

Final

# Feasibility Study Report Munitions Response Site

## Waikane Valley Impact Area Kaneohe, Hawaii

January 2012

Commander  
Naval Facilities Engineering Command, Pacific  
258 Makalapa Drive, Suite 100  
Pearl Harbor, HI 96860-3134



Contract Number N62742-05-D-1868, CTO 0010

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# EXECUTIVE SUMMARY

## INTRODUCTION

The former Waikane Valley Impact Area (WVIA) has been investigated under the Munitions Response Program to determine what types of cleanup actions are needed to reduce risks from munitions and explosives of concern (MEC) or munitions constituents remaining from past training activities. The 2008 Site Inspection (SI) and 2010 Remedial Investigation (RI) concluded that no further action is needed to address munitions constituents in the WVIA because they are not present in concentrations high enough to pose unacceptable risks to human health or the environment. However, hazards were identified from exposure to MEC potentially remaining on WVIA which require further action.

This Feasibility Study (FS) Report documents the development and evaluation of remedial alternatives for the Waikane Valley Impact Area (WVIA) Munitions Response Site (MRS), currently a military reservation located in Waikane Valley, Kaneohe, Oahu, Hawaii. The purpose of the FS is to develop and evaluate potential cleanup and land management actions and select the alternatives which best meet the following remedial action objectives:

- Prevent exposure to MEC through reduction of MEC hazards.
- Support future agricultural, recreational, cultural, and forest reserve land use.

## RESPONSE ACTION AREAS

Based on MEC risks identified during the SI and RI investigations, the 187-acre MRS is divided into the following response action areas (see Figure ES-1):

- **Southern Area** (approximately 34 acres), where no evidence of MEC was found during the SI and RI. No MEC was discovered in this area during the SI or RI. Most of the Southern Area is classified on the zoning map of the Honolulu Department of Planning and Permitting for the Southern Area as “General Agriculture”. This area contains most of the cultural features of WVIA.
- **Northern Non-Target Area** (approximately 106 acres), includes the steepest slopes of WVIA, with field teams unable to investigate the majority of the area. The accessible portions contain minimal MEC, but the area still has potential for explosive hazards. Most of the Northern Non-Target Area is classified on the zoning map as “Restricted Preservation-Forest Reserve”.
- **Northern Target Area** (approximately 47 acres), contains the highest concentration of MEC items and therefore the highest potential explosive hazards. Most of the slopes in this area are also extremely steep. The Northern Target Area is classified on the zoning map as “General Agricultural” for the approximate southern half and “Restricted Preservation-Forest Reserve” for the remaining part.

## DEFINITIONS

For the purposes of alternatives identification and evaluation, the following components of the alternatives are defined:

**Accessible land** – Defined during the RI as areas with less than 30 degrees slopes. However, for the purpose of this FS, based on the field supervisors’ professional judgment and site-specific knowledge acquired during the SI and RI fieldwork, accessible areas are considered to extend beyond the 30 degree slope limitation and are estimated as follows:

### Response Action Areas

<b>Response Action Area</b>	<b>Total Area (acres)</b>	<b>Accessible Area<sup>a</sup> (acres)</b>	<b>Inaccessible Area (acres)</b>	<b>Sensitive Cultural Sites (acres)</b>
Southern Area	33.9	30.5	3.4 <sup>b</sup>	3.7
Northern Non-Target Area	105.8	2.9	102.9	0.3
Northern Target Area	47.3	17.5	29.8	0.2

### Notes:

- Accessible areas are estimated based on field supervisor's professional judgment and site-specific knowledge acquired during the SI and RI fieldwork.
- Inaccessible areas within the Southern Area may be partially accessible using safety ropes, but no detection equipment to conduct MEC clearance can be safely used while descending or ascending steep slopes. Therefore inaccessible land within the Southern Area would be limited to visual sweeps only, with the possibility that the steepest slopes may not be reached at all. Judgment as to which slopes can't be reached on a safety rope would be up to the UXO Technician responsible for site safety.

**Land Use Controls (LUCs)** – Administrative, institutional, and engineered controls designed to control access to the site and maximize protection of potential human receptors.

**Surface clearance** – Removal of MEC from the unaltered ground surface. Metal detectors are used to provide instrument assistance in identifying metal. Handheld tools are used to assist in removal of visible items.

