations. Thus, the RI Addendum #3 Report describes adjustments to MRS configurations and acreages, including: renumbering of the MRS 05 sub-areas to better associate them with MRS 05; the MRS 08 footprint reduction recommendations; and development of new MRS 10, Eastern Shoreline.

1.4.6.1 RI Addendum #3 MRS Delineations

MRS 08 and MRS 10 are described as follows:

- **MRS 08, NPS Excluded Area:** This MRS is 140 acres and encompasses portions of the former proving ground to which NPS had excluded access for geophysical investigation. The RI Addendum #3 effort identified four concentrated munitions use areas (CMUAs). Based on the conclusions of the MEC risk assessment matrices (see Section 1.5.2), two of these CMUAs (08C and 08D) were determined to represent acceptable site conditions and two represented unacceptable conditions (08A and 08B). Consequently, the original 140-acre MRS 08 was reduced to include only those areas that may pose an unacceptable MEC risk, and the revised acreage for MRS 08 became 71 acres (as shown on Figure A-1). To account for FUDS acreages properly, the acres removed from MRS 08 became part of MRS 07 (Remaining Land). However, the acreage of MRS 07 changed again because new MRS 10 was created from MRS 07 shoreline acreage (see below). Consequently, MRS 07 became 862 acres.
- **MRS 10, Eastern Shoreline:** This MRS, created from 179 acres of the dynamic shoreline of MRS 07 as part of RI Addendum #3, was developed to address munitions that have historically been found on the beaches after storm events. It is 179 acres encompassing the beach and surf zone on the eastern side of the Sandy Hook peninsula, where MEC washes onto the shore or is exposed via erosion after large storm events in the Atlantic Ocean (Figure A-1). In part, the MRS encompasses portions of the former proving ground that have eroded into the ocean. Although none were found during the RI, munitions historically found on the beaches have been investigated by Explosives Ordnance Disposal (EOD) units. Items that have washed up (or were exposed via erosion) on the Atlantic beaches since 2010 include: 3.5-inch, 6-inch, and 8-inch projectiles, Marine flare, Mk-25 Marine Marker, and a 5-inch AP projectile. These items were identified as live and blown in place by EOD units from Naval Weapons Station Earle. The MRS extends to the northernmost end of the Sandy Hook peninsula and to the southernmost boundary of the national recreation area.

1.5 Nature and Extent of Contamination Summary

The determination of the nature and extent of MC and MEC/MD contamination for the Fort Hancock FUDS is based on the findings of each of the investigative phases, as detailed in the above described reports.

1.5.1 Human Health and Ecological Risk Assessment

The human health risk assessment (HHRA) and screening level ecological risk assessment (SLERA) presented in the 2014 RI Report concluded that there was no unacceptable MC risk to either human or ecological receptors, with the exception of the B003 Area, which was addressed in RI Addendum #1.

For the RI Addendum #1 effort, additional soil sampling was conducted to update the 2014 RI Report baseline risk assessments, and it was concluded that no unacceptable risk to human health or the environment was present at the B003 Area.

For the RI Addendum #2 effort, discrete soil samples were collected at locations where apparently intact Livens projectiles were found on the inner transects of MRS 06. No MC was detected (non-detects were reported at concentrations less than the screening limits), supporting the conclusion that there is no unacceptable MC risk at MRS 06, therefore, No Action for MC is required.

1.5.2 Explosive Hazards

With regard to potential explosive hazards that may remain at the Fort Hancock FUDS, MEC/MD Hazard Areas were identified in the 2014 RI Report as areas of focus within an MRS representing a “moderate to high” probability of encountering MEC/MD. Those MRSs that were designated as having a moderate to high probability of encountering MEC/MD were considered to require further remedial actions. However, as a means of standardizing MEC risk evaluations across the multiple RI efforts, RI Addendum #3 updated MEC risk evaluations for all previously existing Fort Hancock MRSs using the December 2016 USACE risk management matrix methodology (RMM): *Decision Logic to Assess Risks Associated with Explosive Hazards and to Develop Remedial Action Objectives for Munitions Response Sites* (USACE, 2017a).

The discussions below summarize the RI Addendum #3 Report MEC risk conclusions for all Fort Hancock MRSs.

1.5.2.1 Summary of MEC Risk Matrix Analyses

The RMM involves the use of four matrices to define acceptable and unacceptable risk from MEC hazards based on the likelihood of an encounter, the severity of incident, and the sensitivity of interaction based on expected land use activities. This method is ultimately used to establish remedial action objectives and to help evaluate potential remedial action alternatives. Those MRSs that were designated as having an unacceptable MEC risk were considered to require remedial actions to mitigate the potential explosive hazards they represent, and they are therefore addressed in this FS.

Table 1.1 shows the conclusion of each RMM matrix table for each MRS, indicating whether an MRS was determined to be acceptable or unacceptable with regard to risk posed by explosive hazards. The table is a summary of the detailed analysis presented in the RI Addendum #3 Report.

Table 1.1: Summary of MEC RMM Matrix Analysis				
MRS	Matrix 1: Likelihood of Encounter	Matrix 2: Severity of Incident	Matrix 3: Likelihood of Detonation	Matrix 4: Acceptable and Unacceptable Site Conditions
MRS 03	Frequent - (Confirmed MEC, Regular Access)	A - (Catastrophic Severity, Frequent Likelihood)	1 - (Moderate Sensitivity, High Likelihood)	Unacceptable
MRS 05A	Unlikely - (MEC Suspected, Intermittent Access)	D - (Improbable Severity, Unlikely Likelihood)	3 - (Not Sensitive, Modest Likelihood)	Acceptable
MRS 05B	Occasional - (Confirmed MEC, Intermittent Access)	B - (Catastrophic Severity, Occasional Likelihood)	2 - (Moderate Sensitivity, Modest Likelihood)	Unacceptable
MRS 05C	Unlikely - (MEC Suspected, Intermittent Access)	D - (Improbable Severity, Unlikely Likelihood)	3 - (Not Sensitive, Modest Likelihood)	Acceptable
MRS 05D	Seldom - (MEC Suspected, Often Access)	D - (Improbable Severity, Seldom Likelihood)	3 - (Not Sensitive, Modest Likelihood)	Acceptable
MRS 05E	Occasional - (Confirmed MEC, Intermittent Access)	B - (Catastrophic Severity, Occasional Likelihood)	2 - (Moderate Sensitivity, Modest Likelihood)	Unacceptable
MRS 05F	Seldom - (MEC Suspected, Regular Access)	D - (Improbable Severity, Seldom Likelihood)	3 - (Not Sensitive, Modest Likelihood)	Acceptable
MRS 05G	Occasional - (MEC Based on Physical Evidence, Often Access)	B - (Catastrophic Severity, Occasional Likelihood)	2 - (Moderate Sensitivity, Modest Likelihood)	Unacceptable
MRS 06	Occasional - (Confirmed MEC, Intermittent Access)	B - (Catastrophic Severity, Occasional Likelihood)	2 - (Moderate Sensitivity, Modest Likelihood)	Unacceptable
MRS 07	Seldom - (MEC Suspected, Regular Access)	D - (Improbable Severity, Seldom Likelihood)	2 - (Not Sensitive, High Likelihood)	Acceptable
MRS 08A	Occasional - (Confirmed MEC, Intermittent Access)	B - (Catastrophic Severity, Occasional Likelihood)	2 - (Moderate Sensitivity, Modest Likelihood)	Unacceptable
MRS 08B	Occasional - (Confirmed MEC, Intermittent Access)	B - (Catastrophic Severity, Occasional Likelihood)	2 - (Moderate Sensitivity, Modest Likelihood)	Unacceptable
MRS 08C	Unlikely - (Historical Evidence of MEC, Intermittent Access)	D - (Improbable Severity, Unlikely Likelihood)	3 - (Not Sensitive, Modest Likelihood)	Acceptable
MRS 08D	Unlikely - (Historical Evidence of MEC, Intermittent Access)	D - (Improbable Severity, Unlikely Likelihood)	3 - (Not Sensitive, Modest Likelihood)	Acceptable
MRS 10	Likely - (MEC Based on Physical Evidence, Regular Access)	A - (Catastrophic Severity, Likely Likelihood)	1 - (Moderate Sensitivity, High Likelihood)	Unacceptable

Unacceptable baseline site conditions proceed to the next phase of the CERCLA response process, where some type of remedial action for MEC is required, while Acceptable baseline conditions do not warrant further action with regard to MEC.

Therefore, the following MRSs, categorized as having acceptable site conditions, are not further evaluated in this FS:

- MRS 05A, 05C, 05D, 05F
- MRS 07
- MRS 08C, 08D

The following MRSs, categorized as having unacceptable site conditions, are further evaluated in this FS:

- MRS 03
- MRS 05B, 05E, 05G
- MRS 06
- MRS 08A, 08B
- MRS 10

Note: as described in Section 1.4.4.1, MRS 09, Water Ranges, was previously designated as No DoD Action Indicated (RI Addendum #1), based on the fact that no MEC was found in the water during the RI and that deep water significantly reduces the potential for encounters with MEC (if present) in these areas. MRS 10 addresses the potential for MEC to wash up on shore or be exposed via erosion during storm events.

1.6 MRS Characterization Summary

Of the five MRSs representing unacceptable conditions (03, 05, 06, 08, and 10), two of them, MRS 05 and MRS 08, were configured into smaller MRSs as described in the respective RI Addenda Reports (and as shown in Figure A-1), resulting in a total of eight MRSs addressed in this FS.

For several areas of the Fort Hancock FUDS, the 1998 EE/CA recommended complete MEC removals that were not conducted; it is believed there may be munition items that were left in place at that time, in anticipation of a future removal action. These include the B003 area (which is part of current MRS 03), the Livens Discovery Area (current MRS 06), and MRS 05B (the southern portion only) where two 12-inch unfired projectiles, encountered during the EE/CA investigation, were left in the ground.

Special situations were identified for two of the MRSs: MRS 10 (Eastern Shoreline) where unacceptable conditions were determined based on historical observations of munitions washing onto the shore or being exposed via erosion during storm events in the Atlantic Ocean, and MRS 05G, approximately 2 acres of dynamic shoreline area where a single MEC item was found during the RI. The area of MRS 05G was significantly impacted/alterd by Storm Sandy (2012) following the RI investigation such that more than 5 feet of the sandy terrain was removed. Since no munitions deeper than 1 foot were found at Fort Hancock, and the storm removed 5 feet of cover, it is unlikely that any MEC hazard remains in this small 2 acre area.

1.6.1 CSM Elements

As a means of further organizing the eight MRSs to facilitate analysis in this FS, the MRSs were categorized using conceptual site model (CSM) elements such as whether they represent high pedestrian traffic areas or low pedestrian traffic areas, whether they were considered to contain

MEC such that a previous MEC removal was recommended, or whether they represent the special situations described above. With regard to traffic, a distinction is made in this FS between vehicular traffic over paved roads with no foot trails along the road (little to no pedestrian interaction), and areas of pedestrian traffic where people move more slowly and consequently spend more time in a given area, and may wander off the trail into the MRS (high pedestrian interaction).

1.6.1.1 Scenario 1

Based on CSM elements, Scenario 1 is an area where MEC has been found in a high pedestrian traffic area, or is an area where a previous removal recommendation was made, or is an area where buried munitions are known to exist.

MEC has been found in MRS 03. As shown in Figure A-2, MRS 03 is a region of high pedestrian traffic and is the location of B003 where a previous removal recommendation was made in the EE/CA. As shown in Figure A-3, unfired projectiles remain in the southern portion of MRS 05B. MEC has been found in MRS 06 and it is an area where a removal recommendation was made in the EE/CA (Figure A-4).

1.6.1.2 Scenario 2

Scenario 2 is where MEC has been found in a low/no pedestrian traffic areas. As shown in Figure A-2, MRS 03 has northern and southern portions that contained MEC but which are areas of low pedestrian traffic. Figure A-3 shows MRS 05B (northern portion) and 05E as low traffic areas; both areas where MEC has been found. MRS 05B is intersected by relatively busy Atlantic Drive, but that represents vehicular traffic with no foot traffic trails along the road (little to no pedestrian interaction). MRS 08A and 08B are also areas where MEC has been found, but which experience low/no pedestrian traffic (Figure A-5).

1.6.1.3 Scenario 3

Scenario 3 represents special situations. MRS 10 is the high pedestrian traffic shoreline where MEC has historically been observed washing onto the shore or exposed via erosion during storm events in the Atlantic Ocean. The area of MRS 05G was significantly impacted/alterd by Storm Sandy (2012) following the RI investigation such that more than 5 feet of the sandy terrain was removed. Since no munitions deeper than 1 foot were found at Fort Hancock, and the storm removed 5 feet of cover, it is unlikely that any MEC hazard remains in this small 2 acre area.. Scenario 3 represents special situations in that MEC removal is either impractical or unnecessary even though MEC was previously found at these MRSs and they have been categorized as representing unacceptable site conditions. These MRSs are shown on Figure A-6.

Table 1.2 summarizes the current MRSs that require analysis in this FS, the rationale, and the CSM elements used to group them into similar scenarios.

1.6.2 MRS Groupings

The three CSM scenarios identified in Table 1.2 were developed into MRS Groups that include all of the MRSs determined to pose unacceptable explosive hazards. These groups require follow-on actions, the specific nature of which will be determined through the alternatives analysis presented in this FS. As shown in Table 1.3, each group contains MRSs with attributes similar enough that the FS analysis can be conducted at the MRS Group level. Figures A-7 through A-9 show individual MRS Groups 1 through 3, respectively.

Table 1.2: Summary of MRS Characterization

MRS	Original RI Designation	Current Designation	Evaluated in FS	Rationale ¹	CSM Scenarios
MRS 03 Northern Portion Proving Ground	MRS 03	MRS 03	YES	Unacceptable Site Conditions	Scenario 1: MEC found, high pedestrian traffic area, previous removal recommendations (EE/CA)
MRS 05 Southern Portion Proving Ground	2A ²	05B North	YES	Unacceptable Site Conditions	Scenario 2: MEC found, low/no pedestrian traffic area
		05B South	YES	Unacceptable Site Conditions	Scenario 1: MEC found (existing buried munition items)
	4A	05E	YES	Unacceptable Site Conditions	Scenario 2: MEC found, low/no pedestrian traffic area
	5B	05G	YES	Unacceptable Site Conditions	Scenario 3: MEC found, high pedestrian traffic, but special situation (Storm Sandy significantly impacted/alterd the investigated area)
MRS 06 Livens Discovery Area	MRS 06	MRS 06	YES	Unacceptable Site Conditions	Scenario 1: MEC found, previous MEC removal recommendation (EE/CA)
MRS 08 Former NPS Excluded Areas	NA	08A	YES	Unacceptable Site Conditions	Scenario 2: MEC found, low/no pedestrian traffic area
	NA	08B	YES	Unacceptable Site Conditions	Scenario 2: MEC found, low/no pedestrian traffic area
MRS 10 Eastern Shoreline	NA	MRS 10	YES	Unacceptable Site Conditions	Scenario 3: MEC found, high pedestrian traffic, special situation (munitions historically washing up on shore or being exposed via erosion)

¹ - Due to potential risk posed by explosive hazards.

² - MRS 05B is one MRS divided to call out southern portion with existing buried munitions as identified in EE/CA.

Table 1.3: MRS Groupings

MRS Group	CSM Scenario	MRSs Included
Group 1	Scenario 1: MEC found, high pedestrian traffic, or areas of existing munitions, or where previous MEC removal recommendations have been made (EE/CA)	MRS 03 (30.2 acres), MRS 05B South (1.0 acres), MRS 06 (5.0 acres)
Group 2	Scenario 2: MEC found, low/no pedestrian traffic area*	MRS 05B North (38 acres), MRS 05E (5.1 acres), MRS 08A (11.8 acres), MRS 08B (59.2 acres)
Group 3	Scenario 3: Special situations where MEC has been found in high pedestrian traffic, but where Storm Sandy significantly impacted/alterd the investigated area, or munitions washing onto the shore or being exposed via erosion, has historically been observed	MRS 05G (2.1 acres), MRS 10 (179 acres)

*Some of the Group 2 MRSs categorized as low/no pedestrian traffic have unpaved trails (hiking, walking, etc.) running near them, but these have previously undergone a surface and sub-surface MEC clearance operation.

2.0 REMEDIAL ACTION OBJECTIVES

2.1 Remedial Action Objectives

Remedial action objectives (RAOs) specify the contaminants, military munitions, and media of concern, receptors and exposure pathways, and preliminary remediation goals that permit a range of treatment alternatives to be developed. RAOs drive the development of response actions with a goal of achieving the USEPA’s threshold criteria of “Overall Protection of Human Health and the Environment” and “Compliance with Applicable or Relevant and Appropriate Requirements.

2.1.1 Contaminants and Media of Concern

Based on the conclusions of the HHRA and SLERA presented in the 2014 RI Report, and updated for each RI Addendum (see Section 1.5.1), there is no unacceptable MC risk to either human or ecological receptors. Therefore, the RAOs do not address chemical contamination, but rather focus on MEC-related explosive hazards.

MEC distinguishes specific categories of military munitions that may pose unique explosives safety risks, includes UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); or MC (e.g., trinitrotoluene or cyclotrimethylenetrinitramine), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

The media of concern at the MRSs are surface and subsurface soil that may potentially contain MEC. Potential explosive hazards may remain in the surface and subsurface soil at the Fort Hancock FUDS, and areas categorized as having unacceptable site conditions with regard to potential explosive hazards (described in Section 1.5.2) require remedial actions to mitigate them. Table 2.1 summarizes the identified MEC items found within each MRS.

Table 2.1: Summary of MEC Items by MRS

MRS Group	MRSs	Identified MEC
Group 1	MRS 03	MK 1, 1.44-inch projectile, 10-inch, 4.7-inch, 5-inch, 3-inch and 75 mm projectiles, and a 3.5-inch armor piercing high explosive (APHE) projectile
	MRS 05B South	Two 12-inch unfired projectiles
	MRS 06	3-inch projectile, 4.7-inch projectile, Livens projectile containing FM smoke, potentially live Stokes mortar fuze
Group 2	MRS 05B North	5-inch APHE projectile
	MRS 05E	3-inch Stokes mortar and a 75mm projectile
	MRS 08A	4 inch MK10 APHE projectile
	MRS 08B	57mm Mk1 APHE projectile, 57mm projectile, M303 HE w/fuze, M86 APHE, 3-inch Mk 3 Model 7 projectile
Group 3	MRS 05G	4.5-inch Mark V APHE projectile
	MRS 10	3.5-inch, 6-inch, and 8-inch projectiles, Mk-25 Marine Marker, and a 5-inch AP projectile

2.1.2 Receptors and Exposure Pathways

The Fort Hancock FUDS CSM, presented in the 2014 RI Report, integrated information on the MEC source, receptors, and receptor/MEC interaction to complete the pathway analysis. The source of explosive hazards is primarily UXO resulting from firing activities at the proving ground batteries towards the impact areas. For potential unacceptable explosive hazards, the MEC pathway is considered to be complete because there is a source, potential receptors, and the potential for interaction between them.

Exposure pathways identified for human receptors include direct contact with surface MEC by handling and treading underfoot, and direct contact with subsurface MEC through intrusive activities (e.g., utility, construction, or maintenance workers, or recreational park user activities such as treasure hunting or digging for clams). At the Fort Hancock FUDS, there is a potential for wave action and storm surges during high winds, hurricanes, and strong storms to alter the terrain of the MRSs. While erosion of the sand has been observed to unearth MEC items, human intrusive actions are considered the primary mechanism for exposure to subsurface soil.

With regard to subsurface exposure, review of the previous investigations (EE/CA, RI and Addenda) indicates an average depth of MEC of approximately 0.5 feet below ground surface (bgs) with a maximum of 1 foot bgs. The depth of incidental intrusive activities within any MRS, based on current and future land uses, is not anticipated to exceed 2 feet bgs. That is, digging by hand in unstable sandy terrain, as might be done by a recreational park visitor, would not likely exceed 2 feet bgs. Any deeper excavations would be conducted by authorized park maintenance workers, and would require powered equipment.

2.1.3 Remediation Goals

Unlike RAOs for chemical contaminants, with cleanup levels typically set by the USEPA or state agencies based on specified risk levels, no regulatory guidelines have been promulgated specifying an acceptable hazard level associated with MEC contamination. Rather, MEC RAOs address specific goals for reducing the explosive hazards for MRSs to ensure protection of human health and the environment. For Fort Hancock FUDS MRSs potentially posing unacceptable explosive hazards, the remediation goal is to remove geophysically-identified anomalies that may represent MEC, or limit access to areas potentially containing MEC, thereby reducing the potential for encountering MEC and ensuring protection of human health and the environment.

2.1.4 Proposed Remedial Action Objectives

Fort Hancock FUDS MRSs that were designated as representing unacceptable site conditions require remedial actions to mitigate the potential explosive hazards they represent. The proposed RAOs for the remedial actions are based on site-specific information, including MEC as the contaminant of interest that may occur in the surface and subsurface soil, the depths for potential exposure of receptors (surface to 2 feet bgs), and the receptors most likely to be exposed (park workers and recreational users).

Combining the affected media, the exposure pathways, and the project goals, the proposed RAOs include:

- To reduce the unacceptable risk due to the presence of MEC on the surface or in the subsurface to a depth of 2 feet bgs to address direct contact by park workers and recreational users, and direct contact of MEC in the subsurface to depths greater than 2 feet

bgs by authorized park workers, such that an acceptable condition (as defined by RMM Matrix 4) is achieved.

2.2 Applicable or Relevant and Appropriate Requirements

Applicable or Relevant and Appropriate Requirements (ARARs) must be identified during the development of remedial alternatives. ARARs include federal and/or state promulgated standards, requirements, criteria, and limitations. Chemical-, location-, and action-specific ARARs are identified. Pursuant to CERCLA/NCP, compliance with ARARs is a threshold requirement that a remedial alternative must meet in order to be eligible for selection (unless the ARAR is waived).

The ARAR analysis is directed at substantive, promulgated regulations with regard to on-site activities [CERCLA § 121(d), 42 U.S.C. § 9621(d); NCP, 40 C.F.R. § 300.5]. Furthermore, CERCLA response actions, per CERCLA/NCP, are exempt from permits and similar procedural requirements with regard to on-site activities [42 USC § 9621(e)(1); 40 C.F.R. § 300.400(e)(1)].

For off-site activities (e.g., transportation), compliance is required for applicable, substantive and procedural requirements [NCP, 40 C.F.R. § 300.400(e)(2)]. Such off-site activities are not part of the ARAR analysis, but rather may be discussed under the Implementability factor, to the extent that they pose challenges for certain alternatives.

2.2.1 Definition of ARARs

Pursuant to the NCP, 40 C.F.R. § 300.5, a regulation may qualify as an ARAR if it meets the definition of being either “applicable” or “relevant and appropriate.” Each of these components is discussed below.

“Applicable” requirements means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

“Relevant and appropriate” requirements means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. Only those state standards that are promulgated, are identified by a state in a timely manner, and are more stringent than federal requirements may be relevant and appropriate.

Whether or not a requirement is appropriate (in addition to being relevant) will vary depending on factors such as the existence of wetlands or endangered species on or near the site, the duration of the response action, the form or concentration of the chemicals present, the nature of the release, the availability of other standards that more directly match the circumstances at the site, and other factors. In some cases only a portion of the requirement may be relevant and appropriate. The identification of relevant and appropriate requirements is a two-step process; only those requirements that are considered both relevant and appropriate must be addressed at CERCLA sites.

In addition to ARARs, advisories, criteria, or guidance may be identified as “to be considered” (TBC) information for a particular scenario. TBCs may be developed by USEPA, other Federal agencies, or states.