**Subsurface clearance** – Removal of MEC in subsurface soil, up to 2 feet in depth (based on field experience acquired during the SI and RI, 2 feet bgs is the maximum depth at which any evidence of munitions was found. Metal detectors are used to identify anomalies potentially representing subsurface MEC. Handheld tools are used to remove the source of the anomalies.

**Construction support** – Support provided by a UXO team for anomaly avoidance during construction activities that may be planned at the site.

**Cultural sites** - Archaeological, historical, and Hawaiian sacred sites or any other area where traditional religious practices are conducted. Sensitive cultural sites exist within the WVIA MRS.

**Recreational Use** - Land use activity that does not involve soil disturbance.



## **REMEDIAL ALTERNATIVES ANALYSIS**

The following remedial alternatives were analyzed for each response action area:

### **Southern Area**

- No Action
- LUCs
- Surface clearance of accessible land with LUCs
- Surface and subsurface clearance of accessible land with LUCs

### **Northern Non-Target Area**

- No Action
- LUCs
- LUCs with construction support
- Surface clearance of accessible land with LUCs
- Surface and subsurface clearance of accessible land with LUCs

### **Northern Target Area**

- No Action
- LUCs
- LUCs with construction support
- Surface clearance of accessible land with LUCs
- Surface and subsurface clearance of accessible land with LUCs

## **COMPARATIVE ANALYSIS OF ALTERNATIVES**

A detailed analysis of each of the remedial alternatives was conducted using the following threshold and balancing standard criteria specified in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988):

- Threshold criteria:
  - Criterion 1- Overall Protection of Human Health and the Environment
  - Criterion 2- Compliance with ARARs
- Balancing criteria:
  - Criterion 3- Long-Term Effectiveness and Permanence
  - Criterion 4- Reduction of Mobility, Toxicity, or Volume through Treatment
  - Criterion 5- Short-Term Effectiveness
  - Criterion 6- Implementability
  - Criterion 7- Cost
- Modifying Criteria:
  - Criterion 8 - State/ Agency Acceptance
  - Criterion 9 - Community Acceptance

Threshold criteria must be met for an alternative to be evaluated further. All of the alternatives were shown to meet the threshold criteria. The balancing criteria were then applied, comparing the benefits and drawbacks of each alternative using a relative scoring system which includes five categories. The most favorable is scored "5" and least favorable is scored "1". Table ES-1 below shows the results balancing criteria scoring for the three areas. The No Action alternative provides protection to the public through the current fence and signage, but does not meet the project remedial action objectives and was therefore dismissed as unrealistic. Thus Table ES-1 does not include the scoring for No Action alternative. Surface clearance with LUCs scored highest for all three areas.

### **RECOMMENDED ALTERNATIVES**

Based on the comparative analysis, surface clearance with LUCs scored as the most favorable alternative for the threshold and balancing criteria in all three sectors. The next step in the process is application of the modifying criteria based on public and stakeholder comments generated during review of the draft FS Report (see Appendix C for comments and responses). The following recommendations are structured to address the public and stakeholder comments and to better satisfy the RAOs at the WVIA MRS (Figure 4-1):

#### **Southern Area**

Surface Clearance of Accessible Land with LUCs (30.5 acres) is recommended. However, if any MEC item is discovered on the ground surface during the surface clearance, subsurface clearance to a maximum depth of 2 feet should be conducted within a 50-foot radius from the MEC item. Upon completion of the surface removal, the chain-link fence along the southern, western, and eastern boundaries of the Southern Area could be removed. A chain-link fence should be erected along the boundary between the Southern Area and the two Northern Areas, and a 10-foot buffer strip should be subsurface cleared along the south side of the fence. Clearance of the buffer strip is intended to detect MEC that may have migrated towards Waikane Stream from the target areas through soil erosion.

Future land use status in the Southern Area would depend on whether the above remedial action reveals MEC in the area. If MEC is found during the remedial action, consideration may be given to shifting the boundary to include MEC areas in the northern areas. If no MEC is found, application should be made to Department of Defense to certify the land suitable for unrestricted use. If unrestricted use status cannot be obtained, construction support should be provided for future excavations. This recommendation best meets the RAOs in the Southern Area by ensuring the reduction of MEC hazards, restoring the area to unrestricted land use, providing access to cultural sites, and preventing the migration of MEC into accessible areas.

#### **Northern Non-Target Area**

LUCs are recommended. Public comments show general agreement that this area is almost entirely inaccessible, and that funds should not be spent on MEC clearance for this area. This area would be considered suitable only for forest reserve use after completion of the remedial action.

#### **Northern Target Area**

Surface Clearance of Accessible Land with LUCs (17.5 acres) is recommended. In addition, 8-foot wide corridors leading from Waikane Stream to Kamaka Shrine and Waikane Spring should be defined and fenced off from the rest of the target area. Subsurface clearance should be conducted along the corridors and around the two sites. All detectable metallic anomalies should be excavated to a depth of 2 feet determine their nature. Removal of MEC from the surface of all accessible areas of Northern Target Area does not make the areas suitable for agricultural use, and these areas should be restricted to forest reserve. The cleared corridor would be freely accessed through the Southern Area and would be considered suitable for cultural and recreational use after completion of the remedial action.

### Land Use Controls

The Northern Target and Northern Non-Target Area would be combined into a single area. Land Use Controls should apply to the entire 187 acres and should include: construction of the fence between Southern Area and the northern area; notification letters to local landowners, an educational program to inform the community of risks and mitigation measures; and removal of the current fence bounding the Southern Area.

### Summary

The Recommended Alternative is recommended over other alternatives because it:

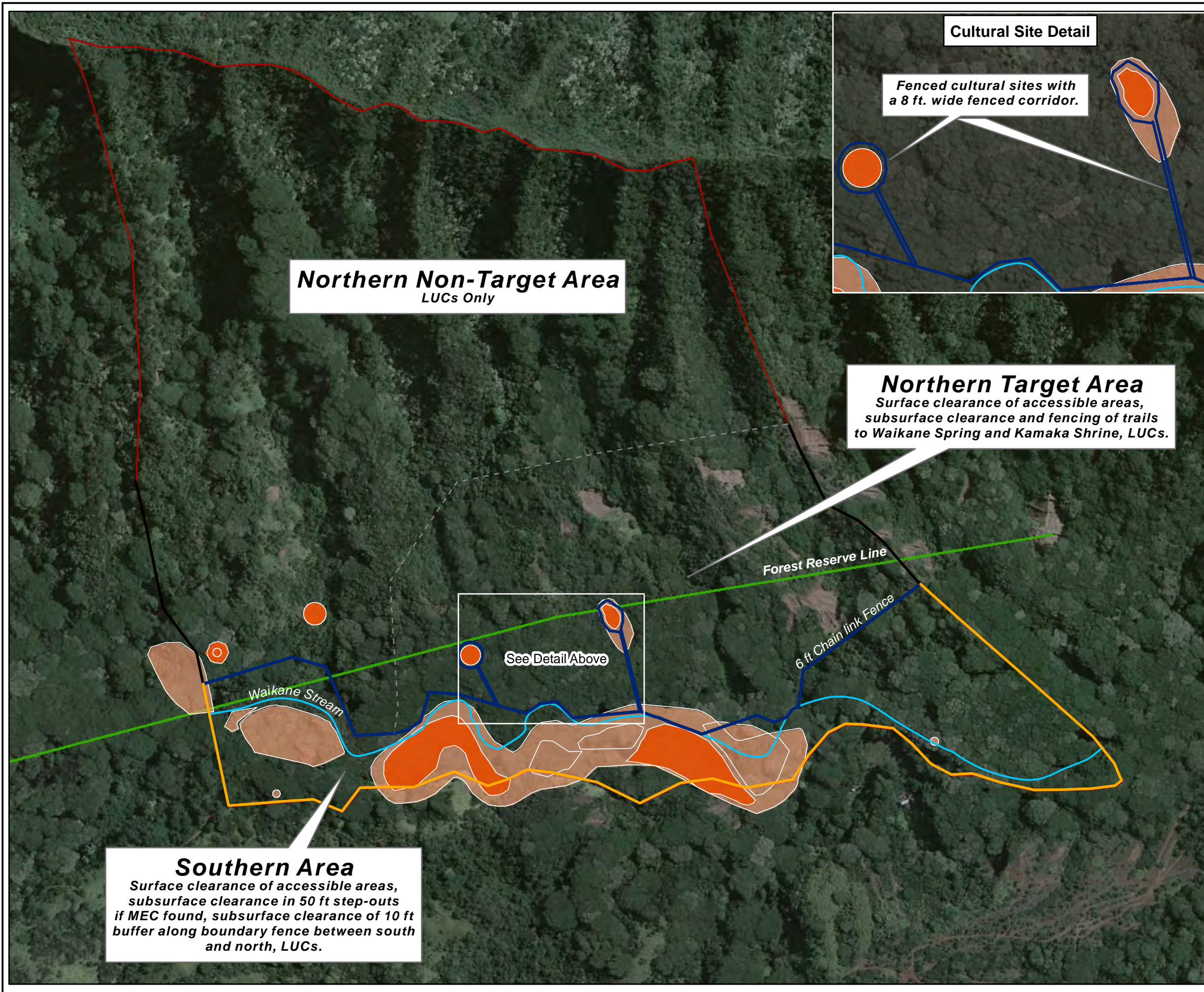
- Provides the removal of risk through removal of MEC;
- Provides controls to minimize future exposure to MEC potentially remaining at the site;
- Can be implemented in a reasonable time frame;
- Provides an opportunity to use the property for the land uses desired by the community;
- Provides access to cultural sites known significance.