2.2.2 Identification of ARARs

Because of their site-specific nature, identification of ARARs calls for evaluation of federal and state environmental and facility siting laws regarding contaminants of concern, site characteristics, and proposed remedial alternatives. Requirements that pertain to the remedial response at a CERCLA site can be categorized as follows:

- **Chemical-specific ARARs** set health- or risk-based concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants. These ARARs establish either protective cleanup levels for the chemicals in the designated media or indicate the appropriate level of concern. For the Fort Hancock FUDS, there are no chemical-specific ARARs identified for MC in soils, since there were no MC risks identified in the HHRA or SLERA in the Fort Hancock RI Report and Addenda.
- **Location-specific ARARs** protect against damage to unique or sensitive areas such as floodplains, wetlands, and fragile ecosystems. They also restrict activities that may be harmful as a result of the characteristics of the site or the immediate environment.

Table 2.2 contains federal and state location-specific ARARs that are listed based on the presence of any threatened or endangered species. These include Piping Plovers, Roseate Terns, Leatherback Turtles, Tiger Beetles, Seabeach Amaranth, American Bittern, Least Terns, Osprey, Loggerhead Shrikes, Sedge Wrens, Eastern Box Turtles, Hop Sedge, and Gypsy Wort, as well as special concern plant, bird (including migratory birds), and insect species, and sensitive ecological communities, including wetlands, that have been documented on the peninsula, overlapping the MRS Group areas.

- **Action-specific ARARs** set controls or restrictions on specific removal/remedial activities at a site. They specify performance levels, actions, or technologies, as well as specific levels for discharges or residual chemicals.

All proposed activities were reviewed for potential impacts to threatened, endangered, and special concern species and sensitive areas, and will receive NPS approval prior to initiation. Disturbances to any such species or locations will be minimized in coordination with NPS.

During remedial activities, no adverse effects to freshwater, marine and fish habitats are expected.

To comply with the identified action-specific ARARs, all appropriate control measures will be in place to prevent impacts to local air and water during remediation. For any alternatives requiring excavation and removal of contaminated soils to an off-site location, the selected remedial action will comply with all applicable substantive and procedural construction management and hazardous waste transportation requirements associated with the off-site activities.

Table 2.2 lists the state and federal location-specific and action-specific ARARs for the remedial alternatives under evaluation. The ARARs, as specifically reviewed relative to each remedial alternative, are discussed in greater detail in Section 5.0, Detailed Analysis of Alternatives.

Table 2.2: Summary of ARARs

Requirement	Citation	Synopsis	Evaluation/Action To Be Taken
Federal Statutes/Laws			
LOCATION-SPECIFIC:			
Federal Endangered Species Act	16 USC 1538(a)(1)(B) (1991, as amended)	Prohibits action that would be considered a "take" of a threatened or endangered species.	Applicable. The following Threatened or Endangered Species have been observed on the site: Piping Plovers, Roseate Terns, Leatherback Turtles, Tiger Beetles, and Seabeach Amaranth. It is possible that the remedial action in Alternatives 2, 3, and 5 could cause a take to these species without specific action taken to avoid the take. Such action will be taken as described in Section 5.
Federal Migratory Bird Treaty Act of 1918	16 U.S.C. 703(a)	Protects over 800 bird species, their nests and their eggs from unlawful possession, transport, and harm. Prohibits action that would be considered a "take" of a threatened or endangered species.	Applicable. The following Migratory Birds have been observed nesting on the site: Piping Plovers, American Bitterns, and Roseate Terns. It is possible that the remedial action in Alternatives 2, 3, and 5 could cause a take to these species without specific action taken to avoid the take. Such action will be taken as described in Section 5.
ACTION-SPECIFIC:			
Federal Resource Conservation and Recovery (RCRA)	40 CFR 264.601/602/603	Establishes requirements under RCRA 40 CFR 264 subpart X applicable to operators of open burning/open detonation of explosive waste, including military munitions/explosive wastes. Specifically, 40 CFR 264.601, 264.602, and 264.603 require that miscellaneous units be located, designed, constructed, operated, maintained, monitored and closed in a manner that will ensure protection of human health and the environment. Only substantive portions are appropriate.	Applicable. Applies only to Alternative 5 and the possible movement of munitions pursuant to that Alternative.

Requirement	Citation	Synopsis	Evaluation/Action To Be Taken
State Statutes/Laws (Proposed by the State of New Jersey)			
LOCATION-SPECIFIC:			
NJDEP Endangered Plant Species List Act and Non-Game Species Conservation Act	NJSA 13:1B-15.151 etseq. NJAC 7:38-5.3 for protection of endangered plant species; NJSA 23:2A-1 to 23:2A-13 et seq for protection of threatened or endangered wildlife	Manages and protects endangered plant species and endangered, threatened and nongame wildlife populations in New Jersey.	Relevant and Appropriate. State threatened or endangered species observed on-site are American Bittern, Least Terns, Osprey, Loggerhead Shrikes, Sedge Wrens, Eastern Box Turtles, Hop sedge, and Gypsy Wort. It is possible that the remedial action in Alternatives 2, 3, and 5 could cause a take to these species without specific action taken to avoid the take. Such action will be taken as described in Section 5.

2.3 General Response Actions

General response actions are those actions that must be taken to satisfy the RAOs for the site. These are developed for each medium of interest defining treatment, excavation, or other actions. Volumes or areas of media are identified for which the general response actions might be applicable. The actions consider the requirements for protectiveness as identified in the RAOs and the chemical and physical characterization of the site. This FS addresses response actions to mitigate the potential explosive hazards due to MEC that may remain within the Fort Hancock FUDS.

For most MMRP sites, the general response actions evaluated typically include Land Use Controls (LUCs) such as fencing or institutional controls, and MEC Removal (geophysical investigation of anomalies followed by removal and destruction/disposal). (USACE, 2009). These are further described below:

Land Use Controls — LUCs include those mechanisms put in place to reduce the potential for receptors to encounter MEC. LUCs are intended to reduce, mitigate, or otherwise prevent direct contact with surface and subsurface MEC. These include physical LUCs (such as fencing), and administrative LUCs or institutional controls (such as signage, environmental covenants, and/or education).

MEC Removal — MEC is first detected through geophysical investigations, for example, DGM, and then removed from the surface or subsurface. Upon removal, the MEC is destroyed or treated, and then disposed.

From these general response actions, remedial alternatives that can achieve the RAOs were developed.

2.3.1 Potential Explosive Hazards Response Action Areas

Potential explosive hazards may remain in the surface and subsurface soil at the Fort Hancock FUDS, and areas categorized as having unacceptable site conditions with regard to potential explosive hazards (described in Section 1.5.2) require remedial actions to mitigate them.

Section 1.6 describes how the MRSs or response action areas were further organized to facilitate analysis in this FS. Table 1.3 presents the three MRS Groups that were developed to include all of the MRSs determined to pose unacceptable explosive hazards. Each group contains MRSs with attributes similar enough that the FS analysis can be conducted on the MRS group.

Figures A-2 through A-6 present the MRSs with shading to indicate the three CSM scenarios/MRS Groups they represent, and Figures A-7 through A-9 show individual MRS Groups 1 through 3, respectively.

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3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

At this step of the FS process, the universe of potentially applicable technology types is reduced by evaluation with respect to implementability, screening out technologies that are clearly ineffective or unworkable at a given site.

The term “technology” refers to general categories of technologies for addressing MEC such as detection, removal, and disposal. The term “process option” refers to specific processes within each technology. For example, the process options for detection technology include such things as magnetometers and electromagnetic induction (EMI) metal detectors.

Technology types and process options are eliminated from further consideration based on technical implementability. In part, this is accomplished by using actual data and on-site experience, focusing on technologies that have been successfully employed previously for similar situations within the Fort Hancock FUDS. In accordance with the USEPA guidance, one representative process is selected, if possible, for each technology type. The remaining process option then undergoes a more detailed evaluation against effectiveness, implementability, and cost criteria.

The technology types discussed below are considered technically implementable at the site. Table 3.1 provides the follow-on detailed screening of the technology types and process options indicating viability with regard to developing the remedial alternatives that can meet the RAOs.

3.1 LUC Technology Types

Administrative and physical LUC technology types include the process options described below.

3.1.1 Administrative LUCs

Process options addressed under administrative LUCs include legal mechanisms, educational awareness programs, and warning signs. Legal mechanisms can include restrictive covenants and deed notices. Administrative mechanisms include notices, local ordinances and land use plans, educational programs, or construction permitting that may be used to ensure use restriction compliance. Educational programs can include a variety of types of information dissemination and training that can be tailored to specifically address an identified hazard and exposed populations. These are institutional controls designed to limit land or resource use by providing information that helps modify or guide human behavior at a site.

3.1.2 Physical LUCs

Process options addressed under physical LUCs include engineered structures to contain or reduce contamination and physical barriers to limit access to property, such as fencing.

3.2 Detection Technology Types

Subsurface detection can be accomplished through use of one or a combination of geophysical process options, including sensors such as magnetometers, EMI sensors, and advanced classification technology. While these options vary in level of cost, ease of use, and availability, under certain conditions, each technology can be capable of achieving the RAO, as described below.

3.2.1 Analog Magnetometers

Hand-held analog geophysical instruments, such as the Schonstedt magnetic locator or any of the White’s All-Metals detectors, are used in sweep mode as the instrument is passed back and forth in well-defined search lanes. These analog instruments emit an audible signal as the instrument is

moved past a metallic item. The UXO Technician stops when an anomaly is encountered, flags, and then excavates the item (a procedure known as “mag & dig”). EM 200-1-15 contains robust QC and seeding program requirements that must be met for analog methodologies.

Due to its effectiveness, simple operation, and availability of hand-held units, magnetometry is a commonly used technology for locating buried UXO. This technology is light and compact and can be used in any traversable terrain, but depending on the size of the item, the detection depth is generally limited to less than 2 feet bgs. At the Fort Hancock FUDS, the smallest item found was a 1.44 inch projectile, which would produce a small but detectable magnetic or electromagnetic signal at a depth of 2 feet, but which would likely be near undetectable at a depth of 4 feet (based on testing conducted by the Naval Research Laboratory (2008, 2012).

Perhaps most significantly for the Fort Hancock FUDS, mag & dig methods may be preferable to DGM (described below) for MEC removals, because hand-held sensors could be used to search for anomalies in thick sensitive vegetation, without cutting, by inserting the sensor between branches; while some vegetation removal would still be needed to clear metallic anomalies, the impact would be far less severe than the vegetation removal requirements for DGM procedures.

Based on previous successful implementation at the Fort Hancock FUDS, effectiveness, and reasonable costs, the analog Schonstedt or All-Metals detectors are technically implementable at the site. In addition, the state regulator has requested that the All-Metals version be used for any future remedial activities.

3.2.2 DGM Instruments

DGM instruments collect geo-referenced sensor data that can be analyzed, processed, and used to identify targets with known coordinates. Because coordinates are known, the target anomalies can be reacquired and excavated at a later date.

Digital magnetometers, such as the Geometrics G-858, work on the same principle as analog magnetometers, detecting anomalies in the earth’s magnetic field. The instruments are effective at detecting MEC items within 4 feet or more into the subsurface depending on the item’s size, shape, attitude and ferrous content. These instruments are readily available for rental and can be easily implemented with a moderate relative cost. The G-858 has previously been successfully used at the Fort Hancock FUDS during the RI field effort.

Digital electromagnetic instruments, such as the Geonics EM61, work on the same principle as analog electromagnetic instruments, transmitting electrical current and measuring either the secondary magnetic field induced in metal objects or the difference between the electrical conductivity of the soil and the object. Electromagnetic instruments detect non-ferrous as well as ferrous metallic items, and thus can detect a broader range of munitions items. However, they may also detect more non-munitions debris. These instruments are readily available and can be easily implemented with a moderate relative cost. The EM61 has previously been successfully used at the Fort Hancock FUDS.

Conducting full DGM operations using these types of instruments necessitates significant clearing of vegetation (including near clear cutting of multiple investigation grids) in order to obtain adequate geophysical coverage, but DGM is considered technically implementable.

3.2.3 Advanced Geophysical Classification Technology

Advanced geophysical classification (AGC) is a relatively new approach to improve the efficiency of munitions response DGM. AGC sensors may be used dynamically to cover areas of investigation similar to an EM61, however, dynamic mode would provide substantially more information about metallic items left on the site to confirm their characterization, and “cued” surveys allow for collection of a large amount of data over a single location where an anomaly has been detected previously. Through advanced processing, it is possible to determine with high confidence that a subsurface metallic object is or is not likely to be a munition item, thereby greatly reducing the number of excavations necessary at a typical MRS, resulting in overall cost savings.

Table 3.1: Technology Types and Process Options Screen

Technology Type	Process Option	Effectiveness	Implementability	Cost	Viability-Status
LUCs (Administrative)	Legal Mechanism	High: Effective for ensuring land use restrictions remain in place during and after changes in property ownership.	Low: The Army cannot impose or enforce new easements on property already transferred to the U.S. Department of Interior (NPS).	Low	Not Retained
	Educational Awareness Program	Moderate: Effectiveness of educational awareness program depends upon ability to notify all potential parties who may go to the site and obtaining their cooperation.	Moderate: Although preparing fact sheets and providing training is relatively easy, it is more difficult to ensure everyone who may potentially visit the site is properly informed, and success depends upon public cooperation.	Low	Retained
	Warning Signs	Moderate-High: Effective in reducing risk associated with potential MEC by limiting access and reducing the potential for receptor exposure to MEC.	High: Signage is common at Fort Hancock. Warning signs are easily implemented (readily available materials). Must be periodically inspected and maintained.	Low	Retained
LUCs (Physical)	Annual Inspections	Moderate: Useful to evaluate performance and maintain integrity of engineering controls.	High: Readily Implemented. Technical staff required to perform inspection and maintenance of LUCs.	Low-Moderate	Retained
	Fencing	Moderate-High: Can prevent access to areas as an engineering control. Must be maintained to remain effective.	Moderate: Fort Hancock is currently open to the public; fencing may be acceptable to the NPS personnel. Installation in some locations may adversely impact sensitive species.	Moderate	Retained
Detection	Analog Sensors	Moderate-High: Analog electromagnetic induction devices may be used with analog magnetometers. Mag & dig is a general term describing analog detection and intrusive investigation in real-time. May be used under dense canopy where GPS denial is common, is relatively simple in operation, and is low maintenance.	High: Analog instrument reliability is proven in almost all weather conditions. It is easy to operate in various terrains and vegetation. Analog instruments, such as Schonstedts or all-metals detectors, are routinely used by UXO technicians, and therefore, trained operators are readily available. EM 200-1-15 contains robust QC and seeding program requirements that must be met for analog methodologies.	Moderate	Retained The all-metals detector version has been requested by state regulators and is recommended for future remedial activities
	Digital Geophysical Mapping	High: DGM (magnetometers and EMI) is effective in detecting ferrous and nonferrous metals. Depth range is variable, depending on size and orientation of object, but can reliably detect medium to large MEC up to a depth of 2-4 feet bgs. Non-munitions related metallic debris may interfere with MEC detection; however, data are less impacted by natural geological interferences. The digital data captured by DGM sensors provides a record of the subsurface at the MRS.	Low-Moderate: DGM equipment is readily available and reliable for use in a variety of terrain and weather conditions. Several detectors can be mounted on a single platform to increase production rates of geophysical data gathering. DGM equipment operators, data processors and analysts require specialized training to effectively utilize the full capability of the instruments. DGM allows potential MEC items to be more easily detected, which adds an increased level of protection for workers conducting future removal activities within the MRS. However, restrictions on vegetation clearance imposed by the site owner is a significant limiting factor in obtaining DGM coverage in many areas.	Moderate	Retained: While the vegetation clearance requirements to achieve a high level of effectiveness for a MEC removal, and the consequent adverse impacts to sensitive species are significant, DGM can be viable for selected areas of the site. However, the anticipated need to supplement DGM with mag & dig for sensitive species areas lessens the overall cost efficiency of this option.
	Advanced Geophysical Classification	High: Although not more effective at detection than DGM, it is considered more effective overall by allowing classification of anomalies as either MEC or non-MEC items. Detects both ferrous and nonferrous metallic objects.	Low-Moderate: AGC systems are currently available for use, including the Geometrics MetalMapper 2x2 and Man Portable Vector (MPV). Both systems require highly trained personnel for data processing and much longer field durations than conventional DGM efforts due to slower production rates. Can be used in most traversable terrain, but requires significant vegetation clearance for equipment access, resulting in adverse impacts to sensitive species. Restrictions on vegetation clearance imposed by the site owner is a significant limiting factor in obtaining AGC coverage in many areas. Although the MPV has a smaller footprint than the MetalMapper, it would still require more cutting of vegetation than the analog Schonstedt or all-metals detectors.	Moderate	Retained: While the vegetation clearance requirements to achieve a high level of effectiveness, and the adverse impacts to the sensitive species are significant, AGC can be viable for selected areas of the site. However, it is anticipated that AGC will also need to be supplemented with mag & dig for sensitive species areas, lessening the overall cost efficiency of this option.

Technology Type	Process Option	Effectiveness	Implementability	Cost	Viability-Status
Positioning	Differential Global Positioning System (DGPS)	High: Very effective in open areas for digital mapping and reacquiring anomalies. Achieves accuracy to a few centimeters, but is dependent on available satellites.	High: Easy to operate and available from various vendors. Highly dependent on site conditions and field time can consequently be lost when insufficient satellites are available because of tree canopy.	Moderate	Retained: Was used effectively during the Fort Hancock RI in open areas.
	Robotic Total Station	High: Effective in open areas for digital mapping and reacquiring anomalies. Effective around buildings and sparse trees. Achieves accuracy to a few centimeters.	Moderate: Easy to operate with trained personnel, but requires existing survey control and must maintain constant line of sight between total station and roving prism. Potential impacts to natural resources based on clearing of areas for highest quality data collection. It is generally more time-consuming than use of DGPS, all other conditions being equal.	Moderate	Retained: While this technology has been used effectively at many sites for DGM, it was not used previously at Fort Hancock; it would be relatively easy to employ in some locations and very difficult in others.
	Fiducial Method	Low-Moderate: Moderate effectiveness when performed by experienced personnel, and low effectiveness when used by inexperienced personnel. Accuracy is 15 to 30 centimeters.	Low-Moderate: Requires a constant pace and detailed field notes. Can be used anywhere, with varying degrees of complexity in the operational setup. Requires additional data processing on the back end.	Moderate	Retained
Removal	Manual (Hand) Excavation	High: Very effective for removing surface and subsurface items. Control of hand digging reduces risk associated with workers excavating potential MEC.	High: Manual excavation of anomalies is the most widely used method for removal of MEC. Requires either a DGM survey to locate target anomalies, or use of the mag & dig approach. UXO-qualified technicians use small hand tools to remove soil overburden. Intrusive activity risk to workers is mitigated through the use of highly skilled UXO-qualified technicians controlling the excavation.	Moderate	Retained: Previously used successfully at Fort Hancock. Sandy soils allow for relatively easy hand digging.
	Mechanical Excavation using Powered Equipment	High: Very effective for removing surface and subsurface items. Reduces risk associated with site workers. Most effective for deeper items where hand digging could be problematic.	Low: Use of powered equipment to excavate anomalies requires a lower degree of direct MEC exposure for workers than hand digging. Requires either a DGM survey to locate target anomalies, or use of the mag & dig approach. UXO-qualified technicians typically use an armored excavator to remove soil overburden. However, at Fort Hancock, where most munitions-related items were less than 2 feet bgs, large-scale use of an excavator would unnecessarily significantly impact sensitive species.	High	Not Retained: Unnecessarily destructive to sensitive species considering most munitions-related items were less than 2 feet bgs. Site owner NPS has expressed lack of support for powered equipment in the subject areas.
	Sifting	High: Provides a high degree of confidence that MEC is effectively removed and increases efficiency in areas of highly concentrated anomalies potentially representing MEC. Not as suitable for areas where primarily single point anomalies are anticipated, such as Fort Hancock.	Low: Requires shielded/armored equipment, and heavy equipment operators. Would require clearing that would adversely impact sensitive species.	High	Not Retained: Unnecessarily destructive to sensitive species considering primarily single point anomalies are anticipated, and only a small area of high anomaly concentrations may be encountered.
Disposal	Blow-in-Place	High: Effective method for conducting MEC disposal operations of items considered not safe to move.	High: Commonly implemented by UXO-qualified technicians on MMRP sites. Sandbags or water mitigation may be used to reduce the intentional detonation minimum separation distance.	Low	Retained: Has been used multiple times at Fort Hancock during the RI activities.
	Consolidated Shot	High: Effective method for conducting MEC disposal operations. Acceptable to move MEC items are consolidated at a collection point within the MRS where controlled detonation renders items safe.	High: Commonly implemented by UXO-qualified technicians on MMRP sites. Sandbags or water mitigation may be used to reduce the intentional detonation minimum separation distance.	Low	Retained: Has been used previously at Fort Hancock during the RI activities.

At the Fort Hancock FUDS, the limitations on DGM coverage imposed by vegetation cutting restrictions will also apply to AGC sensors, significantly impacting the effective implementation of AGC instruments at the site. For example, based on discussions with NPS personnel, it is estimated that approximately 75% of the MRS Group 1 acreage would not allow sufficient vegetation removal to employ AGC technology. However, for the open areas of shoreline in MRS Group 3, AGC technology could be used for 100% of the acreage. Another consideration regarding Analog vs AGC methodology is that the ease of hand digging in the sandy soil may counterbalance the possible cost savings of the use of AGC sensors (i.e., it may be more cost-effective to excavate anomalies in loose sand, than to conduct a lengthy cued survey on them as a means to reduce the number of anomalies to be dug). However, while never used at Fort Hancock, AGC is considered technically implementable.

3.3 Positioning Technology Types

Positioning technology includes process options such as Differential GPS (DGPS), Robotic Total Station (RTS), and the fiducial method. Each of these is considered technically implementable at the site.

3.3.1 Differential GPS

DGPS uses a constellation of satellites to form a worldwide positioning and navigation system. GPS uses these satellites as reference points to calculate positions on the Earth's surface with centimeter accuracy.

3.3.2 Robotic Total Station

RTS is a survey station consists of a robotic precision laser rangefinder and a roving prism. The robot records the distance and angle between itself and the prism. It can be used for conventional surveying or it can be integrated with geophysical instruments for navigation.

3.3.3 Fiducial Method

The fiducial positioning method consists of digitally marking a data string with a known position indicator. That is, markers are placed on the ground at known positions (e.g., 25 feet) as a means of establishing position.

3.4 Removal Technology Types

MEC Removal technologies include the process options of manual excavation (typically using hand shovels), mechanized excavation using powered equipment, and area-wide excavation and sifting. MEC removal can be performed in a targeted fashion, where individual items are detected, identified, and removed one at a time.

The use of heavy equipment is required for both mechanical excavation and area-wide excavation and sifting, often resulting in considerable disturbance to plant communities; this is a major disadvantage for the Fort Hancock FUDS where NPS imposes restrictions on vegetation removal activities.

Hand excavation has been conducted extensively during the EE/CA and RI efforts. Hand excavation is considered the industry standard for MEC recovery and can be done very thoroughly and for a low cost relative to other excavation options that require heavy equipment, particularly at this site where loose sandy beach soil is encountered.

Each of these removal process options is considered technically implementable at the site.

3.5 Disposal Technology Types

Disposal technology includes the process options of in-situ demolition, also known as “blow-in-place” (BIP), and consolidation of items with subsequent on-site demolition. These process options are equally effective at removing MEC from the MRS, but differ in their implementability and cost.

BIP demolition is effective, implementable, and relatively low cost. At the Fort Hancock FUDS, almost all disposal during the previous investigations has been accomplished through in-situ demolition (BIP).

Consolidated on-site demolition is controlled detonation of a number of MEC items that are safe to move to a single disposal site where they are destroyed. This approach reduces the number of detonations and therefore limits impacts to the environment. It also allows for detonations to occur in areas where conditions are favorable for site control, evacuation, access, and fire control. This disposal process option has also been employed successfully at the Fort Hancock FUDS.