The Recommended Alternative would be protective of human health and the environment, would comply with ARARs, would be cost effective, and would utilize permanent solutions and removal technologies to the maximum extent practicable. Because it would treat the source materials constituting principal threats, the remedy would also meet the statutory preference for a remedy that involves treatment as a principal element.

The Recommended Alternative also best addresses the concerns of the community for future land use by providing the potential for unrestricted land use in the Southern Area with free and safe access to sites of cultural significance in the Northern area. If unrestricted land use cannot be attained in the Southern Area, construction support can be requested to allow soil disturbance activities to occur below the maximum clearance depth. Overall cost of **\$4,810,000** assumes that all three areas are addressed under a single contract.

The final selection and schedule for implementation of the remedial alternative depends on the regulatory agencies and community acceptance of the proposed remedial action, the approval of the Proposed Plan and Decision Document, and the availability of government funding.

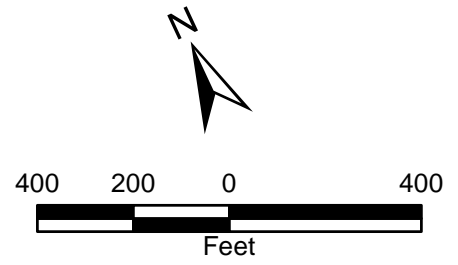
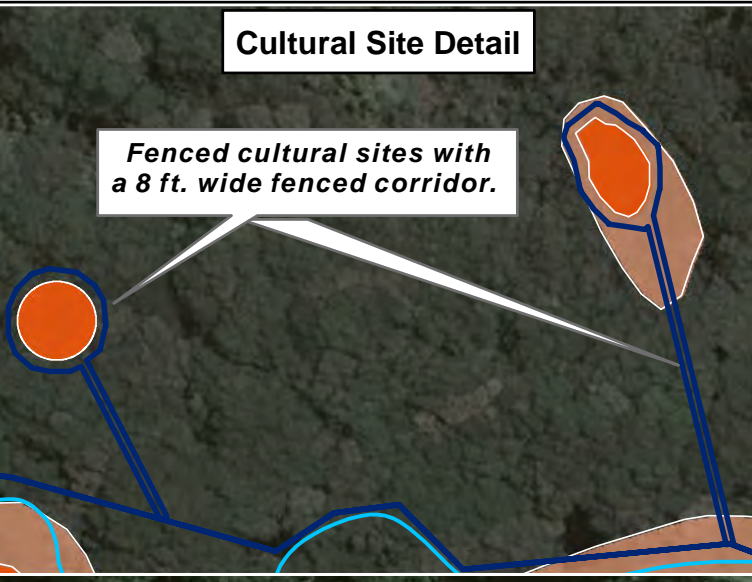




**Northern Non-Target Area**  
LUCs Only

**Northern Target Area**  
Surface clearance of accessible areas,  
subsurface clearance and fencing of trails  
to Waikane Spring and Kamaka Shrine, LUCs.

**Southern Area**  
Surface clearance of accessible areas,  
subsurface clearance in 50 ft step-outs  
if MEC found, subsurface clearance of 10 ft  
buffer along boundary fence between south  
and north, LUCs.



Data is projected to the State Plane Coordinate System:  
Hawaii 3 Zone, NAD83, Units in Feet.