Each of these disposal process options is considered technically implementable at the site.

3.6 Summary of Explosive Hazards Technologies and Process Options

For the process options considered technically implementable at the site, Table 3.1 provides the screen against effectiveness, implementability, and cost.

3.6.1 LUCs

Following the screen, all LUC process options with the exception of legal mechanisms, were retained for the Section 4.0 alternatives development.

3.6.2 Detection

Both mag & dig techniques and DGM followed by anomaly removal have been used successfully to investigate and reduce potential explosive hazards due to MEC. However, as discussed at length in the 2014 RI Report, DGM coverage has historically been limited due to vegetation cutting limitations imposed by NPS. While the DGM coverage obtained during the investigative phases was sufficient to categorize nature and extent, sufficient coverage for a MEC removal would require significant vegetation clearance. Relative to avoiding impact to dense sensitive vegetation, the EM61 instrument footprint is a substantial 0.5 square meters. Conducting full DGM operations using such an instrument necessitates significant clearing of vegetation (including near clear cutting of multiple investigation grids) in order to obtain adequate geophysical coverage. However, selected areas of the site would allow for DGM technology and therefore, the DGM process option was retained for the alternatives development.

The AGC process option would also require significant vegetation impact in areas of sensitive plant communities. The footprint of the TEMTADS and MetalMapper 2x2 instruments are each approximately 1 square meter. The smallest AGC instrument footprint is the MPV, approximately 0.2 square meters, and it would still impact more vegetation than the analog instruments. The additional work involved in identifying an anomaly, as opposed to just digging it, may not be justified from a cost-benefit perspective considering the relative ease of hand digging in the sandy soil conditions. However, selected areas of the site would allow for AGC technology, and therefore, the AGC process option was retained for the alternatives development.

Based on the many field efforts conducted at the site, DGM or AGC surveys would likely require a supplemental mag & dig removal where NPS has prohibited cutting of or impacting sensitive plant communities.

The analog instruments, such as the schonstedt or White's All-Metals detectors, have the smallest footprint, essentially the width of the tip of the device or approximately 0.05 square meters. The vegetation density of sensitive species (up to 50% of some areas based on knowledge of the site) is such that the option that minimizes disturbance to vegetation is more viable for MEC removals than a DGM/AGC option, and therefore, the analog detector process option was also retained for the alternatives development.

The best available geophysical technology detection process option, based on access and vegetation clearance requirements for specific site areas, will be utilized for the alternatives development.

3.6.3 Positioning

While the DGPS process option was used most successfully during the Fort Hancock RI efforts, all positioning options were retained for the alternatives development.

3.6.4 Removal

With regard to removal process options, there are also Fort Hancock FUDS-specific depth considerations that make one option more viable than the others. A distinction can be made for MEC removal down to 2 feet bgs and removal to depths greater than 2 feet.

Recreational park users who may participate in activities such as clam digging or treasure hunting, are unlikely to reach depths greater than two feet in soft unstable sandy conditions without powered equipment; thus, 2 feet bgs is a practical maximum for such activities at the site. Further, 2 feet bgs is a conservative depth that accounts for the maximum depth of previous MEC finds (approximately one foot) plus one foot of soil cover; the extra foot of cover addresses the potential for shifting terrain and sand deposition in a coastal environment (i.e., a MEC item that was originally one foot bgs may now be as deep as 2 feet bgs due to a storm event).

Authorized park workers (utility or construction contractors), who may need to achieve greater depths, could only do so by use of powered equipment. However, there is a practical depth limitation even with powered equipment as the shallow water table of the peninsula (in places less than 4 feet bgs) combined with unstable sandy conditions would tend to collapse an excavation at depths where the sandy soil is saturated. Intrusive activities conducted by authorized park workers that extend to beyond 2 feet bgs could be addressed with a LUC. While the Army cannot impose restrictive covenants on FUDS property, the Army can work with the NPS to ensure needed restrictions or notifications (e.g., no intrusive work greater than 2 feet bgs without adequate safety measures, or notifications of the intent to safely conduct such activities) are implemented and maintained.

Therefore, based on successful previous implementation at this site, the target depth component, effectiveness, and low cost, hand excavation is determined to be the most viable technology removal process option and it has been retained for alternatives development. Excavation using powered equipment, including that needed for sifting operations, is not considered viable based on NPS restrictions regarding disturbance to plant communities, and these options were not retained.

3.6.5 Disposal

BIP and consolidated shot disposal process options have both been used successfully at Fort Hancock, and both were retained for alternatives development. Note that in limited cases at Fort Hancock, EOD personnel from nearby Naval Weapons Station Earle came to the site and physically removed MEC for processing at their facility. However, this was based on special case scenarios for larger size munition items, and the process option is not considered practical for an actual MEC removal based on the low amount of MEC expected; it was not retained.

The technologies and process options retained for alternatives development, as described above, are those that can achieve the RAOs.

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4.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

4.1 Introduction

At this stage of the FS, the results of the technology screening and the media of concern are combined to develop and assemble alternatives that meet the RAOs. Defined alternatives are evaluated against the short and long-term aspects of three broad criteria: effectiveness, implementability, and cost. The purpose of the screening evaluation is to reduce the number of alternatives that will undergo the more thorough and detailed analysis against the CERCLA nine criteria in the next section (Section 5.0), and is therefore, a broader, more general screening.

The DERP Manual, 4715.20 (DoD, 2012) requires consideration of at least three alternatives: No action, action to remediate a site to a condition that allows for UU/UE, and action to remediate a site to a protective condition that requires LUCs.

The remedial alternatives presented in Section 4.2 represent scenarios that meet the RAOs for the potential explosive hazards to varying degrees, and comply with the DERP Manual requirements. The broad criteria against which they are screened are defined as follows:

4.1.1 Effectiveness

This criterion is evaluated with respect to effectiveness in protecting human health and the environment, and providing reduction of MEC volume. The short-term (construction and implementation period) and long-term components (effective period after the remedial action is complete) are also evaluated.

4.1.2 Implementability

This criterion is evaluated as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial alternative. Technical feasibility is the ability to construct, reliably operate and maintain (as required) an alternative, while administrative feasibility refers to the ability to obtain approvals from agencies, and the availability of required goods and services.

4.1.3 Cost

The cost of each alternative is also evaluated. However, at this stage, it is not necessary to define the cost with the same level of detail or accuracy required for the detailed analysis presented in Section 5.0. Prior estimates, sound engineering judgment, and most importantly, real-world cost experience based on having previously completed portions of these efforts within the Fort Hancock FUDS, are sufficient to help evaluate one alternative against another.

4.2 Identification of Remedial Alternatives

4.2.1 Explosive Hazards Remedial Alternatives

Based on the explosive hazards mitigation technologies review in Section 3.0, five remedial alternatives have been identified to mitigate the potential explosive hazards due to MEC that may remain within the Fort Hancock FUDS:

- Alternative 1: No Action
- Alternative 2: Administrative LUCs
- Alternative 3: Physical LUCs
- Alternative 4: MEC Removal to UU/UE

- Alternative 5: MEC Removal to 2 feet with LUCs

4.3 Screening of Explosive Hazards Remedial Alternatives

The following sections provide a brief description of each alternative to mitigate the potential explosive hazards due to MEC that may remain within the Fort Hancock FUDS.

4.3.1 Alternative 1: No Action

The No Action alternative is evaluated to satisfy the NCP requirement of 40 CFR 300.430(e)(6), which requires consideration of this alternative as a baseline against which other alternatives may be compared. The no action alternative would involve leaving the subject areas in their current condition. Under this alternative, no remedial action will be taken, and any potential explosive hazards contaminants are left "as is," without the implementation of any containment, removal, treatment, or other protective actions. This alternative would leave any MEC items potentially present, in place, without further investigation or removal. This alternative does not provide for additional investigation for or removal of MEC items, and does not provide for any active or passive land use controls to reduce the potential for exposure (e.g., physical barriers, deed restrictions).

Effectiveness: The no action alternative would not provide for protection of human health and the environment. The potential explosive hazards associated with MEC would not be expected to decrease significantly over time without removal. Therefore, this alternative would not be effective in achieving the RAOs in the short-term or the long-term, as it does not reduce the volume of MEC, and it does not allow for UU/UE.

Implementability: The no action alternative is easy to implement. No services or materials would be required to implement this alternative. However, it will be technically ineffective and administratively unfavorable and will fail to achieve the RAOs.

Cost: There are no costs associated with the no action alternative.

Outcome: Alternative 1 fails the effectiveness and implementability criteria. However, in accordance with the NCP, this alternative must be evaluated against the threshold criteria and balancing factors in the next section, as a baseline for comparison, and is therefore retained for further evaluation.

4.3.2 Alternative 2: Administrative Land Use Controls

Administrative LUCs can include signage, environmental covenants, and/or education to limit access to the MRS. As developed for the Fort Hancock FUDS, this alternative would include the use of signage installed in appropriate locations to limit access by providing awareness of potential hazards, education concerning the hazards (pamphlets, flyers, etc.) suspected to be present within the MRS. These institutional controls are designed to limit land or resource use by providing information that helps modify or guide human behavior at a site.

A key element of this alternative is the requirement to ensure the safe conduct of any intrusive activity conducted by authorized park utility, maintenance, or construction workers. While the Army cannot impose restrictive covenants on FUDS property, the Army can work with the NPS to ensure needed restrictions or notifications (e.g., no intrusive work greater than 2 feet bgs without adequate safety measures, or notifications of the intent to safely conduct such activities) are implemented and maintained.

The education and awareness initiatives associated with proposed LUCs will apply to the entire Sandy Hook Gateway National Recreation Area community (to include NPS workers, tenants and Park visitors) since these receptors' activities will not be confined to specific MRS boundaries. This will ensure that potential receptors are informed about potential residual explosive safety risks that could be encountered by visitors in this high traffic National Park area.

For this alternative, USACE would develop an LUC Implementation Plan (LUCIP), which would include a delineation of enforcement and maintenance responsibilities, in coordination with NPS. This includes advising the NPS to exercise anomaly avoidance procedures for areas that may be developed in the future, and to perform visual inspections for uncovered munitions following storm events.

Effectiveness: The Administrative LUCs alternative would provide protection of human health and the environment by modifying human behavior and limiting the potential for an encounter with MEC that may be present. However, this alternative does not reduce the volume of MEC, and it does not allow for UU/UE. This alternative can be effective in the short-term and the long-term with the cooperation of the owner (NPS) and the proper protection of workers involved in the implementation (e.g., installing signage). Instituting LUCs requires cooperation and coordination between the federal government, state environmental regulators, and the property owners. In order for LUCs to be effective, the parties must consult and work collaboratively to take responsibility for their implementation, management and enforcement.

Implementability: The Administrative LUCs alternative can be readily implemented by designing and installing signage to limit access to the MRS. Educational materials can be developed and notifications of intrusive work can be enforced. The materials and services required to implement this alternative are available. The administrative feasibility of LUCs, i.e., the ability to obtain approvals from agencies, is likely to be achieved. Administrative services would be necessary in the implementation of this alternative to design signage, educational materials, and develop notification requirements for all intrusive activities.

Cost: The costs for this alternative would not be prohibitive. LUCs would include a LUCIP, installation and operation & maintenance (O&M) of signage costs, and administrative costs for development of educational and notification requirements. O&M costs are included for USEPA's suggested maximum 30 year period as it cannot be determined how long O&M will be required.

Outcome: While Alternative 2 is not effective in reducing the volume of MEC and does not allow for UU/UE, it is effective and implementable. Accordingly, the Administrative LUCs alternative will be evaluated in the detailed analysis because it meets key elements of the effectiveness and implementability criteria.

4.3.3 Alternative 3: Physical Land Use Controls

Physical LUCs can include fencing or covering/paving areas to physically limit access and potential encounters with any MEC. As developed for the Fort Hancock FUDS, this alternative would include the use of fencing installed around the MRS and notification requirements for all intrusive activities. Fencing would be constructed that meets the aesthetic requirements of the NPS while being of sufficient construction to physically prevent access to the MRS.

As described for Alternative 2, a key element of this alternative is the requirement to ensure the safe conduct of any intrusive activity conducted by authorized park utility, maintenance, or construction workers. While the Army cannot impose restrictive covenants on FUDS property, the Army can work with the NPS to ensure needed restrictions or notifications (e.g., no intrusive

work greater than 2 feet bgs without adequate safety measures, or notifications of the intent to safely conduct such activities) are implemented and maintained.

The education and awareness initiatives associated with proposed LUCs will apply to the entire Sandy Hook Gateway National Recreation Area community (to include NPS workers, tenants and Park visitors) since these receptors' activities will not be confined to specific MRS boundaries. This will ensure that potential receptors are informed about potential residual explosive safety risks that could be encountered by visitors in this high traffic National Park area.

For this alternative, USACE would develop a LUCIP, in coordination with NPS, to delineate enforcement and maintenance responsibilities.

Effectiveness: The Physical LUCs alternative would provide protection of human health and the environment by physically limiting the potential for an encounter with MEC that may be present. However, this alternative does not reduce the volume of MEC, and it does not allow for UU/UE. This alternative can be effective in the short-term, although there will be disruption to park activities as fencing is installed. It can also be effective in the long-term with the cooperation of the owner (NPS) and the proper protection of workers involved in the implementation (e.g., installing/maintaining fencing). Instituting LUCs requires cooperation and coordination between the federal government, state environmental regulators, and the property owners. In order for LUCs to be effective, the parties must consult and work collaboratively to take responsibility for their implementation, management and enforcement.

Implementability: The Physical LUCs alternative can be readily implemented by designing and installing fencing to limit access to the MRS, although for some MRSs there will be a need for fencing of pedestrian trails in high traffic areas that may be somewhat impractical (or impracticable for the beach areas). Educational and notification requirements for intrusive work can be enforced. The materials and services required to implement this alternative are available. The administrative feasibility of LUCs, i.e., the ability to obtain approvals from agencies, is likely to be achieved. Administrative services would be necessary in the implementation of this alternative to design fencing and notification requirements for all intrusive activities.

Cost: The costs for this alternative would be low to moderate depending on acreage. LUCs would include a LUCIP, vegetation cutting costs, installation and O&M of fencing costs, and administrative costs for development of educational and notification requirements. O&M costs are included for USEPA's suggested maximum 30 year period as it cannot be determined how long O&M will be required.

Outcome: While Alternative 3 is not effective in reducing the volume of MEC and does not allow for UU/UE, it is effective and implementable. Accordingly, the Physical LUCs alternative will be evaluated in the detailed analysis because it meets key elements of the effectiveness and implementability criteria. However, as it is completely impractical for the dynamic shoreline areas that make up MRS Group 3, it has been screened out of the Section 5.0 analysis for Group 3.

4.3.4 Alternative 4: MEC Removal to UU/UE

As the DERP Manual requires an action to remediate a site to a condition that allows for UU/UE, Alternative 4 was developed. Therefore, Alternative 4 would include complete removal and subsequent destruction of MEC such that LUCs would not be required.

While munition items at the Fort Hancock FUDS were mostly encountered at shallower depths, achievement of the UU/UE standard under Alternative 4 will require excavations to four feet bgs

or greater in some areas. Park maintenance or construction contractors, whose work may require depths greater than approximately 2 feet bgs, could only do so by use of powered equipment. Even with powered equipment there may be a practical depth limitation in locations where the shallow water table of the peninsula (less than 4 feet bgs in places) combined with unstable sandy conditions would tend to collapse excavations. Where saturated conditions are not encountered, the unstable soil conditions would still make the level of excavation necessary for MEC removal to UU/UE conditions problematic, and therefore the use of heavy excavation equipment and elaborate soil-sifting methods would be required.

As Section 3.6 discusses, the best available geophysical technology detection process option, based on access and vegetation clearance requirements for specific site areas, will be utilized for the removal action. Full DGM operations, as discussed in Sections 3.2.2 and 3.2.3, would be required for this alternative, necessitating significant clearing of vegetation to obtain adequate geophysical coverage for a MEC removal to achieve the UU/UE standard.

Effectiveness: This alternative would be protective of human health and the environment. It is effective in the long-term as MEC will be removed and destroyed, reducing the volume of contaminants (MEC), eliminating any residual explosive hazards to four feet bgs, and allowing for UU/UE. However, this alternative does not provide short-term effectiveness as it would take considerable time to implement. During implementation, health and safety precautions would be required to protect workers and park visitors from accidental detonation of MEC items. Additionally, significant safety precautions would be associated with the deeper excavations that may require elaborate shoring methods for worker safety.

Implementability: This alternative is not considered technically and administratively feasible. Technical feasibility is adversely impacted by the need to achieve removal depths that can only be accomplished through significant vegetation cutting for DGM operations and which would also likely require elaborate shoring of unstable subsurface soils. Administrative feasibility is adversely impacted by the need to obtain approval from NPS to block off significant portions of the park to protect visitors and NPS personnel. Further, the potentially significant amount of damage to the sensitive and ecologically valuable plant communities may be problematic.

Cost: The cost to implement this alternative is significant. Costs include multiple teams of vegetation cutters, geophysical survey team field activities, and specially trained UXO Technicians to safely conduct the MEC removal and subsequent destruction. Potentially elaborate excavation operations, including shoring of the deeper unstable subsurface, would need to be planned, designed, and safely implemented.

Outcome: Alternative 4 is not effective in the short term, is not technically or administratively feasible, and is cost prohibitive. Therefore, Alternative 4 will not be retained for the detailed comparative analysis in the next section.

4.3.5 Alternative 5: MEC Removal to 2 feet with LUCs

Alternative 5 entails conducting a partial MEC removal and subsequent destruction using mag & dig procedures down to 2 feet bgs, and implementing an educational and notification requirements LUC should there be a need to go deeper than that for maintenance or construction type activities.

As discussed in Section 3.4, recreational park users who may participate in activities such as clam digging or treasure hunting (which is illegal on NPS sites) are unlikely to reach depths greater than two feet in soft unstable sandy conditions without powered equipment; 2 feet bgs is therefore a

practical maximum depth for such activities at the site. Further, 2 feet bgs is a conservative depth that accounts for the maximum depth of previous MEC finds (approximately one foot) plus one foot of soil cover; the extra foot of cover addresses the potential for shifting terrain and sand deposition in a coastal environment (i.e., a MEC item that was originally one foot bgs may now be as deep as 2 feet bgs due to a storm event).

A removal depth of 2 feet bgs will minimize plant community impacts. Therefore, a MEC removal depth to 2 feet bgs with educational and notification requirements to safely conduct intrusive activities at greater depths, will achieve the RAO. As Section 3.6 discusses, the best available geophysical technology detection process option, based on access and vegetation clearance requirements for specific site areas, will be utilized for this partial removal action. Note that under this alternative, should an anomaly be detected during the partial removal that extends deeper than 2 feet bgs, work will continue until the anomaly is resolved.

For this alternative, MEC removal would not include areas within an MRS (e.g., MRS 03 parking areas) that are paved and therefore have no interaction between possible MEC items and a receptor. However, the requirement to ensure the safe conduct of any intrusive activity conducted by authorized park utility, maintenance, or construction workers would apply should there be a need for intrusive work in these areas, such as for maintenance or construction type activities. While the Army cannot impose restrictive covenants on FUDS property, the Army can work with the NPS to ensure needed restrictions or notifications (e.g., no intrusive work greater than 2 feet bgs without adequate safety measures, or notifications of the intent to safely conduct such activities) are implemented and maintained. LUCs will further manage any remaining potential explosive hazards for MEC deeper than 2 feet bgs through continuing educational awareness to include advisories regarding intrusive activities, safety presentations, and community outreach.

The education and awareness initiatives associated with proposed LUCs will apply to the entire Sandy Hook Gateway National Recreation Area community (to include NPS workers, tenants and Park visitors) since these receptors' activities will not be confined to specific MRS boundaries. This will ensure that potential receptors are informed about potential residual explosive safety risks that could be encountered by visitors in high traffic National Park areas.

Effectiveness: This alternative would be protective of human health and the environment. It is effective in the long-term as MEC will be removed from the zone of likely exposure to receptors, and destroyed, reducing the volume of contaminants (MEC), and eliminating any residual explosive hazards to 2 feet bgs. However, this alternative does not allow for UU/UE. This alternative provides short-term effectiveness as the procedures are relatively quick to conduct. During implementation, while health and safety precautions would be required to protect workers and park visitors from accidental detonation of MEC items, elaborate excavation and shoring procedures necessary for deeper depths would not be required under this alternative.

Implementability: This alternative is technically and administratively feasible. The depth requirement allows for minimal vegetation cutting. Educational and notification requirements for deeper intrusive work can be enforced. The materials and services required to implement this alternative are available. The ability to obtain coordination from NPS, regulators, and the community is likely to be achieved since the impact to sensitive plant communities is minimized.

Cost: The cost to implement this alternative is moderate to high. Costs include geophysical teams and specially trained UXO Technicians to safely conduct the MEC removal and destruction. The process includes the EM 200-1-15 robust QC and seeding program requirements that must be met

for where analog methodologies are needed. A LUCIP and 30 years of O&M to manage the remaining potential explosive hazards would also be required.

Outcome: Alternative 5 meets key elements of the effectiveness and implementability criteria and will be retained for the detailed comparative analysis in the next section.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

5.1 Introduction

In Section 4.0 the five remedial alternatives were screened against the three broad criteria of effectiveness, implementability, and cost. Alternatives 1, 2, 3, and 5 passed the broad criteria screening and were retained for further detailed evaluation. However, as Alternative 3 (Physical LUCs via fencing) is completely impractical for dynamic shoreline areas, it has been screened out of the MRS Group 3 analysis in Section 5.6. Alternative 4 (MEC Removal to UU/UE) did not pass the broad criteria screening and was not retained for further evaluation for any of the MRS Groups.

In this section, the remaining remedial alternatives (1, 2, 3, and 5) undergo a detailed analysis that is intended to allow decision makers to select the appropriate response. During the detailed analysis, each alternative is assessed against the evaluation criteria described below. Then, the alternatives are compared to each other. The results compare the alternatives and identify the key tradeoffs among them to provide decision makers with sufficient information to adequately compare the alternatives, select the appropriate remedy for the site, and demonstrate satisfaction of the CERCLA remedy selection requirements.

Section 1.6 described how the Fort Hancock FUDS MRSs were further organized to facilitate analysis in this FS. Table 1.3 presented the three MRS Groups that were developed to include all of the MRSs determined to pose unacceptable explosive hazards. Each group contains MRSs with attributes similar enough that the FS analysis can be conducted at the MRS Group level. For example, Section 5.2 analyzes all MRS Group 1 alternatives against the nine criteria defined below, while Section 5.3 compares the MRS Group 1 alternatives against each other to determine overall strengths and weaknesses as a means to ultimately select a preferred alternative. Sections 5.4 and 5.5 do the same for MRS Group 2, etc., through all three MRS Groups.

Nine evaluation criteria are directed by the NCP to address CERCLA requirements and technical and policy considerations that have proven to be important for selecting among remedial alternatives. These criteria serve as the basis for analyzing proposed remedial alternatives to determine the most appropriate alternatives to address remediation. The nine criteria are divided into three categories; threshold, balancing and modifying. They are as follows:

- Threshold
 - Overall Protection of Public Health and Environment
 - Compliance with ARARs
- Balancing
 - Long-Term Effectiveness
 - Reduction of Toxicity, Mobility and Volume Through Treatment
 - Short-Term Effectiveness
 - Implementability
 - Technical Feasibility
 - Administrative Feasibility
 - Availability of Materials and services
 - Cost
- Modifying
 - State (Regulator) Acceptance

- Community Acceptance

5.1.1 Threshold Criteria

Assessments against two of the criteria relate directly to statutory findings that must ultimately be made in the Decision Document; therefore, these are categorized as threshold criteria and the remedial alternative chosen must meet the two criteria within this category (USEPA 1988).