## Figure ES-1

### Recommended Remedial Alternatives

Waikane Valley Impact Area  
Koolaupoko District, O'ahu, Hawai'i

#### Legend

- Waikane Stream
- Forest Reserve Line
- Northern Target And Non-Target Area Boundary
- 6 ft Chain Link Fence To Be Installed
- Existing Fence To Be Removed
- Existing Fence To Remain
- Cultural Site
- Sensitive Cultural Site
- Waikane MRS Boundary

USA  
*Environmental, Inc.*

Drawn By: RM	Scale: 1 inch = 400 feet	Rev: 2
Checked By: SC	Date Drawn: 07/19/10	
Submitted By: JC	Revision Date: 12/1/2011	

Path:



TABLE ES-1 Overall Scoring of Alternatives Based on Balancing Criteria

ALTERNATIVE	Long-Term Effectiveness	Reduction of Contaminants	Short-Term Effectiveness	Implementability	Cost	Overall
<b>SOUTHERN AREA</b>						
LUCs	2	1	4	4	4	15
Surface Clearance w/LUCs	4	4	3	3	2	16
Surface & Subsurface Clearance w/LUCs	5	5	2	2	1	15
<b>NORTHERN NON-TARGET AREA</b>						
LUCs	2	1	4	4	4	15
LUCs w/ Construction Support	2	1	4	4	3	14
Surface Clearance w/LUCs	4	4	3	3	2	16
Surface & Subsurface Clearance w/LUCs	5	5	2	2	1	15
<b>NORTHERN TARGET AREA</b>						
LUCs	2	1	4	4	4	15
LUCs w/ Construction Support	2	2	3	4	3	14
Surface Clearance w/LUCs	4	4	2	3	2	15
Surface & Subsurface Clearance w/LUCs	5	5	1	1	1	13

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## **Appendices**

- A Applicable or Relevant and Appropriate Requirements
- B Cost Estimate

## Abbreviations and Acronyms

<b>ARAR</b>	Applicable or Relevant and Appropriate Requirement
<b>bgs</b>	below ground surface
<b>CERCLA</b>	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
<b>CFR</b>	<i>Code of Federal Regulations</i>
<b>DERP</b>	Defense Environmental Restoration Program
<b>DDESB</b>	Department of Defense Explosive Safety Board
<b>DLNR</b>	Department of Land and Natural Resources
<b>DoD</b>	Department of Defense
<b>EP</b>	engineer pamphlet
<b>EPA</b>	U.S. Environmental Protection Agency
<b>FS</b>	Feasibility Study
<b>FUDS</b>	Formerly Used Defense Sites
<b>GRA</b>	general response action
<b>HAR</b>	Hawaii Administrative Rule
<b>HDOH</b>	State of Hawaii Department of Health
<b>LUC</b>	land use control
<b>MC</b>	munitions constituents
<b>MCBH</b>	Marine Corps Base Hawaii
<b>MEC</b>	munitions and explosives of concern
<b>MDAS</b>	Materials Documented as Safe
<b>MECHA</b>	MEC hazard assessment
<b>MMRP</b>	Military Munitions Response Program
<b>MPPEH</b>	material potentially presenting an explosive hazard
<b>MRS</b>	munitions response site
<b>NAVFAC-HI</b>	Naval Facilities Engineering Command, Hawaii
<b>NCP</b>	National Contingency Plan
<b>O&amp;M</b>	operations and maintenance
<b>RAO</b>	remedial action objectives
<b>RI</b>	remedial investigation
<b>SI</b>	site investigation
<b>TBC</b>	to be considered
<b>U.S.</b>	United States
<b>USACE</b>	U.S. Army Corps of Engineers
<b>USMC</b>	U.S. Marine Corps
<b>UXO</b>	unexploded ordnance
<b>WVIA</b>	Waikane Valley Impact Area

# 1.0 Introduction

## 1.1 Summary of Remedial Investigation Findings

This Feasibility Study (FS) Report documents the development and evaluation of remedial alternatives for the Waikane Valley Impact Area (WVIA) Munitions Response Site (MRS) located in Waikane Valley, Kaneohe, Oahu, Hawaii (see Figure 1-1). The WVIA MRS is undergoing an FS to evaluate remedial alternatives for munitions and explosives of concern (MEC) remaining onsite from historical military activities. A Remedial Investigation (RI) (USA Environmental, Inc. [USAE], July 2011) was conducted in 2010 to characterize the nature and extent of MEC at the MRS and any potential impact to environmental media by associated munitions constituents (MC). Because the RI resulted in no unacceptable risk to human health and the environment associated with MC, this FS addresses MEC only. For details on MC characterization refer to the RI Report (USAE, July 2011).