5.1.1.1 Overall Protection of Public Health and Environment

This threshold criterion assesses whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection considers assessments conducted under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

For MMRP sites, protection of human health is a function of whether site conditions are acceptable or unacceptable with regard to potential explosive hazards that may remain at the MRS. According to the RMM, “Unacceptable Explosive Risk” is defined as the presence of munitions having a specific explosive nature, as well as the accessibility supported by the specific land use, such that the likelihood of encounter, sensitivity of the munitions items, and severity of a potential incident are collectively unacceptable.

Section 1.5.2 describes how the RMM tool uses four matrices to make this determination and Table 1.1 summarizes all baseline (pre-remedial alternative) explosive risk determinations (as presented in the RI Addendum #3 Report). For assessment of the protection of human health threshold criterion, the RMM tool is completed after application of each remedial alternative retained in Section 4.0. This post-remedy determination indicates whether the alternative will result in acceptable (protective) or unacceptable (not protective) conditions for this criterion.

Appendix C presents the post-remedy RMM matrices for each MRS Group, showing whether the remedial alternative results in acceptable or unacceptable site conditions.

5.1.1.2 Compliance with ARARs

This threshold criterion is used to determine whether each alternative will meet all of the ARARs (as defined in CERCLA Section 121) that have been identified in Table 2.2. For each alternative, the following should be addressed: compliance with location-specific ARARs and action-specific ARARs. For the Fort Hancock FUDS, there are no chemical-specific ARARs.

5.1.2 Balancing Criteria

Balancing criteria are those that form the basis for comparison among alternatives that meet the threshold criteria. The five criteria in this category represent the primary criteria upon which the analysis is based.

5.1.2.1 Long-Term Effectiveness

This criterion addresses the remedial action in terms of the risk remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by residuals and/or any untreated wastes. The primary focus of the long-term effectiveness analysis is on:

- The magnitude of residual risk following completion of the remedial activities; and

- The adequacy and reliability of any controls (e.g., access limitations, deed restrictions, long-term monitoring, etc.) used to manage the treated residuals or untreated wastes that remain at the site.

5.1.2.2 *Reduction of Toxicity, Mobility or Volume Through Treatment*

Based on USEPA's preference that a chosen removal alternative will reduce toxicity, mobility, or volume through treatment, an alternative must be evaluated based upon the following specific factors:

- The treatment processes employed and the materials it will treat;
- The amount of hazardous materials to be destroyed or treated;
- The degree of reduction expected in toxicity, mobility or volume;
- The degree to which the treatment will be irreversible;
- The type and quantity of residuals that will remain after treatment; and
- Whether the alternative meets the USEPA's preference for treatment.

In accordance with Army guidance (2009), toxicity and mobility are not specifically relevant to MEC; therefore, the reduction of volume through the removal of MEC is the primary factor for MEC. Accordingly, the evaluations for this criterion only assess the reduction of MEC volume.

5.1.2.3 *Short-Term Effectiveness*

This criterion addresses the effects of an alternative during the implementation phase, until the removal objectives are met. More specifically, each alternative will be evaluated for:

- Protection of the community and workers during the remedial action;
- Adverse environmental impacts resulting from construction and implementation; and
- The time required to meet the remedial objectives.

5.1.2.4 *Implementability*

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. This criterion focuses on analysis of the following sub-criterion factors:

Technical Feasibility

This sub-criterion evaluates the ease of implementing a specific alternative. This criterion evaluates:

- The reliability of the alternative and any technical operational difficulties;
- The reliability of the alternative to complete the remediation without significant schedule delays;
- The ease of conducting additional remedial actions following the initial undertaking; and
- The environmental conditions with respect to set-up, construction and operation of the alternative.

Administrative Feasibility

This sub-criterion focuses on the planning stages for each alternative and includes evaluation of:

- Adherence to non-environmental laws (e.g., siting of a treatment plant in a residential neighborhood);
- Coordinating services needed to carry out an alternative;
- Arranging the delivery of services in a timely manner; and

- Addressing the concerns of other regulatory agencies.

Availability of Materials and Services

This sub-criterion evaluates the following:

- Availability of the personnel needed to perform the operations based on schedule;
- Availability of adequate off-site treatment, storage and disposal for materials; and
- Availability of supporting services (e.g., power lines, laboratory services, etc.).

5.1.2.5 Cost

This criterion evaluates projected costs associated with implementing the alternative. These costs include direct capital costs (i.e., costs of the technology or to perform the alternative), indirect capital costs (e.g., design expenses, legal fees, and permit fees), and post remedial site control costs (e.g., monitoring and O&M costs). Where applicable, O&M costs are calculated for a 30-year duration. The USEPA RI/FS Guidance (USEPA 1988) indicates that order-of-magnitude cost estimates having an accuracy of -30% to +50% should suffice for the detailed analysis of response alternatives. All costs presented are rounded to the nearest thousand dollars.

5.1.3 Modifying Criteria

The final two criteria will be evaluated following comment on the FS report and on the Proposed Plan and will be addressed once a final decision is made (USEPA 1988).

5.1.3.1 State (Regulator) Acceptance

This criterion evaluates the technical and administrative issues and concerns the state may have for each of the alternatives (for this project, State/Regulator is defined as including both the USEPA Region 2 and the NJDEP). This criterion will be fully addressed in the Decision Document once comments on the FS and Proposed Plan have been processed during the public comment period.

5.1.3.2 Community Acceptance

This criterion evaluates the issues and concerns the public may have for each of the alternatives. Similar to state acceptance, this criterion will be fully addressed in the Decision Document once comments on the FS and Proposed Plan have been processed during the public comment period.

5.2 Individual Analysis – MRS Group 1 Remedial Alternatives

MRS Group 1 comprises areas of high pedestrian traffic where MEC has been found, or areas of existing munitions, or where previous removal recommendations have been made (as determined by previous investigations). See Figure A-7.

This section individually evaluates the remaining four explosive hazards remedial alternatives for MRS Group 1 against the nine CERCLA criteria, while Section 5.3 compares the four alternatives to each other. The following discussions focus on how, and to what extent, the alternatives address each of the criteria by qualitatively assessing whether the alternative is favorable, moderately favorable, or not favorable, relative to the criterion (note that for the threshold criteria, which must be met, ‘favorable’ means criteria will be met, while ‘unfavorable’ means criteria will not be met). Table 5.1, presented at the end of Section 5.3, summarizes the detailed individual analysis of the MRS Group 1 explosive hazards remedial alternatives.

5.2.1 Alternative 1: No Action

5.2.1.1 Threshold Criteria

For MRS Group 1, under Alternative 1, no remedial action would be taken, and any potential explosive hazards contaminants are left "as is," without the implementation of any containment, removal, treatment, or other protective actions. This alternative would leave any MEC items potentially present, in place, without further investigation or removal and potential explosive hazards are not mitigated. As shown in Appendix B, the post-remedy RMM indicates that taking no action does not change the baseline conditions. Therefore, Alternative 1 does not result in acceptable conditions and is not protective of public health and the environment for MRS Group 1.

Alternative 1 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. Under this alternative, since no action will be taken, all location-specific ARARs will be complied with. Because no actions will be implemented under Alternative 1, no action-specific ARARs are triggered. Therefore, Alternative 1 complies with ARARs.

However, because Alternative 1 is not protective of public health and the environment, it is not favorable for the threshold criteria.

5.2.1.2 Balancing Criteria

Alternative 1 is not favorable for the long-term effectiveness criterion because it would leave any MEC items potentially present, in place, and potential explosive hazards are not mitigated. Alternative 1 is not favorable in reducing the volume of contaminants (MEC) at the site because it would leave any MEC items in place, without further investigation or removal. Alternative 1 is not favorable in meeting the short-term effectiveness criterion because although no time is needed to implement this alternative, MEC removal objectives will not be met.

Alternative 1 is favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion in that there are no activities proposed.

There are no costs associated with the no action alternative.

5.2.1.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan. Therefore, these modifying criteria have not been included in this analysis, but will be included following review and input from those parties.

5.2.2 Alternative 2: Administrative Land Use Controls

5.2.2.1 Threshold Criteria

For MRS Group 1, Alternative 2 would include the use of signage installed in appropriate locations to limit access by providing awareness of potential hazards, education concerning the potential hazards (pamphlets, flyers, etc.) suspected to be present, and notifications for future intrusive activities. Future intrusive activity would need to be conducted by UXO trained technicians to ensure safety of personnel or resources from potential explosive hazards.

As shown in Appendix B, the post-remedy RMM indicates that by using signage designed to help modify human behavior at the site, the frequency of use of the area and the likelihood of encountering and imparting energy to a potential MEC item are reduced, and acceptable

conditions are achieved. This is based on the expectation of very limited or rare occurrences of pedestrians ignoring signage to encounter potential MEC items. Therefore, Alternative 2 is protective of public health and the environment based on using Administrative LUCs to limit access to the MRS Group 1 areas (Figure A-7).

Alternative 2 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. The species listed in Table 2.2 have been documented on the peninsula, with habitats overlapping the MRS areas, including MRS Group 1. It is very unlikely that the installation of signs would cause a take to the identified species, however, coordination with NPS will ensure compliance by eliminating any take to these species, should they be encountered in the specific areas of the MRS Group. Therefore, under this alternative, all location-specific ARARs will be complied with, in coordination with NPS. Therefore, Alternative 2 complies with ARARs.

Alternative 2 is protective of public health and the environment and complies with ARARs, and is therefore favorable for the threshold criteria

5.2.2.2 Balancing Criteria

Alternative 2 is moderately favorable in providing long-term effectiveness by informing the public of the potential explosive hazards within the area, minimizing human exposure. But it would leave any MEC items in place, and while the access of receptors to potential explosive hazards is reduced, it is not eliminated.

Alternative 2 is not favorable in reducing the volume of MEC at the site because it would leave any MEC items in place, without further investigation or removal.

Alternative 2 is favorable in meeting the short-term effectiveness criterion because no significant work would be performed beyond the installation of signs, and the community, workers, and the environment can easily be protected during implementation. The estimated time to meet the remedial objectives would be short.

Overall, Alternative 2 is favorable in meeting the implementability (technical feasibility and availability of materials and services) criterion. It is technically feasible to install signage, produce educational materials, and provide notifications of intrusive work. The materials and services to implement this alternative are readily available. However, the administrative feasibility sub-criterion is only moderately favorable for Alternative 2 in terms of ensuring that signage alone will address the concerns of the regulatory agency.

The cost to implement Alternative 2 is relatively low. For MRS Group 1, Administrative LUCs would include a LUCIP, installation and maintenance of approximately 10 warning signs strategically located around the MRS Group, production/distribution of educational materials concerning the potential hazards (pamphlets, flyers, etc.), and administrative costs for development of educational and notification requirements. The estimated cost for Alternative 2 is approximately \$128,000 in capital costs plus \$353,000 for 30-years of O&M for a total of \$481,000. Cost summary worksheets (RACER Version 11.5) are included in Appendix C.

5.2.2.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.2.3 Alternative 3: Physical Land Use Controls

5.2.3.1 Threshold Criteria

For MRS Group 1, Alternative 3 would include the use of fencing to physically limit access and notifications of all intrusive activities. Fencing would be constructed that meets the aesthetic requirements of NPS while being of sufficient construction to physically prevent access.

As shown in Appendix B, the post-remedy RMM indicates that by using fencing to physically limit access to the site, the frequency of use of the area and the likelihood of encountering and imparting energy to a potential MEC item are reduced, and acceptable conditions are achieved. This is based on the expectation of very limited or rare occurrences of pedestrians ignoring or breaching fencing to encounter potential MEC items. Therefore, Alternative 3 is protective of public health and the environment based on using Physical LUCs to limit access to the MRS Group 1 areas (Figure A-7).

Alternative 3 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. The species listed in Table 2.2 have been documented on the peninsula, with habitats overlapping the MRS areas, including MRS Group 1. It is unlikely that the implementation of this remedy (fencing) would result in the take of a species. However, Alternative 3 would be implemented to comply with these ARARs through close coordination with NPS to ensure compliance by eliminating the chance of take to these species, should they be encountered in the specific areas of the MRS Group. The fencing will be done in a way not to impact the movement of these species. Therefore, under this alternative, physical LUCs will be built to comply with all location-specific ARARs, in coordination with NPS. Because no MEC removals will be implemented under Alternative 3, action-specific ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 3 complies with ARARs.

Alternative 3 is protective of public health and the environment and complies with ARARs, and is therefore favorable for the threshold criteria.

5.2.3.2 Balancing Criteria

Alternative 3 is moderately favorable in providing long-term effectiveness by informing the public of the potential explosive hazards within the area, minimizing human exposure. Physical LUCs (fencing) would be an effective access deterrent, mitigating possible interactions between MEC and human receptors. However, Alternative 3 still leaves any MEC items in place, and while the adequacy and reliability of fencing is well established for the long term, and the access of receptors to potential explosive hazards is reduced, it is not eliminated.

Alternative 3 is not favorable in reducing the volume of MEC at the site because it would leave any MEC items in place, without further investigation or removal.

Alternative 3 is only moderately favorable in meeting the short-term effectiveness criterion because even though the community, workers, and the environment can relatively easily be protected during fencing construction, fencing in high pedestrian traffic areas could be problematic. In some cases, fencing would have to be designed and constructed around existing multi-use paths, causing disruption to park activities. The estimated time to meet the remedial objectives would be relatively short.

Overall, Alternative 3 is moderately favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion. The materials and

services to implement this alternative are readily available. However, while it is technically and administratively feasible to install fencing and provide notifications of intrusive activities, the high pedestrian traffic areas will have many paths/trails to fence off. NPS may have issues with the disruptions to park schedules, and the perception of permanently fencing off areas that are adjacent to historical tourist attractions, may not be fully acceptable.

The cost to implement Alternative 3 is low to moderate based on fencing construction in high traffic areas. For MRS Group 1, Physical LUCs would include a LUCIP, some vegetation cutting, then installation and maintenance of approximately 11,000 feet of fencing, and administrative costs for development of notification requirements for intrusive work. The estimated cost for Alternative 3 is approximately \$521,000 in capital costs plus \$353,000 for 30-years of O&M for a total of \$874,000. Cost summary worksheets (RACER Version 11.5) are included in Appendix C.

5.2.3.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.2.4 Alternative 5: MEC Removal to 2 feet with LUCs

5.2.4.1 Threshold Criteria

For MRS Group 1, Alternative 5 would entail conducting a partial MEC removal down to 2 feet bgs using best available geophysical technology based on access and vegetation clearance requirements for MRS Group 1 areas, destroying the MEC, and implementing an educational and notification LUC should there be a need to go deeper than 2 feet bgs for maintenance or construction type activities. Any MEC removed would be inspected to determine its explosive safety status and properly destroyed and disposed of per applicable policy and regulations. LUCs will further manage any remaining potential explosive hazards for MEC deeper than 2 feet bgs through continuing educational awareness to include advisories regarding intrusive activities, safety presentations, and community outreach.

As shown in Appendix B, the post-remedy RMM indicates that MEC removal to 2 feet bgs reduces the likelihood of encountering and imparting energy to a potential MEC item by physically removing MEC, and consequently acceptable conditions are achieved. This is based on the mitigated ability of pedestrians to encounter potential MEC items. Therefore, Alternative 5 is protective of public health and the environment based on MEC Removal to reduce the amount of MEC in the MRS Group 1 areas (Figure A-7).

Alternative 5 was reviewed with respect to compliance with ARARs (see Table 2.2). There are no chemical-specific ARARs at this site. Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. The species listed in Table 2.2 have been documented on the peninsula, with habitats overlapping the MRS areas, including MRS Group 1. The removal and demolition of any MEC found at the site could cause a take of an identified species without specific action taken to avoid such a circumstance. Alternative 5 would be implemented to comply with these ARARs through close coordination with NPS and the employment of biologists with expertise in the identified species to eliminate any take of these species, should they be encountered in the specific areas of the MRS Group.

Action-specific ARARs relating to identification, removal, and transportation of MEC items will be complied with. It is not anticipated that removal of soil surrounding MEC items will be

necessary, so ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 5 complies with ARARs.

Alternative 5 is protective of public health and the environment and is compliant with ARARs, and is therefore favorable for the threshold criteria.

5.2.4.2 Balancing Criteria

Alternative 5 is favorable for the long-term effectiveness criterion in addressing the potential explosive hazards because it removes and destroys all MEC to 2 feet bgs (the depth for potential exposure of receptors), or greater than 2 feet (with UXO-qualified personnel removing all discovered MEC from the 'construction' footprint). Further, the adequacy and reliability of MEC removal procedures are well established.

This alternative will result in the reduction of the volume of MEC for the MRS Group 1 areas. During the removal, any MEC that is identified would be treated using the disposal process options described in Section 3.3.

Alternative 5 is moderately favorable in meeting the short-term effectiveness criterion because although the community, workers, and the environment can be protected during implementation, there is an increased short-term hazard to workers and the public because MEC will be intrusively removed under this alternative. Engineering controls to perform this work safely and effectively have been well established for this type of operation, but there may be some risk to site workers due to possible challenging site conditions if MEC must be removed from areas where sensitive plant communities must be protected. While MEC removal and its destruction would cause some disruption to park activities, the estimated time to meet the remedial objectives would be relatively short (i.e., a few weeks as opposed to months).

Overall, Alternative 5 is favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion. The materials and services to implement this alternative are readily available. It is technically and administratively feasible to conduct MEC removals to 2 feet bgs and provide notifications of deeper intrusive activities that may occur in the future. The temporary disruption to park activities in high pedestrian traffic areas will likely be acceptable given the removal of MEC in these areas and the lack of resulting physical obstructions, such as fencing, to park workers and visitors.

The cost to implement Alternative 5 is moderate to high based on working in areas of high pedestrian traffic. Costs include geophysical teams and specially trained UXO Technicians to safely conduct the MEC removal. For MRS Group 1, the UXO team will comprise seven UXO technicians plus the UXO Supervisor, UXO Quality Control Officer and UXO Safety Officer. The educational and notification LUC would include administrative costs. The cost for a Work Plan and Report, would also be included.

The total estimated cost for Alternative 5 is approximately \$1,851,000 in capital costs plus \$167,000 for 30-years of O&M for a total of \$2,018,000. Cost worksheets (RACER Version 11.5) are included in Appendix C.

5.2.4.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.3 Comparative Analysis – MRS Group 1 Remedial Alternatives

While Section 5.2 described and individually assessed each of the four MRS Group 1 explosive hazards alternatives against the nine criteria, this section evaluates the performance of each alternative relative to each other. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs can be identified, and a preferred alternative selected. Table 5.1, presented at the end of this section, summarizes the detailed comparative analysis of the MRS Group 1 explosive hazards remedial alternatives.

The most important evaluation is against the threshold criteria, as these must be met. With the exception of the no action alternative, all of the alternatives achieved acceptable site conditions and were considered protective of human health and the environment. However, Alternative 5, which is the only alternative that physically removes and destroys MEC, was considered to have fewer unknowns than the other alternatives with regard to mitigation of potential explosive hazards.

All four alternatives were compliant with ARARs.

With regard to the balancing criteria, only Alternative 5 was favorable regarding long term effectiveness due to physically removing and destroying MEC. Alternatives 2 and 3 were moderately effective in the long term, because while signage or fencing would mitigate interactions between MEC and human receptors, any MEC items would remain in place. Alternative 1 was not favorable for this criterion.

Only Alternative 5 was ranked as favorable for the reduction of the volume of MEC criterion for MRS Group 1, because it is the only alternative to physically remove MEC. With regard to the short-term effectiveness criterion, Alternative 2 was considered favorable because no significant work would be performed beyond the installation of signs, and the community, workers, and the environment can relatively easily be protected during implementation. The estimated time to meet the remedial objectives would be short. Alternatives 3 and 5 were moderately favorable for this criterion because while both could be effective in the short term, fencing in high pedestrian traffic areas could be disruptive and there is an increased hazard to workers and the public during MEC removal. The estimated time to meet the remedial objectives would still be relatively short in both cases. Alternative 1 was considered not favorable for this criterion.

Alternative 1 was ranked favorable in meeting the implementability (technical and administrative feasibility, and availability of materials and services) criterion, but only in that there are no activities proposed. Alternative 5 was ranked favorable and more technically and administratively feasible than Alternative 3 because any disruptions to park activity during MEC removal operations would be temporary and would not result in fencing off park visitors from areas directly adjacent to historical tourist attractions. While Alternative 2 was favorable overall for implementability, the administrative feasibility sub-criterion was only moderately favorable because of the difficulty in ensuring that administrative LUCs (i.e., signage), as opposed to physical LUCs (i.e., fencing), are routinely followed in high-use public areas.

Alternative 5 had the highest costs based on the need for full geophysical teams and specially trained UXO Technicians to safely conduct the MEC removal and destruction, as well as notification requirements to safely conduct intrusive activities greater than 2 feet bgs. Alternative 3 had the next highest costs based on designing and constructing a fence around the MRS Group 1 areas. Alternative 2 was the next highest cost. Alternative 1 had no associated costs.

Based on previous interactions and communications with NPS regarding this high traffic area, acceptance of Alternatives 3 and 5 will likely be achievable, while Alternatives 1 and 2 will not likely be acceptable for MRS Group 1.

Alternative 5, MEC Removal to 2 feet with LUCs, was ranked favorable for more CERCLA criteria than were the other alternatives. It is protective of human health and the environment, is compliant with ARARs, is effective in the long term, and is the only alternative to reduce the volume of MEC. It is moderately favorable relative to short term effectiveness, and favorable for implementability. While Alternative 5 is the most costly alternative, it is also the only one that physically removes and destroys MEC from these high pedestrian traffic areas.

Table 5.1: Summary of Detailed Analysis of Explosive Hazards Remedial Alternatives – MRS Group 1

	Screening Criterion	Alternative 1: No Further Action	Alternative 2: Administrative Land Use Controls	Alternative 3: Physical Land Use Controls	Alternative 5: MEC Removal to 2 feet with LUCs
Threshold	Overall Protection of Human Health and Environment ¹	○	●	●	●
	Compliance with ARARs	●	●	●	●
Balancing	Long-Term Effectiveness	○	◐	◐	●
	Reduction of Toxicity, Mobility and Volume Through Treatment ²	○	○	○	●
	Short-Term Effectiveness	○	●	◐	◐
	Implementability:				
	Technical Feasibility	●	●	◐	●
	Administrative Feasibility	●	◐	◐	●
	Availability of Materials and Services	●	●	●	●
	Cost ³	\$0.00	\$481,000	\$874,000	\$2,018,000
Modifying ⁴	State Acceptance	TBD	TBD	TBD	TBD
	Community Acceptance	TBD	TBD	TBD	TBD

- Favorable ('YES' for threshold criteria),
- ◐ Moderately Favorable
- Not Favorable ('NO' for threshold criteria)

\1 – Favorable for this criterion requires achieving 'Acceptable' site conditions using the RMM (see Appendix B).

\2 – For MEC, this criterion addresses reduction of volume of MEC.

\3 - Costs were developed using RACER. O&M for a 30-year duration is included, as applicable, for an alternative. Details are provided in Appendix C.

\4 – The Modifying criteria of state and community acceptance are 'To Be Determined (TBD)' following review and input from these parties.

5.4 Individual Analysis – MRS Group 2 Remedial Alternatives

MRS Group 2 comprises areas of low/no pedestrian traffic where MEC has been found (Figure A-8). Table 5.2, presented at the end of Section 5.5, summarizes the detailed individual analysis of the MRS Group 2 explosive hazards remedial alternatives.

5.4.1 Alternative 1: No Action

5.4.1.1 Threshold Criteria

For MRS Group 2, under Alternative 1, no remedial action would be taken, and any potential explosive hazards contaminants are left "as is," without the implementation of any containment, removal, treatment, or other protective actions. This alternative would leave any MEC items potentially present, in place, without further investigation or removal and potential explosive hazards are not mitigated. As shown in Appendix B, the post-remedy RMM indicates that taking no action does not change the baseline conditions. Therefore, Alternative 1 does not result in acceptable conditions and is not protective of public health and the environment for MRS Group 2.

Alternative 1 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. Under this alternative, since no action will be done, all location-specific ARARs will be complied with. Because no actions will be implemented under Alternative 1, no action-specific ARARs are triggered. Therefore, Alternative 1 complies with ARARs.

However, Alternative 1 is not protective of public health and the environment and is therefore not favorable for the threshold criteria.

5.4.1.2 Balancing Criteria

Alternative 1 is not favorable for the long-term effectiveness criterion because it would leave any MEC items in place, without further investigation or removal, and potential explosive hazards are not mitigated. Alternative 1 is not favorable in reducing the volume of MEC because it would leave any MEC items in place. Alternative 1 is not favorable in meeting the short-term effectiveness criterion because although no time is needed to implement this alternative, RAOs will not be met. Alternative 1 is favorable in meeting the implementability criterion in that there are no activities proposed.

There are no costs associated with the no action alternative.

5.4.1.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.4.2 Alternative 2: Administrative Land Use Controls

5.4.2.1 Threshold Criteria

For MRS Group 2, Alternative 2 would include the use of signage installed in appropriate locations to limit access by providing awareness of potential hazards, education concerning the potential hazards suspected to be present, and notifications of intrusive activity. As shown in Appendix B, the post-remedy RMM indicates that by using signage designed to help modify human behavior at the site, the frequency of use of the area and the likelihood of encountering and imparting

energy to a potential MEC item are reduced, and acceptable conditions are achieved. This is based on the expectation of very limited or rare occurrences of pedestrians ignoring signage to encounter potential MEC items. Therefore, Alternative 2 is protective of public health and the environment based on using Administrative LUCs to limit access to the MRS Group 2 areas (Figure A-8).

Alternative 2 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. The species listed in Table 2.2 have been documented on the peninsula, with habitats overlapping the MRS areas, including MRS Group 2. It is very unlikely that the installation of signs would cause a take to the identified species, however, coordination with NPS will ensure compliance by eliminating any take to these species, should they be encountered in the specific areas of the MRS Group. Therefore, under this alternative, all location-specific ARARs will be complied with, in coordination with NPS.

Because no MEC removals or construction of physical LUCs will be implemented under Alternative 2, action-specific ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 2 complies with ARARs.

Alternative 2 is protective of public health and the environment and complies with ARARs, and is therefore favorable for the threshold criteria.

5.4.2.2 *Balancing Criteria*

Alternative 2 is moderately favorable in providing long-term effectiveness by informing the public of the potential explosive hazards within the area, minimizing human exposure. But it would leave any MEC items in place, and while the access of receptors to potential explosive hazards is reduced, it is not eliminated.

Alternative 2 is not favorable in reducing the volume of MEC at the site because it would leave any MEC items in place, without further investigation or removal.

Alternative 2 is favorable in meeting the short-term effectiveness criterion because no significant work would be performed beyond the installation of signs, and the community, workers, and the environment can relatively easily be protected during implementation. The estimated time to meet the remedial objectives would be short.

Overall, Alternative 2 is favorable in meeting the implementability criterion. It is technically feasible to install signage, produce educational materials, and provide notifications of intrusive work. The materials and services to implement this alternative are readily available. However, the administrative feasibility sub-criterion is only moderately favorable for Alternative 2 in terms of ensuring that signage alone will address the concerns of the regulatory agency.

The cost to implement Alternative 2 is relatively low. For MRS Group 2, Administrative LUCs would include a LUCIP, installation and maintenance of 16 warning signs strategically located around the MRS Group, production/distribution of educational materials concerning the potential hazards (pamphlets, flyers, etc.), and administrative costs for development of educational and notification requirements. The estimated cost for Alternative 2 is approximately \$133,000 in capital costs plus \$353,000 for 30-years of O&M for a total of \$486,000. Cost summary worksheets (RACER) are included in Appendix C.

5.4.2.3 *Modifying Criteria*

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.4.3 **Alternative 3: Physical Land Use Controls**

5.4.3.1 *Threshold Criteria*

For MRS Group 2, Alternative 3 would include the use of fencing to physically limit access and notifications of all intrusive activities. Fencing would be constructed that meets the aesthetic requirements of the NPS while being of sufficient construction to physically prevent access.

As shown in Appendix B, the post-remedy RMM indicates that by using fencing to physically limit access to the site, the frequency of use of the area and the likelihood of encountering and imparting energy to a potential MEC item are reduced, and acceptable conditions are achieved. This is based on the expectation of very limited or rare occurrences of pedestrians ignoring or breaching fencing to encounter potential MEC items. Therefore, Alternative 3 is protective of public health and the environment based on using Physical LUCs to limit access to the MRS Group 2 areas (Figure A-8).

Alternative 3 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. The species listed in Table 2.2 have been documented on the peninsula, with habitats overlapping the MRS areas, including MRS Group 2. It is unlikely that the implementation of this remedy (fencing) would result in the take of a species. However, Alternative 3 would be implemented to comply with these ARARs through close coordination with NPS to ensure compliance by eliminating the chance of take to these species, should they be encountered in the specific areas of the MRS Group. The fencing will be done in a way not to impact the movement of these species. Therefore, under this alternative, physical LUCs will be built to comply with all location-specific ARARs, in coordination with NPS. Because no MEC removals will be implemented under Alternative 3, action-specific ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 3 complies with ARARs.

Alternative 3 is protective of public health and the environment and complies with ARARs, and is therefore favorable for the threshold criteria.

5.4.3.2 *Balancing Criteria*

Alternative 3 is moderately favorable in providing long-term effectiveness by informing the public of the potential explosive hazards within the area, minimizing human exposure. Physical LUCs (fencing) would be an effective access deterrent, mitigating possible interactions between MEC and human receptors. However, Alternative 3 still leaves any MEC items in place, and while the adequacy and reliability of fencing is well established for the long term, and the access of receptors to potential explosive hazards is reduced, it is not eliminated.

Alternative 3 is not favorable in reducing the volume of MEC at the site because it would leave any MEC items in place, without further investigation or removal.

Alternative 3 is favorable in meeting the short-term effectiveness criterion because the community, workers, and the environment can relatively easily be protected during fencing construction, and fencing in these low/no pedestrian traffic areas would not be problematic (as opposed to the high

pedestrian traffic areas of MRS Group 1). The estimated time to meet the remedial objectives would be relatively short.

Overall, Alternative 3 is moderately favorable in meeting the implementability criterion. The materials and services to implement this alternative are readily available. However, while it is technically and administratively feasible to install fencing and provide notifications for intrusive activities, there exist paths/trails to fence off even in these low/no pedestrian traffic areas. NPS may have issues with the disruptions to park schedules, and the perception of permanently fencing off nature areas along walking paths may not be fully acceptable.

The cost to implement Alternative 3 is moderate based on fencing construction in these low/no pedestrian traffic areas that tend to have more vegetation that would have to be cut or would be more difficult to access. For MRS Group 2, Physical LUCs would include a LUCIP, some vegetation cutting, installation and maintenance of approximately 33,000 feet of fencing, and legal/administrative costs for development of educational and notification requirements. The estimated cost for Alternative 3 is approximately \$1,326,000 in capital costs plus \$353,000 for 30-years of O&M for a total of \$1,680,000. Cost summary worksheets (RACER) are included in Appendix C.

5.4.3.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan

5.4.4 Alternative 5: MEC Removal to 2 feet with LUCs

5.4.4.1 Threshold Criteria

For MRS Group 2, Alternative 5 would entail conducting a MEC removal down to 2 feet bgs using best available geophysical technology based on access and vegetation clearance requirements for MRS Group 2 areas, destroying the MEC, and implementing an educational and notification requirements LUC should there be a need to go deeper for maintenance or construction type activities. Any MEC removed would be inspected to determine its explosive safety status and properly destroyed and disposed of per applicable policy and regulations. LUCs will further manage any remaining potential explosive hazards for MEC deeper than 2 feet bgs through continuing educational awareness to include advisories regarding intrusive activities, safety presentations, and community outreach.

As shown in Appendix B, the post-remedy RMM indicates that MEC removal to 2 feet bgs reduces the likelihood of encountering and imparting energy to a potential MEC item by physically removing MEC, and consequently acceptable conditions are achieved. This is based on the mitigated ability of pedestrians to encounter potential MEC items. Therefore, Alternative 5 is protective of public health and the environment based on MEC Removal to reduce the amount of MEC in the MRS Group 2 areas (Figure A-8).

Alternative 5 was reviewed with respect to compliance with ARARs (see Table 2.2). There are no chemical-specific ARARs at this site. Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. The species listed in Table 2.2 have been documented on the peninsula, with habitats overlapping the MRS areas, including MRS Group 2. The removal and demolition of any MEC found at the site could cause a take of an identified species without specific action taken to avoid such a circumstance. Alternative 5 would be implemented to comply with these ARARs through close coordination with NPS and the

employment of biologists with expertise in the identified species to eliminate any take of these species, should they be encountered in the specific areas of the MRS Group.

Action-specific ARARs relating to identification, removal, and transportation of MEC items will be complied with. It is not anticipated that removal of soil surrounding MEC items will be necessary, so ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 5 complies with ARARs.

Alternative 5 is protective of public health and the environment and is compliant with ARARs, and is therefore favorable for the threshold criteria.

5.4.4.2 Balancing Criteria

Alternative 5 is favorable for the long-term effectiveness criterion in addressing the potential explosive hazards because it removes and destroys all MEC to 2 feet bgs (the depth for potential exposure of receptors), or greater than 2 feet through notification to conduct such activity safely. Further, the adequacy and reliability of MEC removal procedures are well established.

This alternative will result in the reduction of the volume of MEC for the MRS Group 2 areas. During the removal, any MEC that is identified would be treated using the disposal process options described in Section 3.3.

Alternative 5 is only moderately favorable in meeting the short-term effectiveness criterion because although the community, workers, and the environment can be protected during implementation, there is an increased short-term hazard to workers and the public because MEC will be intrusively removed under this alternative. Engineering controls to perform this work safely and effectively have been well established, but there may be some risk to site workers due to possible challenging site conditions if MEC must be removed from areas where sensitive plant communities must be protected. MEC removal and its destruction would cause some disruption to park activities; however, the estimated time to meet the remedial objectives would be relatively short.

Overall, Alternative 5 is favorable in meeting the implementability criterion. The materials and services to implement this alternative are readily available. It is technically and administratively feasible to conduct MEC removals to 2 feet bgs and provide notifications of deeper intrusive activities. However, it will involve temporary disruptions to park activities that may be slightly less administratively acceptable in these low/no pedestrian traffic areas; that is, while active MEC removal may be deemed more understandable in high traffic areas, it may be considered more disruptive than necessary in the low/no pedestrian traffic areas of MRS Group 2.

The cost to implement Alternative 5 is significant based on the acreage of MRS Group 2 and accessing some of these high vegetation, low/no pedestrian traffic areas. Costs include geophysical teams and specially trained UXO Technicians to safely conduct the MEC removals. For MRS Group 2, each UXO team will comprise seven UXO technicians plus the UXO Supervisor, UXO Quality Control Officer and UXO Safety Officer. The educational and notification LUC would include administrative costs. The cost for a Work Plan and Report would also be included. The total estimated cost for Alternative 5 is approximately \$3,379,000 in capital costs plus \$167,000 for 30-years of O&M for a total of \$3,546,000. Cost worksheets (RACER) are included in Appendix C.

5.4.4.3 *Modifying Criteria*

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.5 Comparative Analysis – MRS Group 2 Remedial Alternatives

While Section 5.4 described and individually assessed each of the four MRS Group 2 explosive hazards alternatives against the nine criteria, this section evaluates the performance of each alternative relative to each other. Table 5.2, presented at the end of this section, summarizes the detailed comparative analysis of the MRS Group 2 explosive hazards remedial alternatives.

With the exception of the no action alternative, all of the alternatives achieved acceptable site conditions and were considered protective of human health and the environment. However, Alternative 5, which removes and destroys MEC, was considered to have fewer unknowns than the other alternatives with regard to mitigation of potential explosive hazards.

All four alternatives were compliant with ARARs.

With regard to the balancing criteria, only Alternative 5 was favorable regarding long term effectiveness by physically removing and destroying MEC. Alternatives 2 and 3 were moderately effective in the long term, because while signage or fencing would mitigate interactions between MEC and human receptors, any MEC items would remain in place. Alternative 1 was not favorable for this criterion.

Only Alternative 5 was ranked as favorable for the reduction of the volume of MEC criterion for MRS Group 2, because it is the only alternative to physically remove and destroy MEC. The other alternatives leave any MEC in place. With regard to the short-term effectiveness criterion, Alternative 2 was considered favorable because no significant work would be performed beyond the installation of signs, and the community, workers, and the environment can relatively easily be protected during implementation. The estimated time to meet the remedial objectives would be short. Alternative 3 was also favorable in the short term because the disruptions of fencing in these low/no pedestrian traffic areas would not be problematic. The estimated time to meet the remedial objectives would be relatively short. Alternative 5 was moderately favorable because while it would be effective in the short term, there is an increased hazard to workers and the public during MEC removal. Alternative 1 was considered not favorable for this criterion.

Alternative 1 was ranked favorable in meeting the implementability criterion, but only in that there are no activities proposed. Alternative 2 was ranked as favorable overall in meeting the implementability criterion as the materials and services to implement this alternative are readily available, and it is technically feasible to install signage in these low/no pedestrian traffic areas. However, the administrative feasibility sub-criterion was only moderately favorable because of the difficulty in ensuring that administrative LUCs (i.e., signage) are routinely followed. Alternative 5 was also ranked favorable overall for implementability. However, it will involve temporary disruptions to park activities that may be slightly less administratively acceptable in these low/no pedestrian traffic areas; that is while active MEC removal may be deemed more understandable in high traffic areas, it may be considered more disruptive than necessary in the low/no pedestrian traffic areas of MRS Group 2. Alternative 3 was ranked moderately favorable overall in meeting the implementability criterion, because while it is technically and administratively feasible to install fencing and provide notification of intrusive activities, there exist paths/trails to fence off even in these low/no pedestrian traffic areas. NPS, as well as park

users, may have issues with the disruptions to park schedules, and the perception of permanently fencing off nature areas along walking paths may not be fully acceptable.

Alternative 2 had the lowest costs. Alternative 5 had the highest costs based on the need for full geophysical teams and specially trained UXO Technicians to safely conduct the MEC removals, and Alternative 3 had the next highest costs based on designing and constructing a fence around the MRS Group 2 areas. Alternative 1 had no associated costs.

Based on previous communications with NPS, acceptance of Alternatives 2, 3, and 5 is likely achievable for these low/no pedestrian traffic areas, while Alternative 1 will not likely be acceptable for MRS Group 2.

Alternative 2, Administrative Land Use Controls, is protective of human health and the environment, is compliant with ARARs, is effective in the short term, is favorable overall for implementability, and is the lowest cost alternative. While this alternative does not remove MEC, it sufficiently alters behavior to limit interactions, and state and community acceptance is likely achievable given that these are low/no pedestrian traffic areas. Alternative 5 is favorable for as many CERCLA criteria as Alternative 2, but it costs more than 7 times as much, and there may be some consideration that active MEC removal and destruction is more disruptive to the park than necessary for these low/no pedestrian traffic areas.

Table 5.2: Summary of Detailed Analysis of Explosive Hazards Remedial Alternatives – MRS Group 2

	Screening Criterion	Alternative 1: No Further Action	Alternative 2: Administrative Land Use Controls	Alternative 3: Physical Land Use Controls	Alternative 5: MEC Removal to 2 feet with LUCs
Threshold	Overall Protection of Human Health and Environment ¹	○	●	●	●
	Compliance with ARARs	●	●	●	●
Balancing	Long-Term Effectiveness	○	◐	◐	●
	Reduction of Toxicity, Mobility and Volume Through Treatment ²	○	○	○	●
	Short-Term Effectiveness	○	●	●	◐
	Implementability:				
	Technical Feasibility	●	●	◐	●
	Administrative Feasibility	●	◐	◐	◐
	Availability of Materials and Services	●	●	●	●
	Cost ³	\$0.00	\$486,000	\$1,680,000	\$3,546,000
Modifying ⁴	State Acceptance	TBD	TBD	TBD	TBD
	Community Acceptance	TBD	TBD	TBD	TBD

- Favorable ('YES' for threshold criteria)
- ◐ Moderately Favorable
- Not Favorable ('NO' for threshold criteria)

¹ – Favorable for this criterion requires achieving 'Acceptable' site conditions using the RMM (see Appendix B).

² – For MEC, this criterion addresses reduction of volume of MEC.

³ - Costs were developed using RACER. O&M for a 30-year duration is included, as applicable, for an alternative. Details are provided in Appendix C.

⁴ – The Modifying criteria of state and community acceptance are 'To Be Determined (TBD)' following review and input from these parties.

5.6 Individual Analysis – MRS Group 3 Remedial Alternatives

MRS Group 3 comprises areas of high pedestrian traffic where MEC has been found, but which represent special situations: historical observations of munitions washing onto the shore (or being exposed via erosion during storm events), or where Storm Sandy significantly impacted/alterd the area (Figure A-9) after it was investigated and characterized during the 2011 RI field effort. For this group, Alternative 3, Physical Land Use Controls via fencing, has been screened out as it is impractical for these dynamic shoreline areas. Table 5.3, presented at the end of Section 5.7, summarizes the detailed individual analysis of the MRS Group 3 explosive hazards remedial alternatives.

5.6.1 Alternative 1: No Action

5.6.1.1 Threshold Criteria

Alternative 1 is not protective of public health and the environment for MRS Group 3. No remedial action will be taken. This alternative would leave any MEC items in place, without further investigation or removal. This alternative does not provide for any active or passive land use controls to reduce the potential for exposure (e.g., physical barriers, deed restrictions), and potential explosive hazards are not mitigated. As shown in Appendix B, the post-remedy RMM indicates that taking no action does not change the baseline conditions. Therefore, Alternative 1 does not result in acceptable conditions and is not protective of public health and the environment for MRS Group 2.

Alternative 1 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. Under this alternative, since no action will be done, all location-specific ARARs will be complied with. Because no actions will be implemented under Alternative 1, no action-specific ARARs are triggered. Therefore, Alternative 1 complies with ARARs.

However, Alternative 1 is not protective of public health and the environment and is therefore not favorable for the threshold criteria.

5.6.1.2 Balancing Criteria

Alternative 1 is not favorable for the long-term effectiveness criterion because it would leave any MEC items in place, without further investigation or removal, and potential explosive hazards are not mitigated. Alternative 1 is not favorable in reducing the volume of MEC because it would leave any MEC items in place. Alternative 1 is not favorable in meeting the short-term effectiveness criterion because although no time is needed to implement this alternative, RAOs will not be met. Alternative 1 is favorable in meeting the implementability criterion in that there are no activities proposed.

There are no costs associated with the no action alternative.

5.6.1.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.6.2 Alternative 2: Administrative Land Use Controls

5.6.2.1 Threshold Criteria

For MRS Group 3, Alternative 2 would include the use of signage installed in appropriate locations to limit access by providing awareness of potential hazards suspected to be present, and notifications of intrusive activity. As shown in Appendix B, the post-remedy RMM indicates that by using signage designed to help modify human behavior at the site, the frequency of use of the area and the likelihood of encountering and imparting energy to a potential MEC item are reduced, and acceptable conditions are achieved. This is based on the expectation of very limited or rare occurrences of pedestrians ignoring signage to encounter potential MEC items. Therefore, Alternative 2 is protective of public health and the environment based on using Administrative LUCs to limit access to the MRS Group 3 areas (Figure A-9).

Alternative 2 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. For the MRS Group 3 shoreline areas, there are several federal and state threatened or endangered species (shown in Table 2.2), including Piping Plovers, Sedge Wrens, turtle species, and plant species such as Seabeach Amaranth and Hop Sedge, that could be impacted. While wildlife species can be avoided as a function of seasonal habitat (i.e., work could be scheduled for the winter months when none of the species are present), the plant species are present year-round. It is very unlikely that the installation of signs would cause a take to the identified species, however, coordination with NPS will ensure compliance by eliminating any take to these species, should they be encountered in the specific areas of the MRS Group.

Therefore, under this alternative, all location-specific ARARs will be complied with, in consultation with NPS. Because no MEC removals or construction of physical LUCs will be implemented under Alternative 2, action-specific ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 2 complies with ARARs.

Alternative 2 is protective of public health and the environment and complies with ARARs, and is therefore favorable for the threshold criteria.

5.6.2.2 Balancing Criteria

Alternative 2 is moderately favorable in providing long-term effectiveness by informing the public of the potential explosive hazards within the area, minimizing human exposure. But it would leave any MEC in place, and while the access of receptors to potential explosive hazards is reduced, it is not eliminated.

Alternative 2 is not favorable in reducing the volume of MEC at the site because it would leave any MEC items in place, without further investigation or removal.

Alternative 2 is favorable in meeting the short-term effectiveness criterion because no significant work would be performed beyond the installation of signs, and the community, workers, and the environment can easily be protected during implementation. The estimated time to meet the remedial objectives would be short.

Alternative 2 is favorable, overall, in meeting the implementability criterion. It is technically feasible to install signage, produce educational materials, and provide notifications of intrusive work. The materials and services to implement this alternative are readily available. However, the administrative feasibility sub-criterion is only moderately favorable for Alternative 2 in terms of ensuring that signage alone will address the concerns of the regulatory agency.

The cost to implement Alternative 2 is relatively low. For MRS Group 3, Administrative LUCs would include a LUCIP, installation and maintenance of approximately 30 warning signs

strategically located around the MRS (approximately 1 per 1,000 feet along these shore areas), production/distribution of educational materials concerning the potential hazards (pamphlets, flyers, etc.), and administrative costs for development of educational and notification requirements. The estimated cost for Alternative 2 is approximately \$151,000 in capital costs plus \$353,000 for 30-years of O&M for a total of \$504,000. Cost summary worksheets (RACER) are included in Appendix C.

5.6.2.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.6.3 Alternative 5: MEC Removal to 2 feet with LUCs

5.6.3.1 Threshold Criteria

For MRS Group 3, Alternative 5 would entail conducting a MEC removal down to 2 feet bgs using best available geophysical technology based on access and vegetation clearance requirements for MRS Group 3 areas, destroying the MEC, and implementing an educational and notification requirements LUC should there be a need to go deeper for maintenance or construction type activities. Any MEC removed would be inspected to determine its explosive safety status and properly destroyed and disposed of per applicable policy and regulations. LUCs will further manage any remaining potential explosive hazards for MEC deeper than 2 feet bgs through continuing educational awareness to include advisories regarding intrusive activities, safety presentations, and community outreach.

As shown in Appendix B, the post-remedy RMM indicates that MEC removal to 2 feet bgs reduces the likelihood of encountering and imparting energy to a potential MEC item by physically removing MEC, and consequently acceptable conditions are achieved. This is based on the mitigated ability of pedestrians to encounter potential MEC items. Therefore, Alternative 5 is protective of public health and the environment based on MEC Removal to reduce the amount of MEC in the MRS Group 3 areas (Figure A-9).

However, for these dynamic shoreline areas, after MEC removals were complete, MEC would potentially continue to wash up onshore or be exposed via erosion through storm events. It is assumed that such MEC items would be identified in real time in these high pedestrian traffic areas and would be handled by EOD units.