The distribution of MEC, materials potentially presenting an explosives hazard (MPPEH) and materials documented as safe (MDAS) shown in Figure 1-2 was the basis for the identification of the Southern Area, Northern Target Area, and Northern Non-Target Area as separate and distinct response action areas. MEC distribution is summarized as follows (assumptions and limitations that apply to the MEC assessment are specified in Section 4.1 of the Final RI Report [USAE, July 2011]):

- Significant evidence of MEC was discovered on the ground surface during the 2008 SI. Visual evidence of MDAS appeared in similar distribution to the MEC. A total of 70 MPPEH were found, 69 of which were recovered and disposed of during the 2010 RI activities (the missing item was not found at the surveyed location and is suspected to have migrated down slope because of erosion). MEC items were concentrated in the area now identified as Northern Target Area.
- A total of 92 MEC and 26 MPPEH were identified during the 2010 RI, concentrated in the Northern Target Area, almost all on the ground surface. One of the MEC items and one of the MPPEH items were found during the subsurface investigations, both items at approximately 1 inch bgs. Depth of MDAS items ranged from 1 inch to 24 inches bgs. No MEC, MPPEH, or MDAS were found within Northern Non-Target Area, only expended small arms projectiles found near what was thought to be a small arms target.
- The areas where MEC and MPPEH were found are generally characterized by steep slopes, erosion features, and various degrees of vegetation densities. Storm water runoff and erosion in these areas may have caused limited migration of MEC/MPPEH from the upper elevations to lower locations. However, there is no evidence that MEC/MPPEH has washed down to Waikane Stream. The entire length of the stream within the site boundaries was observed by UXO Technicians during the RI collection of composite sediment stream samples, and no evidence of MEC or MPPEH was observed within or near the stream.

- All accessible areas in the Southern Area were surveyed during the SI and RI fieldwork. A total of 2.92 acres in transects and grids were surveyed with all-metals detectors in the Southern Area during the SI and RI combined. The remaining accessible acres were visually inspected by UXO personnel during the RI fieldwork while traversing through this area. No MEC, MPPEH, or MDAS were observed in the Southern Area during the RI daily activities<sup>1</sup>. However, no clearance activities were conducted in this area to confirm survey and field observations.

This FS Report has been prepared according to the EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988), which includes nine standard evaluation criteria (as detailed in Section 4), and considering the Department of Defense (DoD)-EPA unexploded ordnance (UXO) Management Principles (DoD and EPA, March 7, 2000). Other guidance documents that were considered to prepare this FS Report include the following:

- *Department of the Navy Environmental Restoration Program Manual* (Department of the Navy, August 2006).
- *Guidance for Optimizing Remedy Evaluation, Selection, and Design* (NAVFAC-HI, March 9, 2010).
- *Munitions Response Remedial Investigation / Feasibility Study Guidance* (U.S. Army - Military Munitions Response Program, November 2009).
- *National Oil and Hazardous Substances Contingency Plan* (NCP), Title 40 of the Code of Federal Regulations (CFR), Part 300.430 "Remedial Investigation/Feasibility Study and Selection of Remedy".
- *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA, July 2000)

## 1.2 Purpose

The NCP, 40 CFR, Part 300.430, subpart (e) states that "*The primary objective of the FS is to ensure that appropriate remedial alternatives are developed and evaluated.....and an appropriate remedy selected*". The main objectives of this FS are therefore to evaluate potential remedial alternatives and to recommend the most appropriate remedial approach to address explosive hazards associated with MEC at the MRS. To satisfy the EPA criteria, the selected remedial alternative must:

- Protect human health and the environment.
- Comply with applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws.

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<sup>1</sup> Three items identified as MDAS were found south of the division line during the SI and removed during the RI. They are assumed to have been carried out from the north side of the stream by trespassers. Two items, 3.5-inch practice rockets, were found leaning against the fence along the access road. One item, a practice rifle grenade, was found leaning against a tree, next to an abandoned bus. None of these three items were embedded in the topsoil or vegetation, all were above the vegetation deadfall, and all pointed in a direction incompatible with impact from the firing area.