Alternative 5 was reviewed with respect to compliance with ARARs (see Table 2.2). Location-specific ARARs are related to the operation of the area as a national park and protection of wildlife species. For the MRS Group 3 shoreline areas, there are several federal and state threatened or endangered species (shown in Table 2.2), including Piping Plovers, Sedge Wrens, turtle species, and plant species such as Seabeach Amaranth and Hop Sedge, that could be impacted. While wildlife species can be avoided as a function of seasonal habitat (i.e., work could be scheduled for the winter months when none of the species are present), the plant species are present year-round. The removal and demolition of any MEC found at the site could cause a take of an identified species without specific action taken to avoid such a circumstance. Alternative 5 would be implemented to comply with these ARARs through close coordination with NPS and the employment of biologists with expertise in the identified species to eliminate any take of these species, should they be encountered in the specific areas of the MRS Group.

Action-specific ARARs relating to identification, removal, and transportation of MEC items will be complied with. It is not anticipated that removal of soil surrounding MEC items will be necessary, so ARARs related to soil removal, water quality, or air quality are not triggered. Therefore, Alternative 5 complies with ARARs.

Alternative 5 is protective of public health and the environment and complies with ARARs, and is therefore favorable for the threshold criteria.

5.6.3.2 Balancing Criteria

Alternative 5 is moderately favorable for the long-term effectiveness criterion in addressing the potential explosive hazards because it removes and destroys all MEC to 2 feet bgs (the depth for potential exposure of receptors), or greater than 2 feet through notification to conduct such activity safely. However, this alternative does not mitigate the potential for MEC to continue to wash up onshore or be exposed via erosion after MEC removals were completed.

This alternative will result in the partial reduction of the volume of MEC for the MRS Group 3 areas as MEC would potentially continue to wash up onshore or be exposed via erosion in these dynamic shoreline areas.

Alternative 5 is only moderately favorable in meeting the short-term effectiveness criterion because although the community, workers, and the environment can be protected during implementation, there is an increased short-term hazard to workers and the public because MEC will be intrusively removed and destroyed under this alternative. MEC removal and its destruction would cause disruption to park activities.

Overall, Alternative 5 is moderately favorable in meeting the implementability criterion. The materials and services to implement this alternative are readily available. While it is technically and administratively feasible to conduct MEC removals to 2 feet bgs and provide notifications of deeper intrusive activities, the disruption to park activities in these high pedestrian traffic areas and the potential for MEC to continue to wash up onshore or be exposed via erosion, makes this alternative only moderately feasible.

The cost to implement Alternative 5 is significant based on the acreage of the MRS Group 3 shoreline portions, and completing removal actions in these high pedestrian traffic areas. Costs include geophysical teams and specially trained UXO Technicians to safely conduct the MEC removal. For MRS Group 3, two UXO teams comprising seven UXO technicians plus a UXO Supervisors, UXO Quality Control Officer and UXO Safety Officer, were costed. The educational and notification LUC would include administrative costs. The cost for a Work Plan and Report would also be included. The total estimated cost for Alternative 5 is approximately \$4,735,000 in capital costs plus \$167,000 for 30-years of O&M for a total of \$4,902,000. Cost summary worksheets (RACER) are included in Appendix C.

5.6.3.3 Modifying Criteria

State and community acceptance cannot be fully assessed until comments are processed following the public review period on the Proposed Plan.

5.7 Comparative Analysis – MRS Group 3 Remedial Alternatives

While Section 5.6 described and individually assessed each of the three MRS Group 3 explosive hazards alternatives against the nine criteria, this section evaluates the performance of each

alternative relative to each other. Table 5.3, presented at the end of this section, summarizes the detailed comparative analysis of the MRS Group 3 explosive hazards remedial alternatives.

With the exception of the no action alternative, the alternatives achieved acceptable site conditions and were considered protective of human health and the environment. However, Alternative 5, which removes and destroys MEC, was considered to have fewer unknowns than the other alternatives with regard to mitigation of potential explosive hazards, even though it does not address MEC that may wash up onshore or be exposed via erosion following the MEC removal.

All three alternatives were compliant with ARARs.

With regard to the balancing criteria, Alternative 2 was only moderately effective in the long term by informing the public of the potential explosive hazards within the area and minimizing human exposure. But it would leave any MEC in place. Alternative 5 was only moderately effective in the long term because while it removed and destroyed MEC, the removal does not mitigate the potential for MEC to continue to wash up onshore or be exposed via erosion. Alternative 1 was not favorable for this criterion.

Alternative 5 provides a partial reduction of the volume of MEC, while the other alternatives provide no reduction and leave any MEC in place.

With regard to the short-term effectiveness criterion, Alternative 2 was considered favorable because no significant work would be performed beyond the installation of signs, and the community, workers, and the environment can easily be protected during implementation. The estimated time to meet the remedial objectives would be short. However, Alternative 5 was only moderately favorable in the short term because there is an increased short-term hazard to workers and the public because MEC will be intrusively removed under this alternative. Alternative 1 was considered not favorable for this criterion.

Alternative 1 was ranked favorable in meeting the implementability criterion, but only in that there are no activities proposed. Alternative 2 is favorable overall, in meeting the implementability criterion, because it is technically feasible to install signage, produce educational materials, and provide notifications of intrusive work, and the materials and services to implement this alternative are readily available. However, administrative feasibility is only moderately favorable for Alternative 2 because ensuring that signage is routinely followed in high-use public areas can be problematic. Alternative 5 was ranked as only moderately favorable overall for this criterion because of the large scale disruption to park activities in high pedestrian traffic areas and the potential for MEC to continue to wash up onshore or be exposed via erosion.

Alternative 5 had significantly higher costs than Alternative 2 based on the need for full geophysical teams and specially trained UXO Technicians to safely conduct the MEC removal and destruction in high pedestrian traffic areas. Alternative 1 had no associated costs.

Based on previous interactions and communications with NPS, acceptance of Alternative 2 will likely be achievable, while Alternative 5 that removes MEC to 2 feet bgs, but causes large scale disruptions to park activities without mitigating the potential for MEC to continue to wash up onshore or be exposed via erosion, may not be achievable.

Alternative 2, Administrative Land Use Controls, was ranked favorable for more CERCLA criteria than were the other alternatives. It is protective of human health and the environment, is compliant with ARARs, is effective in the short term, and is favorable overall for implementability. While it does not remove MEC (or mitigate the potential for MEC to continue to wash up onshore or be

exposed via erosion), it educates the public concerning the potential hazards suspected to be present, and is relatively low cost.

Table 5.3: Summary of Detailed Analysis of Explosive Hazards Remedial Alternatives – MRS Group 3

	Screening Criterion	Alternative 1: No Further Action	Alternative 2: Administrative Land Use Controls	Alternative 5: MEC Removal to 2 feet with LUCs
Threshold	Overall Protection of Human Health and Environment ¹	○	●	●
	Compliance with ARARs	●	●	●
Balancing	Long-Term Effectiveness	○	◐	◐
	Reduction of Toxicity, Mobility and Volume Through Treatment ²	○	○	◐
	Short-Term Effectiveness	○	●	◐
	Implementability:			
	Technical Feasibility	●	●	◐
	Administrative Feasibility	●	◐	◐
	Availability of Materials and Services	●	●	●
	Cost ³	\$0.00	\$504,000	\$4,902,000
Modifying ⁴	State Acceptance	TBD	TBD	TBD
	Community Acceptance	TBD	TBD	TBD

- Favorable ('YES' for threshold criteria)
- ◐ Moderately Favorable
- Not Favorable ('NO' for threshold criteria)

\1 – Favorable for this criterion requires achieving 'Acceptable' site conditions using the RMM (see Appendix B).

\2 – For MEC, this criterion addresses reduction of volume of MEC.

\3 - Costs were developed using RACER. O&M for a 30-year duration is included, as applicable, for an alternative. Details are provided in Appx C.

\4 – The Modifying criteria of state and community acceptance are 'To Be Determined (TBD)' following review and input from these parties.

5.8 Conclusions

5.8.1 MRS Group 1 Remedial Alternatives

Four remedial alternatives were evaluated for MRS Group 1: No Action, Administrative LUCs, Physical LUCs, and MEC Removal to 2 feet with LUCs. Table 5.1 presents the summary of the detailed analysis of the explosive hazards remedial alternatives.

5.8.2 MRS Group 2 Remedial Alternatives

Four remedial alternatives were evaluated for MRS Group 2: No Action, Administrative LUCs, Physical LUCs, and MEC Removal to 2 feet with LUCs. Table 5.2 presents the summary of the detailed analysis of the explosive hazards remedial alternatives.

5.8.3 MRS Group 3 Remedial Alternatives

Three remedial alternatives were evaluated for MRS Group 3: No Action, Administrative LUCs, and MEC Removal to 2 feet with LUCs. Physical Land Use Controls via fencing was screened out as an alternative as it is impractical for the dynamic shoreline areas of MRS Group 3. Table 5.3 presents the summary of the detailed analysis of the explosive hazards remedial alternatives.

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6.0 REFERENCES

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Appendix A: Site Figures

Figure A-1: Fort Hancock Current MRS Locations

Figure A-2: MRS 03

Figure A-3: MRS 05 (05B North and 05B South, and 05E)

Figure A-4: MRS 06

Figure A-5: MRS 08 (08A and 08B)

Figure A-6: MRS 05G and MRS 10

Figure A-7: MRS Group 1

Figure A-8: MRS Group 2

Figure A-9: MRS Group 3

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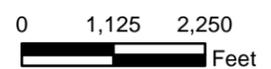
Legend

- | | |
|-----------------------------|--|
| Approximate MRS 03 Boundary | U.S. Coast Guard Station Entrance |
| Approximate MRS 05 Boundary | Sandy Hook Lighthouse |
| Approximate MRS 06 Boundary | Fort Hancock Museum |
| Approximate MRS 07 Boundary | Marine Academy of Science and Technology |
| Approximate MRS 08 Boundary | Sandy Hook Ranger Station |
| Approximate MRS 10 Boundary | Sandy Hook Visitor's Center |
| | Sandy Hook Bird Observatory |



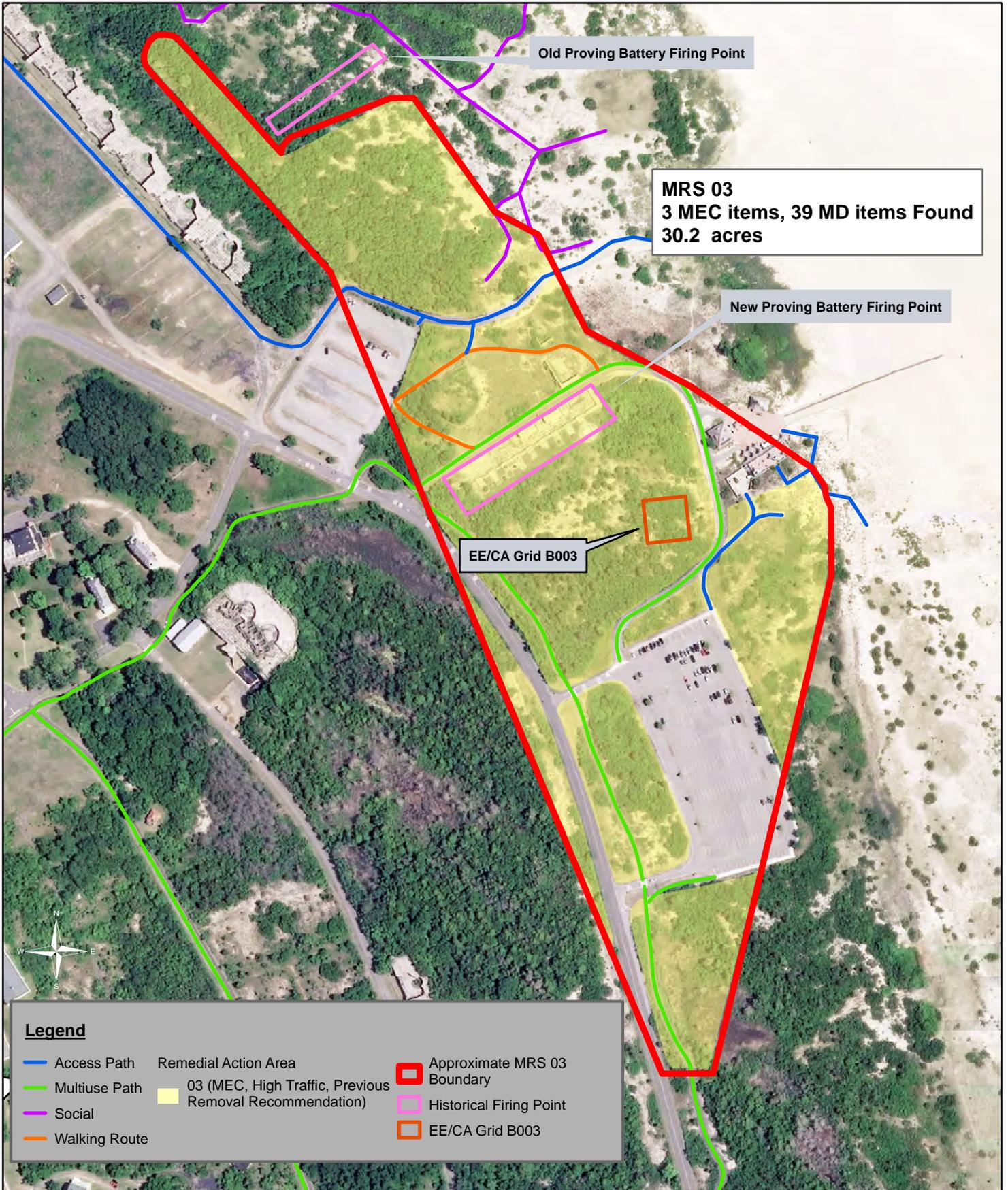
Feasibility Study
 Fort Hancock Formerly Used Defense Site,
 Monmouth County, New Jersey
 Contract No.: W912QR-12-D-0011

Figure A-1
 Fort Hancock
 MRS Locations



Date: January 2019

Data Sources: National Agriculture Imagery Program (NAIP), 2015



US Army Corps of Engineers
BUILDING STRONG

ERT

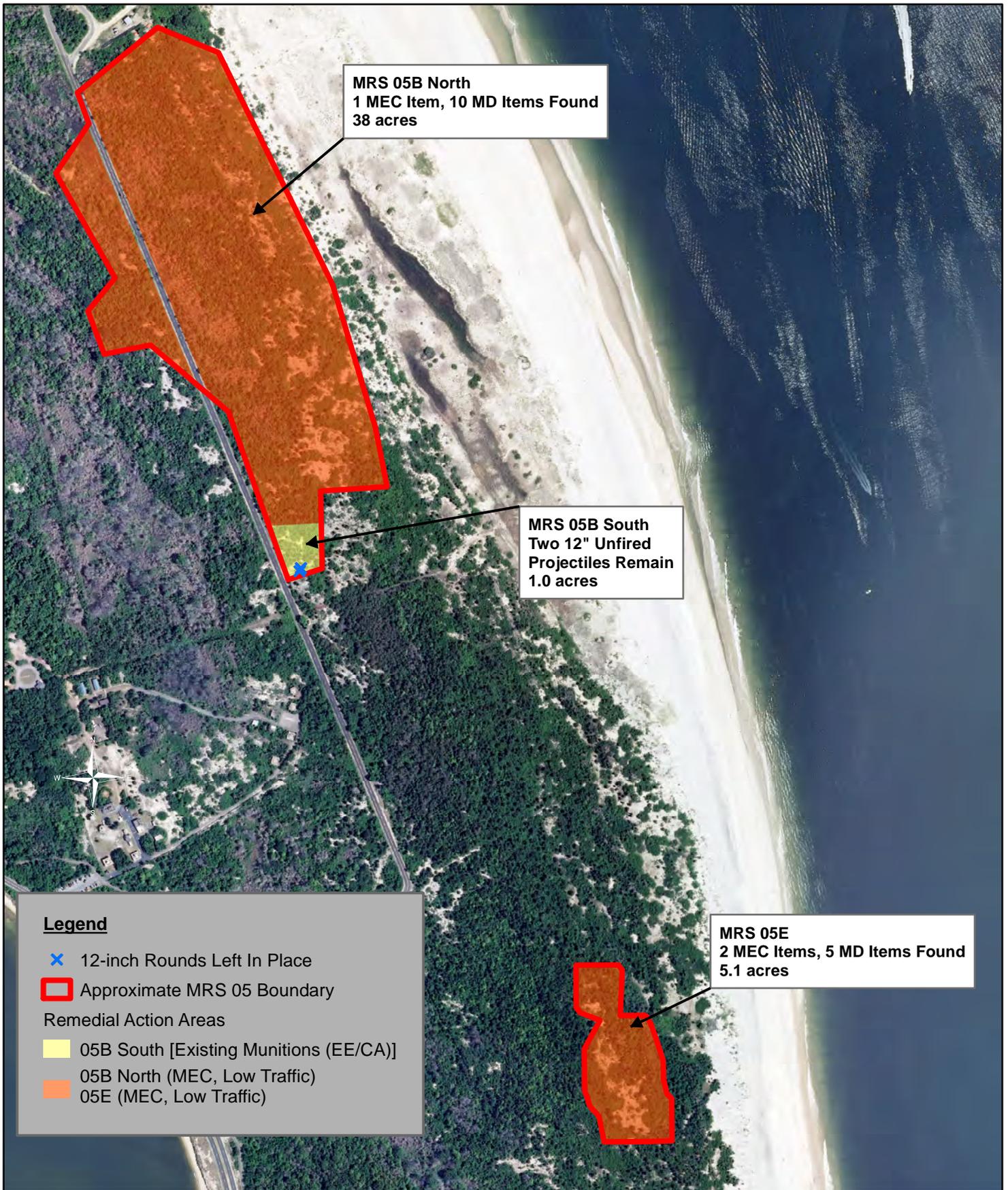
Date: February 2020

Feasibility Study
Fort Hancock Formerly Used Defense Site,
Monmouth County, New Jersey
Contract No.: W912QR-12-D-0011

Data Sources: 2014 Imagery Provided by NOAA

Figure A-2
MRS 03

0 150 300
Feet



US Army Corps of Engineers
BUILDING STRONG

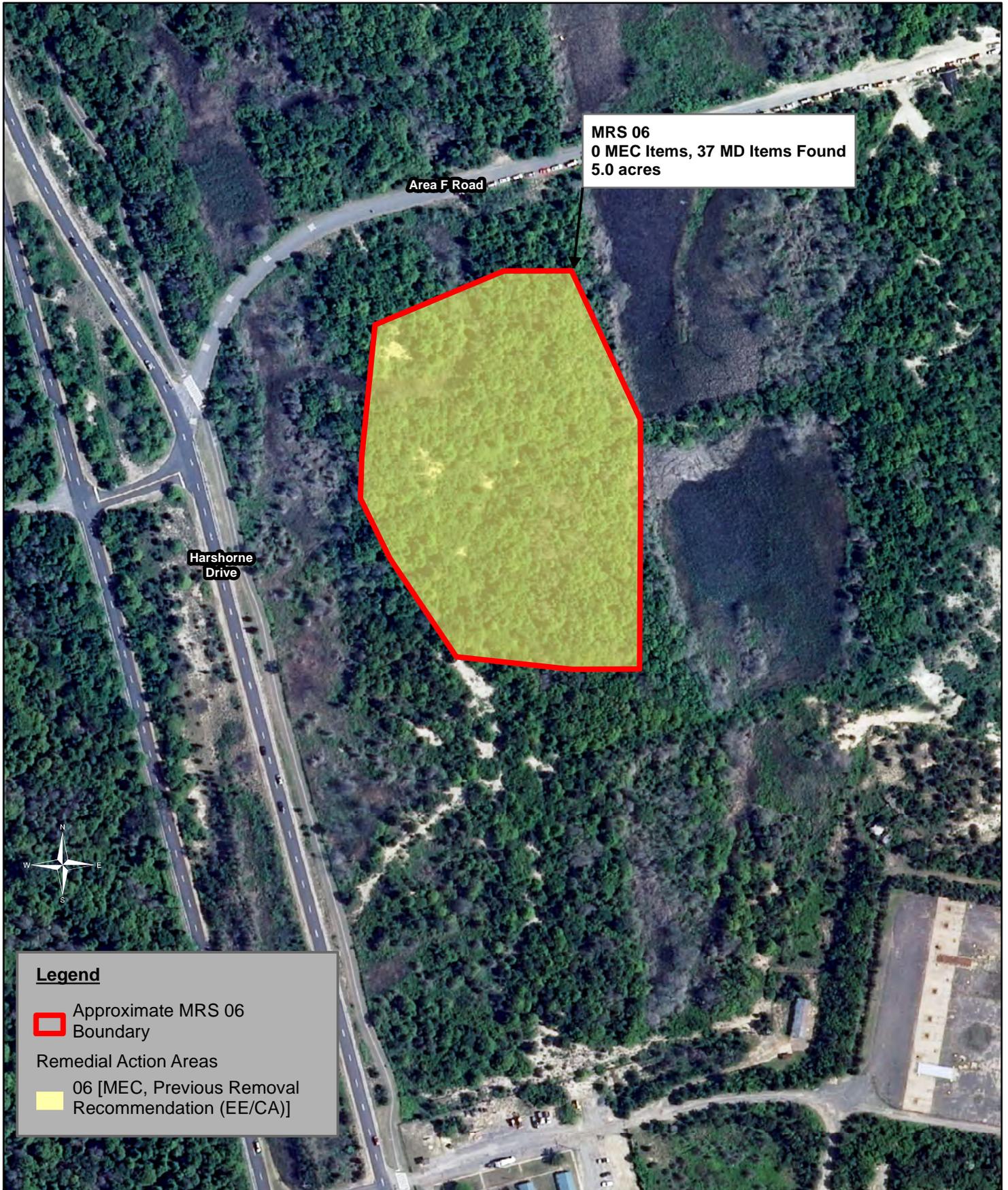
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Date: January 2019

Feasibility Study
Fort Hancock Formerly Used Defense Site,
Monmouth County, New Jersey
Contract No.: W912QR-12-D-0011

Data Sources: 2014 Imagery Provided by NOAA

Figure A-3
MRS 05
(05B North and South,
05E)



MRS 06
 0 MEC Items, 37 MD Items Found
 5.0 acres

Area F Road

Harshorne Drive

Legend

 Approximate MRS 06 Boundary

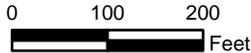
Remedial Action Areas

 06 [MEC, Previous Removal Recommendation (EE/CA)]



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 Fort Hancock Formerly Used Defense Site,
 Monmouth County, New Jersey
 Contract No.: W912QR-12-D-0011

**Figure A-4
 MRS 06**



Date: January 2019

Data Sources: 2014 Imagery Provided by NOAA



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Monmouth County, New Jersey
Contract No.: W912QR-12-D-0011

Figure A-5
MRS 08
(08A and 08B)

Date: January 2019

Data Sources: 2014 Imagery Provided by NOAA

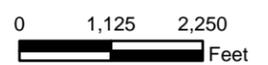


Document Path: N:\GIS\Northeast\NewJersey\FortHancock\MXD\FS\MRSGroup2V4.mxd



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Fort Hancock Formerly Used Defense Site,
Monmouth County, New Jersey
Contract No.: W912QR-12-D-0011

Figure A-6
MRS 05G and MRS 10



Date: January 2019

Data Sources: ESRI Online



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 Monmouth County, New Jersey
 Contract No.: W912QR-12-D-0011