- Use permanent solutions and innovative treatment technologies to the extent practicable.
- Satisfy the regulatory preference for treatment that reduces contaminant toxicity, mobility, or volume.
- Address the short-term effectiveness of the solution during the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during implementation. (MEC removal risks must be considered and controlled.)
- Be cost-effective and implementable.
- Be acceptable to state regulatory agencies and the public.

In consultation with the HDOH, and with input from the public, the U.S. Navy will use the above objectives to select an appropriate remedial alternative for the MRS. Also, coordination with Department of Defense Explosives Safety Board (DDESB) has been underway since the beginning of the FS to define the remedial alternatives currently under consideration so that they best achieve future land use objectives.

To meet the objectives listed above, the scope of this FS includes:

- Developing the remedial action objectives (RAOs).
- Identifying general response actions and remedial alternatives that address the RAOs.
- Conducting a detailed analysis of the identified remedial alternatives according to the standard CERCLA evaluation criteria.
- Recommending the remedial alternative that best satisfies the RAOs.

Following completion of the FS, the preferred remedial action to address potential risks associated with explosives hazards at the MRS will be recommended in the Proposed Plan. After responding to public comments on the Proposed Plan, the selected remedy will be formally selected and documented in a Decision Document.

## 2.0 Identification and Screening of Response Actions

Based on the 2008 SI and 2010 RI findings summarized above, no unacceptable risk to human and ecological receptors is currently present at the MRS because of potential exposure to MC in soil or sediment. However, MEC hazards must be addressed for the portions of the MRS, where low to high potential explosive hazards were found. An FS was therefore recommended to evaluate the appropriate response action that can be implemented at the site to address the MEC hazards. Based on the RI/FS guidance document (EPA, 1988) and information required by the NCP (40 CFR 300.430[e]), the FS for the MRS consisted of three main phases:

- Developing remedial alternatives
- Screening the alternatives
- Conducting a detailed analysis of the alternatives

The following steps were used in selecting the preferred remedial alternative.

1. Identify the ARARs
2. Develop the RAOs
3. Develop and screen general response actions
4. Identify remedial alternatives
5. Identify response action areas and select remedial alternatives to be evaluated for each area
6. Conduct detailed and comparative analysis of alternatives
7. Identify the recommended remedial action alternative for each response action area

This section presents steps 1 through 3. Section 3 addresses steps 4 and 5. Section 4 discusses steps 6 and 7.

### 2.1 Summary of ARARs

#### 2.1.1 Definition

Section 121 of CERCLA requires that site cleanups comply with federal ARARs, or with state ARARs in cases where these requirements are more stringent than federal requirements. ARARs are derived from both federal and state laws. Under CERCLA Section 121(d)(2), the federal ARARs for remedial action could include requirements under any of the federal environmental laws. Federal and state regulators are provided the opportunity to review this document and comment on the applicability, relevance, or appropriateness of the potential ARARs.

A requirement may be either *applicable* or *relevant and appropriate*. Applicable requirements are defined in 40 CFR 300.5 as “those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance,

pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. 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.”

A requirement is applicable if the specific terms of the statute or regulation directly address the circumstances at the site. If not applicable, a requirement may be relevant and appropriate if circumstances at the site are sufficiently similar to the problems or situations regulated by the requirement. Relevant and appropriate is defined in 40 CFR 300.5 as “those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not ‘applicable’ to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.”

The relevance and appropriateness of a requirement can be judged by comparing a number of factors including the characteristics of the remedial action, the items in question, or the physical circumstances of the site, with those addressed in the requirement. If there is sufficient similarity between the requirements and circumstances at the site, determination of the requirement as relevant and appropriate may be made. Determining whether a requirement is both relevant and appropriate is a two-step process. First, to determine relevance, a comparison is made between the response action, location, or chemicals covered by the requirement and related conditions at the site, release, or potential remedy. A requirement is relevant if it generally pertains to these conditions. Second, to determine whether the requirement is appropriate, the comparison is further refined by focusing on the nature of the items, the characteristics of the site, the circumstances of the release, and the proposed response action. The requirement is appropriate if, based on such comparison, its use is well suited to the particular site. The facility must comply with requirements that are determined to be both relevant and appropriate.

ARARs that govern actions at CERCLA sites fall into three broad categories based upon the chemical contaminants present, site characteristics, and alternatives proposed for cleanup. These three categories (chemical-specific, location-specific, and action-specific) are described in the following subsections.