Figure A-7
MRS Group 1

Date: February 2020

Data Sources: 2014 Imagery Provided by NOAA





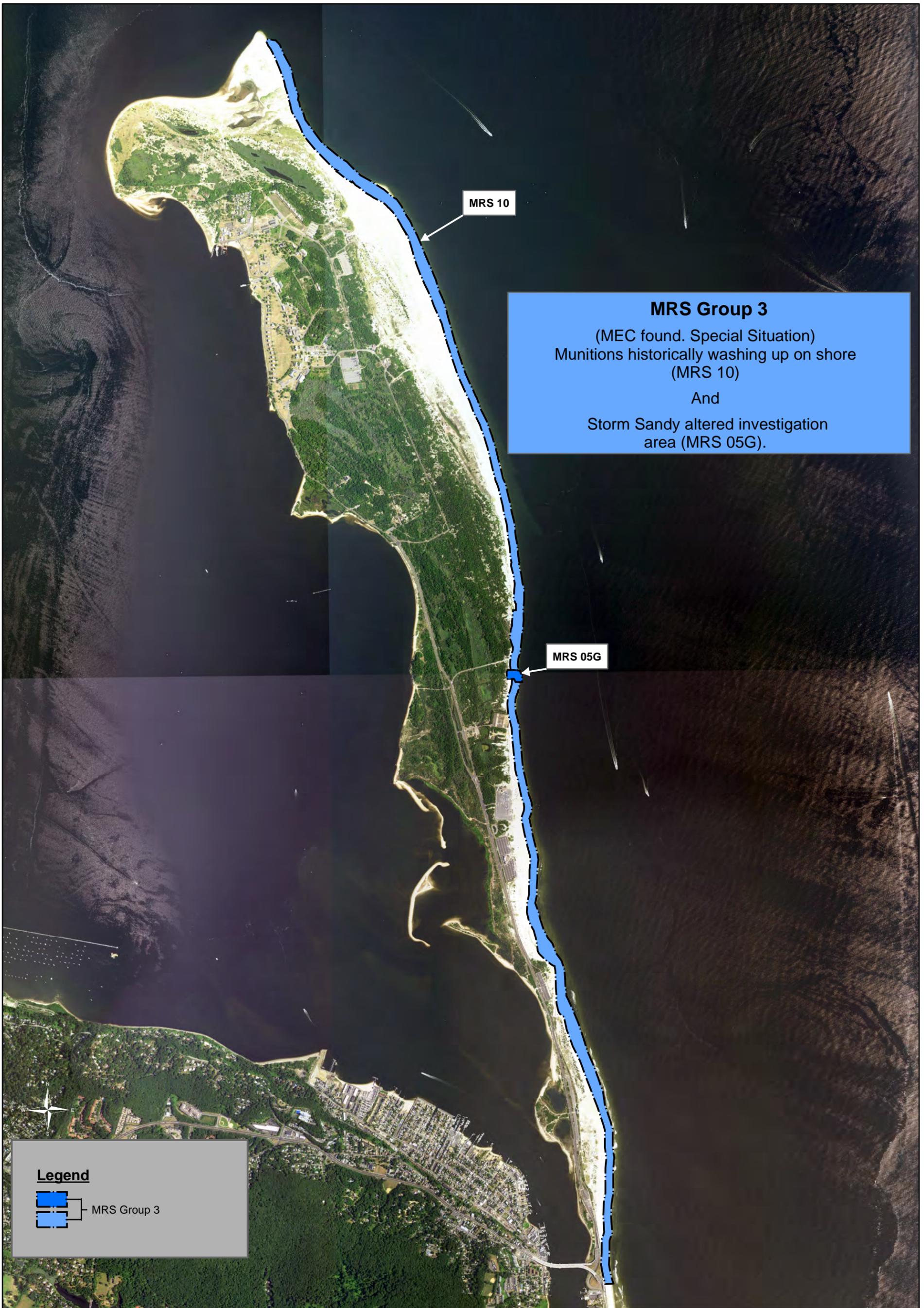
Feasibility Study
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 Monmouth County, New Jersey
 Contract No.: W912QR-12-D-0011

Figure A-8
MRS Group 2

Date: February 2020

Data Sources: 2014 Imagery Provided by NOAA





MRS Group 3
 (MEC found. Special Situation)
 Munitions historically washing up on shore
 (MRS 10)
 And
 Storm Sandy altered investigation
 area (MRS 05G).

Legend

 MRS Group 3

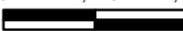



Date: January 2019

Feasibility Study
 Fort Hancock Formerly Used Defense Site,
 Monmouth County, New Jersey
 Contract No.: W912QR-12-D-0011

Data Sources: ESRI Online

Figure A-9
MRS Group 3

0 1,125 2,250
 Feet

Appendix B:
Post-Remedy Risk Management Methodology (RMM) Matrices

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Matrix 1 – Likelihood of Encounter. This matrix relates the site characterization data for amount of MEC to site use (including accessibility) to determine the likelihood of encountering MEC at a specific site

Matrix 1. Likelihood of Encounter

Likelihood of Encounter, Matrix 1: Amount of MEC vs. Access Conditions		Access Conditions (frequency of use)			
		Regular (e.g., daily use, open access)	Often (e.g., less regular or periodic use, some access)	Intermittent (e.g., some irregular use, or access limited)	Rare (e.g., very limited use, access prevented)
Amount of MEC	<ul style="list-style-type: none"> MEC is visible on the surface and detected in the subsurface. 	Frequent	Frequent	Likely	Occasional
	<ul style="list-style-type: none"> The area is identified as a Concentrated Munitions Use Area (CMUA) where MEC is known or suspected (e.g., MD indicative of MEC is identified) to be present in surface and subsurface. 	Frequent	Likely	Occasional	Seldom
					Seldom
	<ul style="list-style-type: none"> MEC presence based on physical evidence (e.g., MD indicative of MEC), although the area is not a CMUA, or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 1.0/acre at 95% confidence). 	Likely	Occasional	Seldom	Unlikely
	<ul style="list-style-type: none"> MEC presence is based on isolated historical discoveries (e.g., EOD report) prior to investigation, or A DERP response action has been conducted to physically remove MEC and known or suspected hazard remains to support this selection, (e.g., surface removal where subsurface not addressed) or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.5/acre at 95% confidence). 	Occasional	Seldom	Unlikely	Unlikely
	<ul style="list-style-type: none"> MEC presence is suspected based on historical evidence of munitions use only, or A DERP response action has been conducted to physically remove surface and subsurface MEC (evidence that some residual hazard remains to support this selection), or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.25/acre at 95% confidence). 	Seldom	Seldom	Unlikely	Unlikely
	<ul style="list-style-type: none"> Investigation of the MRS did not identify evidence of MEC presence, or A DERP response action has been conducted that will achieve UU/UE. 	Unlikely	Unlikely	Unlikely	Unlikely

Baseline Conditions

Baseline Amount of MEC:

MRS Group 1 comprises MRS 03 Central, MRS 05B South, and MRS 06. These are areas of MEC in high pedestrian traffic, or areas of existing munitions, or where previous removal recommendations have been made (EE/CA), and are considered CMUAs.

MRS 03 Central encompasses the new firing point of the former proving ground. MEC and MD items were found below the ground surface during the original 2014 RI. The MRS also includes the B003 Area where several MEC items were found during the 1998 EE/CA.

Unfired projectiles remain in the southern portion of MRS 05B. MEC has been found in MRS 06 and it is an area where a removal recommendation was made in the EE/CA.

The following MEC and MD items were found in the subsurface of MRS Group 1:

- MEC: MK 1, 1.44-inch projectile, 10-inch, 4.7-inch, 5-inch, 3-inch projectiles, two 12-inch unfired projectiles, a 3-inch and a 4.7-inch projectile, one Livens projectile containing FM smoke, and a potentially live Stokes mortar fuze.
- MD: Numerous items including 3.5-inch, 4.7-inch, 6-inch projectiles and 75mm shells, Stokes mortar fuzes, base of a 4.7” projectile, empty Livens projectiles.

Baseline Access Conditions:

MRS 03 Central comprises areas of high pedestrian traffic, open and accessible by park visitors, and contains unpaved and paved trails, paved roads, and a large paved parking lot. It represents the highest level of access and frequency of use for MRS Group 1, and is assessed as **Regular**. MRS 05B and MRS 06 are assessed as intermittent access or frequency of use as they are low pedestrian traffic areas.

Baseline Matrix 1 Result: Based on Amount of MEC and Access Conditions, the Likelihood of Encounter for MRS Group 1 is **Frequent**.

Post-Remedy Matrix 1 Results:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage (Administrative) LUC mitigation, the Likelihood of Encounter is **reduced from Frequent to Seldom**. This is based on moving to the right in Matrix 1, to very limited or rare occurrences of pedestrians ignoring signage to encounter potential MEC items.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Likelihood of Encounter is **reduced from Frequent to Seldom**. This is based on moving to the right in Matrix 1, to very limited or rare occurrences of pedestrians ignoring fencing to encounter potential MEC items.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood of Encounter is **reduced from Frequent to Seldom**. This is based on moving downward in Matrix 1 to a DERP response action that removes MEC and the subsequent very limited or rare occurrences of pedestrians encountering potential MEC items following the clearance.

Matrix 2 – Severity of Incident. This matrix assesses the likelihood of encounter rating (from Matrix 1) as related to the severity of an unintentional detonation.

Matrix 2. Severity of Incident

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of Encounter						
		Frequent: Regular, or inevitable occurrences	Likely: Several or numerous occurrences	Occasional: Sporadic or intermittent occurrences	Seldom: Infrequent, rare occurrences	Unlikely: Not probable		
Severity Associated with Specific Munitions items	Catastrophic/Critical: May result in 1 or more deaths, permanent total or partial disability, or hospitalization	A	A	B	B	B	B	D
	Modest: May result in 1 (or more) injury resulting in emergency medical treatment, without hospitalization	B	B	B	C		D	
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C		D	
	Improbable: No injury is anticipated	D	D	D	D		D	

Baseline Conditions

Baseline Severity of Incident:

Detonation of the identified MEC items while being handled by a human would likely result in at least partial disability or hospitalization (Catastrophic/Critical). Combined with a Frequent Likelihood of Encounter, this results in a worst-case MRS Group 1 *Severity of Incident of A*.

Post-Remedy Matrix 2 Results:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage (Administrative) LUC mitigation, the Matrix 1 Likelihood of Encounter is **reduced from Frequent to Seldom (B)**, based on infrequent or rare occurrences of pedestrians ignoring signage to encounter potential MEC items.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Matrix 1 Likelihood of Encounter is **reduced from Frequent to Seldom (B)**, based on infrequent or rare occurrences of pedestrians ignoring fencing to encounter potential MEC items.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood of Encounter is **reduced from Frequent to Seldom (B)**. This is based on a DERP response action removing MEC and the subsequent rare occurrence of pedestrians encounter potential MEC items following the clearance.

Matrix 3 – Likelihood of Detonation. This matrix relates sensitivity of the MEC items to the likelihood for energy to be imparted to an item during an encounter by specific land users.

Matrix 3. Likelihood of Detonation

Likelihood of Detonation, Matrix 3: Munitions Sensitivity vs. Likelihood of Energy to be Imparted		Likelihood to Impart Energy on an Item		
		High e.g., areas planned for development, or seasonally tilled	Modest e.g., undeveloped, wildlife refuge, parks	Inconsequential e.g., not anticipated, prevented, mitigated
Sensitivity: Susceptibility to Detonation	High (e.g., classified as sensitive)	1	1	3
	Moderate (e.g., high explosive (HE) or pyrotechnics)	1	2	3
	Low (e.g., propellant or bulk secondary explosives)	1	3	3
	Not Sensitive	2	3	3

Baseline Conditions

Baseline Sensitivity:

The identified MEC items contained some amount of HE. Therefore, the baseline sensitivity is assessed as *Moderate*.

Baseline Likelihood to Impart Energy:

MRS 03 Cenrtal represents the worst-case scenario for MRS Group 1, and as a high traffic area, open and accessible by park visitors, the baseline likelihood to impart energy is assessed as *High*.

Post-Remedy Matrix 3 Result:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage or Fencing LUC mitigation, the Likelihood to Impart Energy is **reduced from High to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following imposition of LUCs.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Likelihood to Impart Energy is **reduced from High to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following imposition of LUCs.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood to Impart Energy is **reduced from High to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following the clearance.

Matrix 4 – Acceptable and Unacceptable Site Conditions. This final matrix combines the results of Matrices 2 and 3 to differentiate Acceptable and Unacceptable site conditions.

Matrix 4: Acceptable and Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Result From Matrix 2			
		A	B	C	D
Result from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable
	Acceptable				
	Acceptable				

Baseline Conditions

The baseline risk matrices demonstrate that MRS Group 1 has an *Unacceptable* risk from MEC hazards due to the combination of severity of incident and likelihood of detonation factors.

Post Remedy Matrix 4 Result:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage LUC mitigation, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

Physical LUCs – Alternative 3

Using Fencing LUC mitigation, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

Matrix 1 – Likelihood of Encounter. This matrix relates the site characterization data for amount of MEC to site use (including accessibility) to determine the likelihood of encountering MEC at a specific site.

Matrix 1. Likelihood of Encounter

Likelihood of Encounter, Matrix 1: Amount of MEC vs. Access Conditions		Access Conditions (frequency of use)			
		Regular (e.g., daily use, open access)	Often (e.g., less regular or periodic use, some access)	Intermittent (e.g., some irregular use, or access limited)	Rare (e.g., very limited use, access prevented)
Amount of MEC	<ul style="list-style-type: none"> MEC is visible on the surface and detected in the subsurface. 	Frequent	Frequent	Likely	Occasional
	<ul style="list-style-type: none"> The area is identified as a Concentrated Munitions Use Area (CMUA) where MEC is known or suspected (e.g., MD indicative of MEC is identified) to be present in surface and subsurface. 	Frequent	Likely	Occasional	Seldom
				Seldom	
	<ul style="list-style-type: none"> MEC presence based on physical evidence (e.g., MD indicative of MEC), although the area is not a CMUA, or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 1.0/acre at 95% confidence). 	Likely	Occasional	Seldom	Unlikely
	<ul style="list-style-type: none"> MEC presence is based on isolated historical discoveries (e.g., EOD report) prior to investigation, or A DERP response action has been conducted to physically remove MEC and known or suspected hazard remains to support this selection, (e.g., surface removal where subsurface not addressed) or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.5/acre at 95% confidence). 	Occasional	Seldom	Unlikely	Unlikely
	<ul style="list-style-type: none"> MEC presence is suspected based on historical evidence of munitions use only, or A DERP response action has been conducted to physically remove surface and subsurface MEC (evidence that some residual hazard remains to support this selection), or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.25/acre at 95% confidence). 	Seldom	Seldom	Unlikely	Unlikely
	<ul style="list-style-type: none"> Investigation of the MRS did not identify evidence of MEC presence, or A DERP response action has been conducted that will achieve UU/UE. 	Unlikely	Unlikely	Unlikely	Unlikely

Baseline Conditions

Baseline Amount of MEC:

MRS Group 2 comprises MRS 03 North & South, MRS 05B North, MRS 05E, MRS 8A, and 8B. These are areas of MEC in low/no pedestrian traffic, are considered to be a CMUAs. The following MEC and MD items were found on the surface or the subsurface of MRS Group 2:

- MEC: 57mm Mk1 APHE projectile, 57mm projectile, M303 HE w/fuze, 57mm projectile, M86 APHE, 3-inch Mk 3 Model 7 projectile, 4-inch MK10 APHE projectile, 3-inch Stokes mortar, 75mm projectiles, 5-inch APHE projectile, and a 3.5-inch APHE projectile.
- MD: Approximately 77 items including 75mm shells, 5-inch Naval projectile, 8-inch Mk19 projectile, and an 8-inch Mk 24/25 projectile.

Baseline Access Conditions:

Unpaved recreational trails and the paved Multi-Use Path pass through portions of MRS Group 2. There are no man-made barriers preventing access, but these are primarily low/no pedestrian traffic location with areas of dense natural vegetation functioning to limit pedestrian access. Therefore, access or frequency of use is assessed as *Intermittent*.

Baseline Matrix 1 Result: *Occasional*

Post-Remedy Matrix 1 Results:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage (Administrative) LUC mitigation, the Likelihood of Encounter is **reduced from Occasional to Seldom**. This is based on moving to the right in Matrix 1, to very limited or rare occurrences of pedestrians ignoring signage to encounter potential MEC items.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Likelihood of Encounter is **reduced from Occasional to Seldom**. This is based on moving to the right in Matrix 1, to very limited or rare occurrences of pedestrians ignoring fencing to encounter potential MEC items.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood of Encounter is **reduced from Occasional to Unlikely**. This is based on moving downward in Matrix 1 to a DERP response action that removes MEC and the subsequent very limited or rare occurrences of pedestrians encountering potential MEC items following the clearance.

Matrix 2 – Severity of Incident. This matrix assesses the likelihood of encounter rating (from Matrix 1) as related to the severity of an unintentional detonation.

Matrix 2. Severity of Incident

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of Encounter					
		Frequent: Regular, or inevitable occurrences	Likely: Several or numerous occurrences	Occasional: Sporadic or intermittent occurrences	Seldom: Infrequent, rare occurrences	Unlikely: Not probable	
Severity Associated with Specific Munitions	Catastrophic/Critical: May result in 1 or more deaths, permanent total or partial disability, or hospitalization	A	A	B	B	B	D
	Modest: May result in 1 (or more) injury resulting in emergency medical treatment, without hospitalization	B	B	B	C		D
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C		D
	Improbable: No injury is anticipated	D	D	D	D		D

Baseline Conditions

Baseline Severity:

Detonation of the identified MEC items while being handled by a human would likely result in partial disability or hospitalization. Therefore, the severity is assessed as **Catastrophic/Critical**. Combined with an Occasional Likelihood of Encounter, this results in a MRS Group 2 **Severity of Incident of B**.

Post-Remedy Matrix 2 Results:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage (Administrative) LUC mitigation, the Matrix 1 Likelihood of Encounter is **reduced from Occasional to Seldom (B)**, based on infrequent or rare occurrences of pedestrians ignoring signage to encounter potential MEC items.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Matrix 1 Likelihood of Encounter is **reduced from Occasional to Seldom (B)**, based on infrequent or rare occurrences of pedestrians ignoring fencing to encounter potential MEC items.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood of Encounter is **reduced from Occasional to Unlikely (D)**. This is based on a DERP response action removing MEC and the subsequent rare occurrence of pedestrians encounter potential MEC items following the clearance.

Matrix 3 – Likelihood of Detonation. This matrix relates sensitivity of the MEC items to the likelihood for energy to be imparted to an item during an encounter by specific land users.

Matrix 3. Likelihood of Detonation

Likelihood of Detonation, Matrix 3: Munitions Sensitivity vs. Likelihood of Energy to be Imparted		Likelihood to Impart Energy on an Item				
		High e.g., areas planned for development, or seasonally tilled	Modest e.g., undeveloped, wildlife refuge, parks	Inconsequential e.g., not anticipated, prevented, mitigated		
Sensitivity: Susceptibility to	High (e.g., classified as sensitive)	1	1	3		
	Moderate (e.g., high explosive (HE) or pyrotechnics)	1	2	3	3	3
	Low (e.g., propellant or bulk secondary explosives)	1	3	3		
	Not Sensitive	2	3	3		

Baseline Conditions

Baseline Sensitivity:

The identified MEC items contained some amount of HE, although they were not considered inherently sensitive. Therefore, the baseline sensitivity is assessed as **Moderate**.

Baseline Likelihood to Impart Energy:

The area is an undeveloped portion of park land and will remain so for the foreseeable future. Therefore, the baseline likelihood to impart energy is assessed as **Modest**.

Post-Remedy Matrix 3 Result:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage LUC mitigation, the Likelihood to Impart Energy is **reduced from Modest to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following imposition of LUCs.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Likelihood to Impart Energy is **reduced from Modest to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following imposition of LUCs.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood to Impart Energy is **reduced from Modest to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following the clearance.

Matrix 4 – Acceptable and Unacceptable Site Conditions. This final matrix combines the results of Matrices 2 and 3 to differentiate Acceptable and Unacceptable site conditions.

Matrix 4: Acceptable and Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Result From Matrix 2			
		A	B	C	D
Result from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable

Baseline Conditions

The baseline risk matrices demonstrate that MRS Group 2 has an *Unacceptable* risk from MEC hazards due to the combination of severity of incident and likelihood of detonation factors.

Post Remedy Matrix 4 Result:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage LUC mitigation, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

Physical LUCs – Alternative 3

Using Fencing LUC mitigation, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (D-3)* conditions.

Matrix 1 – Likelihood of Encounter. This matrix relates the site characterization data for amount of MEC to site use (including accessibility) to determine the likelihood of encountering MEC at a specific site

Matrix 1. Likelihood of Encounter

Likelihood of Encounter, Matrix 1: Amount of MEC vs. Access Conditions		Access Conditions (frequency of use)			
		Regular (e.g., daily use, open access)	Often (e.g., less regular or periodic use, some access)	Intermittent (e.g., some irregular use, or access limited)	Rare (e.g., very limited use, access prevented)
Amount of MEC	<ul style="list-style-type: none"> MEC is visible on the surface and detected in the subsurface. 	Frequent	Frequent	Likely	Occasional
	<ul style="list-style-type: none"> The area is identified as a Concentrated Munitions Use Area (CMUA) where MEC is known or suspected (e.g., MD indicative of MEC is identified) to be present in surface and subsurface. 	Frequent	Likely	Occasional	Seldom
	<ul style="list-style-type: none"> MEC presence based on physical evidence (e.g., MD indicative of MEC), although the area is not a CMUA, or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 1.0/acre at 95% confidence). 	Likely	Occasional	Seldom	Unlikely
				Seldom	
	<ul style="list-style-type: none"> MEC presence is based on isolated historical discoveries (e.g., EOD report) prior to investigation, or A DERP response action has been conducted to physically remove MEC and known or suspected hazard remains to support this selection, (e.g., surface removal where subsurface not addressed) or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.5/acre at 95% confidence). 	Occasional	Seldom	Unlikely	Unlikely
	<ul style="list-style-type: none"> MEC presence is suspected based on historical evidence of munitions use only, or A DERP response action has been conducted to physically remove surface and subsurface MEC (evidence that some residual hazard remains to support this selection), or The MEC concentration is below a project-specific threshold to support this selection (e.g., less than 0.25/acre at 95% confidence). 	Seldom	Seldom	Unlikely	Unlikely
	<ul style="list-style-type: none"> Investigation of the MRS did not identify evidence of MEC presence, or A DERP response action has been conducted that will achieve UU/UE. 	Unlikely	Unlikely	Unlikely	Unlikely

Baseline Conditions

Baseline Amount of MEC:

MRS Group 3 comprises MRS 10 and MRS 05G. These are areas defined as special situations where MEC has been found in high pedestrian traffic areas. In part, MRS Group 3 encompasses portions of the former proving ground that have eroded into the ocean. MRS 10 was defined to address munitions that have historically been found on the beaches after storm events, and MRS 05G is possibly an overshoot zone of the historical 3,000-yard target impact area (it is also a beach area where MEC item may have washed up on shore following a storm event).

MEC presence based on physical evidence (MEC finds), although the areas are not CMUAs.

The following MEC and MD items were found in the subsurface of MRS Group 3:

- MEC: 4.5-inch Mark V APHE projectile, 3.5-inch, 6-inch, and 8-inch projectiles, Mk-25 Marine Marker, and a 5-inch AP projectile.
- MD: Numerous miscellaneous items documented found on the beach over the years.

Baseline Access Conditions:

MRS Group 3 is the open beach area and is highly trafficked by pedestrians. MRS 10 represents the highest level of access and frequency of use for MRS Group 3, and is assessed as **Regular**. MRS 05G is assessed as Often access or frequency of use as it is a low pedestrian traffic area.

Baseline Matrix 1 Result: Based on Amount of MEC and Access Conditions, the Likelihood of Encounter for MRS Group 3 is **Likely**.

Post-Remedy Matrix 1 Results:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage (Administrative) LUC mitigation, the Likelihood of Encounter is **reduced from Likely to Seldom**. This is based on moving to the right in Matrix 1, to limited access or irregular use by pedestrians ignoring signage to encounter potential MEC items.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Likelihood of Encounter is **reduced from reduced from Likely to Seldom**. This is based on moving to the right in Matrix 1, to very limited or rare occurrences of pedestrians ignoring fencing to encounter potential MEC items.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood of Encounter is **reduced from Likely to Seldom**. This is based on moving downward in Matrix 1 to a DERP response action that removes MEC and the subsequent rare occurrences of pedestrians encountering potential MEC items following the clearance.

Matrix 2 – Severity of Incident. This matrix assesses the likelihood of encounter rating (from Matrix 1) as related to the severity of an unintentional detonation.

Matrix 2. Severity of Incident

Severity of Explosive Incident, Matrix 2: Severity vs. Likelihood of Encounter		Likelihood of Encounter						
		Frequent: Regular, or inevitable occurrences	Likely: Several or numerous occurrences	Occasional: Sporadic or intermittent occurrences	Seldom: Infrequent, rare occurrences	Unlikely: Not probable		
Severity Associated with Specific Munitions items	Catastrophic/Critical: May result in 1 or more deaths, permanent total or partial disability, or hospitalization	A	A	B	B	B	B	D
	Modest: May result in 1 (or more) injury resulting in emergency medical treatment, without hospitalization	B	B	B	C			D
	Minor: May result in 1 or more injuries requiring first aid or medical treatment	B	C	C	C			D
	Improbable: No injury is anticipated	D	D	D	D			D

Baseline Conditions

Baseline Severity of Incident:

Detonation of the identified MEC items while being handled by a human would likely result in at least partial disability or hospitalization (Catastrophic/Critical). Combined with a Likely Likelihood of Encounter, this results in a worst-case MRS Group 3 *Severity of Incident of A*.

Post-Remedy Matrix 2 Results:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs – Alternative 2

Using Signage (Administrative) LUC mitigation, the Matrix 1 Likelihood of Encounter is **reduced from Likely to Seldom (B)**, based on infrequent or rare occurrences of pedestrians ignoring signage to encounter potential MEC items.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Matrix 1 Likelihood of Encounter is **reduced from Likely to Seldom (B)**, based on infrequent or rare occurrences of pedestrians ignoring fencing to encounter potential MEC items.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood of Encounter is **reduced from Likely to Seldom (B)**. This is based on a DERP response action removing MEC and the subsequent rare occurrence of pedestrians encounter potential MEC items following the clearance.

Matrix 3 – Likelihood of Detonation. This matrix relates sensitivity of the MEC items to the likelihood for energy to be imparted to an item during an encounter by specific land users.

Matrix 3. Likelihood of Detonation

Likelihood of Detonation, Matrix 3: Munitions Sensitivity vs. Likelihood of Energy to be Imparted		Likelihood to Impart Energy on an Item		
		High e.g., areas planned for development, or seasonally tilled	Modest e.g., undeveloped, wildlife refuge, parks	Inconsequential e.g., not anticipated, prevented, mitigated
Sensitivity: Susceptibility to Detonation	High (e.g., classified as sensitive)	1	1	3
	Moderate (e.g., high explosive (HE) or pyrotechnics)	1	2	3
	Low (e.g., propellant or bulk secondary explosives)	1	3	3
	Not Sensitive	2	3	3

Baseline Conditions

Baseline Sensitivity:

The identified MEC items contained some amount of HE. Therefore, the baseline sensitivity is assessed as *Moderate*.

Baseline Likelihood to Impart Energy:

MRS 10 represents the worst-case scenario for MRS Group 3, and as a high traffic area, open and accessible by park visitors, the baseline likelihood to impart energy is assessed as *High*.

Post-Remedy Matrix 3 Result:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage LUC mitigation, the Likelihood to Impart Energy is **reduced from High to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following imposition of LUCs.

Physical LUCs – Alternative 3

Using Fencing (Physical) LUC mitigation, the Likelihood to Impart Energy is **reduced from High to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following imposition of LUCs.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Likelihood to Impart Energy is **reduced from High to Inconsequential (3)**. This is based on unanticipated or mitigated ability to impart energy to the MEC item following the clearance.

Matrix 4 – Acceptable and Unacceptable Site Conditions. This final matrix combines the results of Matrices 2 and 3 to differentiate Acceptable and Unacceptable site conditions.

Matrix 4: Acceptable and Unacceptable Site Conditions

Acceptable and Unacceptable Site Conditions		Result From Matrix 2			
		A	B	C	D
Result from Matrix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
	2	Unacceptable	Unacceptable	Acceptable	Acceptable
	3	Unacceptable	Acceptable	Acceptable	Acceptable
	Acceptable				
	Acceptable				

Baseline Conditions

The baseline risk matrices demonstrate that MRS Group 3 has an *Unacceptable* risk from MEC hazards due to the combination of severity of incident and likelihood of detonation factors.

Post Remedy Matrix 4 Result:

No Further Action – Alternative 1 Does not change the baseline conditions.

Administrative LUCs - Alternative 2

Using Signage LUC mitigation, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

Physical LUCs – Alternative 3

Using Fencing LUC mitigation, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

MEC Removal to 2 ft with LUCs - Alternative 5

Following MEC Removal to 2 ft bgs, the Severity of Incident and Likelihood of Detonation matrices result in *Acceptable (B-3)* conditions.

**Appendix C:
Costing Backup**

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APPENDIX C: FORT HANCOCK FUDS FEASIBILITY STUDY COSTS
SUMMARY SHEET

	Alternative 1	Alternative 2			Alternative 3			Alternative 5		
	No Further Action	Administrative Land Use Controls (Signs)			Physical Land Use Controls (Fencing)			MEC Removal to 2 ft with LUCs		
		Capital	O&M	TOTAL	Capital	O&M	TOTAL	Capital	O&M	TOTAL
MRS Group 1	\$ -	\$ 128,051.00	\$ 353,230.00	\$ 481,281.00	\$ 520,673.00	\$ 353,230.00	\$ 873,903.00	\$ 1,851,356.00	\$ 167,250.00	\$ 2,018,606.00
MRS Group 2	\$ -	\$ 132,927.00	\$ 353,230.00	\$ 486,157.00	\$ 1,326,372.00	\$ 353,230.00	\$ 1,679,602.00	\$ 3,378,840.00	\$ 167,250.00	\$ 3,546,090.00
MRS Group 3	\$ -	\$ 150,805.00	\$ 353,230.00	\$ 504,035.00	NA	NA	NA	\$ 4,734,760.00	\$ 167,250.00	\$ 4,902,010.00

Assumptions:

	number of signs	perimeter (feet)	area (acres)
Group 1	10	11,417	36.2
Group 2	16	33,134	114.1
Group 3	30	(35,000 length)	181.2

Administrative LUCs

Planning Document includes LUCIP of low complexity and one meeting.
Signs cost \$544.50 each, without markup.
Periodic review includes Document Review, Site Inspection, Report, and Travel. Six reviews beginning in 2024.
30-year O&M includes 15 (biennial) reports and site visits (\$353,230).

Physical LUCs

Planning includes LUCIP and meeting.
Implementation includes Process Agreement and Plan Execution.
Fence is 'Boundary' (5' galvanized), cost \$23.95 per foot (materials, labor, equip.), without markup.
Periodic review includes Document Review, Site Inspection, Report, and Travel. Six reviews beginning in 2024.
30-year O&M includes 15 (biennial) reports and site visits (\$353,230).

Removal Action

Includes 3 meetings, 1 site visit, UFP QAPP, GIS Database, CRP, ESS, PMP, QASP, HASP.
Group 1 and 2: 25% DGM/AGC, 75% analog mag & dig
Group 3: 100% DGM/AGC (towed array followed by AGC cueing)
Anomaly Density 250/acre.
Removal areas shown above.
No Onsite Donor Explosive Storage.
Topography is gently rolling, Vegetation is "Low Grass with Few Shrubs." Low vegetation removal cost reflects limitations set by NPS (i.e., many species prohibited from being cut).
Group 1: Vegetation removal is 25% moderate removal, 50% light removal, 25% no removal
Group 2: Vegetation removal is 50% light removal, 50% no removal (areas where cutting prohibited).
Reports include After Action Report, Independent Blind Seed Tracking, IVS Memo, Anomaly Selection Memo, TOI Memo.
Remedial Action starts January 2021.
LUCIP of low complexity to establish educational awareness measures.
30-year O&M (MEC Monitoring) includes four site visits, outreach/safety presentations (\$167,250).

Costs developed using RACER 11.5.99 (2018).

Site Cost Detail Report (with Markups)

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: C:\RACER_local\FH_FSv2_11_5.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 2

Name: Administrative LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

<u>Location Modifier</u>	<u>Default</u>	<u>User</u>	<u>Reason for changes</u>
	1.210	1.210	

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description Administrative Land Use Controls

Site:

Site Cost Detail Report (with Markups)

ID: Group 1
Name: MEC Found, High Traffic
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input type="checkbox"/>	
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found, High Traffic
Previous Recommendation of Removal Action (Central MRS 03, MRS 06)
Existing buried munitions (Southern MRS 05B)

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: James Stuby

Site Cost Detail Report (with Markups)

Estimator Title: Geophysicist
Agency/Org./Office: ERT, Inc.
Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707
Telephone Number: 301-323-1429
Email Address: james.stuby@ertcorp.com
Estimate Prepared Date: 07/20/2017

Estimator Signature: _____

Date: _____

Reviewer Information

Reviewer Name: Thomas Bachovchin
Reviewer Title: Project Manager
Agency/Org./Office: ERT, Inc.
Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707
Telephone Number: 301-323-1442
Email Address: thomas.bachovchin@ertcorp.com
Date Reviewed: 07/20/2017

Reviewer Signature: _____

Date: _____

Site Cost Detail Report (with Markups)

Phase (Markup Template)	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
5-yr Review (System Defaults)	\$0	\$0	\$33,920	\$4,721	\$0	\$7,011	\$45,652	\$71,796
30-yr O&M (System Defaults)	\$0	\$0	\$163,427	\$23,013	\$0	\$34,174	\$220,615	\$353,230
Admin LUC - signs (System Defaults)	\$0	\$0	\$22,467	\$3,738	\$0	\$5,551	\$31,756	\$56,255
Total Site Cost	\$183,260	\$0	\$219,814	\$31,472	\$0	\$46,736	\$298,022	\$481,282

Total Site Cost \$481,282

	Direct Cost	Markups	Total
Total Site Cost	\$183,260	\$298,022	\$481,282

Site Cost Detail Report (with Markups)

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: C:\RACER_local\FH_FSv2_11_5.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 2

Name: Administrative LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

<u>Location Modifier</u>	<u>Default</u>	<u>User</u>	<u>Reason for changes</u>
	1.210	1.210	

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description Administrative Land Use Controls

Site:

Site Cost Detail Report (with Markups)

ID: Group 2
Name: MEC Found, Low Traffic
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input type="checkbox"/>	
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found, Low Traffic
Low traffic parts of MRS 03
Northern MRS 05B
MRS 05E
MRS 08A and 08B

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Site Cost Detail Report (with Markups)

Estimator Information

Estimator Name: James Stuby

Estimator Title: Geophysicist

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1429

Email Address: james.stuby@ertcorp.com

Estimate Prepared Date: 01/30/2019

Estimator Signature: _____

Date: _____

Reviewer Information

Reviewer Name: Thomas Bachovchin

Reviewer Title: Project Manager

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1442

Email Address: thomas.bachovchin@ertcorp.com

Date Reviewed: 01/31/2019

Reviewer Signature: _____

Date: _____

Site Cost Detail Report (with Markups)

Phase (Markup Template)	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit Contingency	Owner Cost	Markup Total	Total
5-yr Review (System Defaults)	\$0	\$0	\$33,920	\$4,721	\$0	\$7,011	\$71,796
30-yr O&M (System Defaults)	\$0	\$0	\$163,427	\$23,013	\$0	\$34,174	\$353,230
Admin LUC - signs (System Defaults)	\$0	\$0	\$23,267	\$4,063	\$0	\$6,034	\$61,131
Total Site Cost	\$186,527	\$0	\$220,615	\$31,797	\$0	\$47,219	\$486,158

Total Site Cost \$486,158

Total Site Cost	Direct Cost	Markups	Total
	\$186,527	\$299,631	\$486,158

Site Cost Detail Report (with Markups)

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: C:\RACER_local\FH_FSv2_11_5.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 2

Name: Administrative LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

<u>Location Modifier</u>	<u>Default</u>	<u>User</u>	<u>Reason for changes</u>
	1.210	1.210	

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description Administrative Land Use Controls

Site:

Site Cost Detail Report (with Markups)

ID: Group 3
Name: Special Situation
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input type="checkbox"/>	
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found and High Pedestrian Traffic
Munitions historically wash up on beach in MRS 07
Storm Sandy (2012) altered/obliterated MRS 05G

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: James Stuby

Site Cost Detail Report (with Markups)

Estimator Title: Geophysicist

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1429

Email Address: james.stuby@ertcorp.com

Estimate Prepared Date: 01/31/2019

Estimator Signature: _____

Date: _____

Reviewer Information

Reviewer Name: Thomas Bachovchin

Reviewer Title: Project Manager

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1442

Email Address: thomas.bachovchin@ertcorp.com

Date Reviewed: 01/31/2019

Reviewer Signature: _____

Date: _____

Site Cost Detail Report (with Markups)

Phase (Markup Template)	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
30-yr O&M (System Defaults)	\$0	\$0	\$163,427	\$23,013	\$0	\$34,174	\$220,615	\$353,230
5-yr Review (System Defaults)	\$0	\$0	\$33,920	\$4,721	\$0	\$7,011	\$45,652	\$71,796
Admin LUC - signs (System Defaults)	\$0	\$0	\$26,202	\$5,257	\$0	\$7,806	\$39,264	\$79,009
Total Site Cost	\$198,506	\$0	\$223,549	\$32,990	\$0	\$48,991	\$305,531	\$504,036

Total Site Cost \$504,036

	Direct Cost	Markups	Total
Total Site Cost	\$198,506	\$305,531	\$504,036

Site Cost Detail Report (with Markups)

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: C:\RACER_local\FH_FSv2_11_5.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 3

Name: Physical LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

<u>Location Modifier</u>	<u>Default</u>	<u>User</u>	<u>Reason for changes</u>
	1.210	1.210	

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description Physical Land Use Controls (fencing)

Site:

Site Cost Detail Report (with Markups)

ID: Group 1
Name: MEC Found, High Traffic
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input type="checkbox"/>	
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found, High Traffic
Previous Recommendation of Removal Action (Central MRS 03, MRS 06)
Existing buried munitions (Southern MRS 05B)

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: James Stuby

Site Cost Detail Report (with Markups)

Estimator Title: Geophysicist

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1429

Email Address: james.stuby@ertcorp.com

Estimate Prepared Date: 06/05/2019

Estimator Signature: _____

Date: _____

Reviewer Information

Reviewer Name: Thomas Bachovchin

Reviewer Title: Project Manager

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1442

Email Address: thomas.bachovchin@ertcorp.com

Date Reviewed: 06/05/2019

Reviewer Signature: _____

Date: _____

Site Cost Detail Report (with Markups)

Phase (Markup Template)	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit Contingency	Owner Cost	Markup Total	Total
5-yr Review (System Defaults)	\$0	\$0	\$33,920	\$4,721	\$0	\$7,011	\$71,796
30-yr O&M (System Defaults)	\$0	\$0	\$163,427	\$23,013	\$0	\$34,174	\$353,230
Physical LUC - fence (System Defaults)	\$0	\$0	\$73,227	\$29,808	\$0	\$44,265	\$448,877
Total Site Cost	\$460,337	\$0	\$270,575	\$57,542	\$0	\$85,450	\$873,904

Total Site Cost \$873,904

	Direct Cost	Markups	Total
Total Site Cost	\$460,337	\$413,567	\$873,904

Site Cost Detail Report (with Markups)

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: C:\RACER_local\FH_FSv2_11_5.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 3

Name: Physical LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

<u>Location Modifier</u>	<u>Default</u>	<u>User</u>	<u>Reason for changes</u>
	1.210	1.210	

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description Physical Land Use Controls (fencing)

Site:

Site Cost Detail Report (with Markups)

ID: Group 2
Name: MEC Found, Low Traffic
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input type="checkbox"/>	
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found, Low Traffic
Low traffic parts of MRS 03
Northern MRS 05B
MRS 05E
MRS 08A and 08B

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Site Cost Detail Report (with Markups)

Estimator Information

Estimator Name: James Stuby

Estimator Title: Geophysicist

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1429

Email Address: james.stuby@ertcorp.com

Estimate Prepared Date: 06/05/2019

Estimator Signature: _____

Date: _____

Reviewer Information

Reviewer Name: Thomas Bachovchin

Reviewer Title: Project Manager

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1442

Email Address: thomas.bachovchin@ertcorp.com

Date Reviewed: 06/05/2019

Reviewer Signature: _____

Date: _____

Estimate Documentation Report - Layout 1

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: N:\Projects_Ongoing\3361- Ft Hancock-Livens MRS 6\005_Feasibility Study\RACER\Racer_Backup_3_18_2020.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 5

Name: MEC Removal with LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

Location Modifier

Default

User

Reason for changes

1.210

1.210

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description

MEC Removal to 2 Ft with Administrative Land Use Controls

Estimate Documentation Report - Layout 1

Site:

ID: Group 1
Name: MEC Found, High Traffic
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input checked="" type="checkbox"/>	Safety Level: D
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found, High Traffic
Previous Recommendation of Removal Action (Central MRS 03, MRS 06)
Existing buried munitions (Southern MRS 05B)

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: James Stuby

Estimator Title: Geophysicist

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1429

Email Address: james.stuby@ertcorp.com

Estimate Prepared Date: 06/05/2019

Estimator Signature: _____

Date: _____

Estimate Documentation Report - Layout 1

Reviewer Information

Reviewer Name: Thomas Bachovchin
Reviewer Title: Project Manager
Agency/Org./Office: ERT, Inc.
Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707
Telephone Number: 301-323-1442
Email Address: thomas.bachovchin@ertcorp.com
Date Reviewed: 06/05/2019

Reviewer Signature: _____

Date: _____

Estimate Costs:

<u>Phase Names</u>	<u>Marked-Up Cost</u>
5-yr Review	\$71,796
MEC Removal	\$1,779,560
30 yr O&M	\$167,250
Total Cost:	\$2,018,607

Phase Documentation:

Phase Type: Remedial Action
Phase Name: 5-yr Review
Description: 5 year Review
Approach: Ex Situ
Start Date: June, 2019
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups

	<u>Markup</u>	<u>% Prime</u>	<u>% Sub.</u>
Five-Year Review	Yes	100	0

Total Marked-up Cost: \$71,796.46

Estimate Documentation Report - Layout 1

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: N:\Projects_Ongoing\3361- Ft Hancock-Livens MRS 6\005_Feasibility Study\RACER\Racer_Backup_3_18_2020.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 5

Name: MEC Removal with LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

<u>Location Modifier</u>	<u>Default</u>	<u>User</u>	<u>Reason for changes</u>
	1.210	1.210	

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description MEC Removal to 2 Ft with Administrative Land Use Controls

Estimate Documentation Report - Layout 1

Site:

ID: Group 2
Name: MEC Found, Low Traffic
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input checked="" type="checkbox"/>	Safety Level: D
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found, Low Traffic
Low traffic parts of MRS 03
Northern MRS 05B
MRS 05E
MRS 08A and 08B

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: James Stuby
Estimator Title: Geophysicist
Agency/Org./Office: ERT, Inc.
Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707
Telephone Number: 301-323-1429
Email Address: james.stuby@ertcorp.com
Estimate Prepared Date: 06/05/2019

Estimator Signature: _____

Date: _____

Estimate Documentation Report - Layout 1

Reviewer Information

Reviewer Name: Thomas Bachovchin
Reviewer Title: Project Manager
Agency/Org./Office: ERT, Inc.
Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707
Telephone Number: 301-323-1442
Email Address: thomas.bachovchin@ertcorp.com
Date Reviewed: 06/05/2019

Reviewer Signature: _____

Date: _____

Estimate Costs:

<u>Phase Names</u>	<u>Marked-Up Cost</u>
5-yr Review	\$71,796
Removal Action	\$3,307,044
30 yr O&M	\$167,250
Total Cost:	\$3,546,090

Phase Documentation:

Phase Type: Remedial Action

Phase Name: 5-yr Review

Description: 5 year Review

Approach: Ex Situ

Start Date: June, 2019

Labor Rate Group: System Labor Rate

Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups

Five-Year Review

<u>Markup</u>	<u>% Prime</u>	<u>% Sub.</u>
Yes	100	0

Total Marked-up Cost: \$71,796.46

Estimate Documentation Report - Layout 1

Software:

RACER Version: RACER® Version 11.5.99.0

Database Location: N:\Projects_Ongoing\3361- Ft Hancock-Livens MRS 6\005_Feasibility Study\RACER\Racer_Backup_3_18_2020.mdb

Folder:

Folder Name: Fort Hancock Feasibility Study

Project:

ID: Alternative 5

Name: MEC Removal with LUC

Category: None

Location

State / Country: NEW JERSEY

City: FORT HANCOCK

Location Modifier

Default

User

Reason for changes

1.210

1.210

Options

Database: System Costs

Cost Database Date: 2019

Report Option: Fiscal

Description

MEC Removal to 2 Ft with Administrative Land Use Controls

Estimate Documentation Report - Layout 1

Site:

ID: Group 3
Name: Special Situation
Type: None

Media/Waste Type

Primary: Ordnance (not residual)
Secondary: N/A

Contaminant

Primary: None
Secondary: None

Phase Names

Pre-Study	<input type="checkbox"/>	
Study	<input type="checkbox"/>	
Design	<input checked="" type="checkbox"/>	Safety Level: E
Removal/Interim Action	<input type="checkbox"/>	
Remedial Action	<input checked="" type="checkbox"/>	Safety Level: D
Operations & Maintenance	<input checked="" type="checkbox"/>	Safety Level: D
Long Term Monitoring	<input checked="" type="checkbox"/>	Safety Level: D
Site Closeout	<input type="checkbox"/>	

In the RACER Preferences the default value for the Safety Level is established. This sets the default value for the safety level for each technology model based on the type of work being completed. Note: RACER Technologies that safety level is not appropriate to change from the default are hard-coded to estimate costs without a safety level productivity factor, which is Safety Level E.

Documentation

Description: MEC Found and High Pedestrian Traffic
Munitions historically wash up on beach in MRS 07
Storm Sandy (2012) altered/obliterated MRS 05G

Support Team: Michelle Chesnut

References: Documentation of reference sources used in the preparation of the estimate.

Estimator Information

Estimator Name: James Stuby

Estimator Title: Geophysicist

Agency/Org./Office: ERT, Inc.

Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707

Telephone Number: 301-323-1429

Email Address: james.stuby@ertcorp.com

Estimate Prepared Date: 06/05/2019

Estimator Signature: _____

Date: _____

Estimate Documentation Report - Layout 1

Reviewer Information

Reviewer Name: Thomas Bachovchin
Reviewer Title: Project Manager
Agency/Org./Office: ERT, Inc.
Business Address: 14401 Sweitzer Lane
Suite 300
Laurel, MD 20707
Telephone Number: 301-323-1442
Email Address: thomas.bachovchin@ertcorp.com
Date Reviewed: 06/05/2019

Reviewer Signature: _____

Date: _____

Estimate Costs:

<u>Phase Names</u>	<u>Marked-Up Cost</u>
5-yr Review	\$71,796
Removal Action	\$4,662,964
30 yr O&M	\$167,250
Total Cost:	\$4,902,010

Phase Documentation:

Phase Type: Remedial Action
Phase Name: 5-yr Review
Description: 5 year Review
Approach: Ex Situ
Start Date: June, 2019
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markup Template: System Defaults

Technology Markups

	<u>Markup</u>	<u>% Prime</u>	<u>% Sub.</u>
Five-Year Review	Yes	100	0

Total Marked-up Cost: \$71,796.46