### **2.1.2 Chemical-Specific ARARs**

Chemical-specific ARARs include those environmental laws and regulations that regulate the release to the environment of materials with certain chemical or physical characteristics or that contain specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limits for specific hazardous substances by media. Chemical-specific ARARs are triggered by the specific chemical contaminants found at a particular site.

### **2.1.3 Location-Specific ARARs**

Location-specific ARARs govern activities in certain environmentally sensitive areas. These requirements are triggered by the particular location and the proposed activity at the site.

Location-specific ARARs, for example, focus on wetland or floodplain protection areas, or on archaeologically significant areas.

#### **2.1.4 Action-Specific ARARs**

Action-specific ARARs are restrictions that define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities. An example might be a state Air Quality Management Authority that sets limitations on fugitive dust generated as a result of grading and excavation activities during a removal action.

#### **2.1.5 To Be Considered**

In addition to ARARs, non-promulgated criteria, advisories, guidance or policies referred to as *to be considered* (TBC) materials may also apply to the conditions found at a site. Unlike ARARs, identification of and compliance with TBCs are not mandatory or legally binding. However, where a TBC is used, its use should be explained and justified. TBCs become legally binding if they are included in the Decision Document.

#### **2.1.6 ARARs Waivers**

There are circumstances under which ARARs may be waived. CERCLA Section 121(d) allows the selection of alternative that will not attain ARAR status if any of six conditions for a waiver of ARARs exists. However, the selected alternative must be protective even if an ARAR is waived. Only five of the conditions for a waiver may apply to a DoD site. The five conditions for a waiver that may be applicable to a DoD site are as follows:

- The action selected is only part of a total response action that will attain the required level or standard of control when completed.
- Compliance with the designated requirement at that site will result in greater risk to human health and the environment (e.g., worker safety) than alternative options.
- Compliance with the designated requirement is technically impracticable from an engineering perspective.
- The action selected will result in a standard of performance that is equivalent to an applicable requirement through the use of another method or approach.
- A state requirement has not been equitably applied in similar circumstances on other clearance actions with the state.

#### **2.1.7 Identification of Site-Specific ARARs**

In determining whether a requirement was pertinent to future munitions response actions, potential ARARs were initially screened for applicability. If determined not to be applicable, the requirement was then reviewed for both relevance and appropriateness. Requirements that are considered relevant and appropriate command the same importance as applicable requirements. Potential federal and state ARARs and TBCs determined to be specific to the WVIA are identified in Appendix A (Tables A-1, A-2, and A-3), along with



common standards that have been screened out as not applicable or relevant and appropriate.

## 2.2 Remedial Action Objectives

The RAOs describe what remedial actions are designed to accomplish and form the basis for the selection of remedial alternatives. The RAOs for remedial actions at the WVIA MRS are based on the following site-specific information:

- The contaminant of interest at the MRS is MEC, which occurs at the surface and within the upper 2 feet of soil.
- The pathways for exposure to MEC are activities associated with future recreational (such as hunting, hiking, and swimming) and cultural land uses and hypothetical future residents and construction workers.
- The depths for potential exposure associated with these activities range from the surface to 2 feet bgs.
- The media of interest are surface soil and subsurface soil to a depth of about 2 feet bgs (the maximum depth at which MDAS was found in the MRS).
- The goal of remedial action would be to achieve an MEC HA score of 3 or better for the MRS. This means that the moderate to high potential explosive hazards have been eliminated and that potential risks posed by any residual explosive hazards are low enough to be managed by LUCs.

Based on these considerations, the following RAOs have been developed for the MRS.

- Prevent exposure to MEC through reduction of MEC hazards.
- Support future agricultural, recreational, cultural and forest reserve land use.

## 2.3 General Response Actions

The RAOs identified in Section 2.2 can be achieved through a variety of potential actions. EPA guidance specifies that remedial alternatives be developed from applicable remedial technologies and representative process options (EPA, 1988). This section identifies and screens remedial technologies and process options that are potentially suitable for addressing human exposure at the WVIA MRS.

As a starting point in the identification of suitable technologies and process options, general response actions (GRAs) are developed. Specific remedial technologies and process options are then identified for each of the GRAs and initially screened mainly against the RAOs and technical practicability. The results of the screening process are summarized in Section 2.4. The retained technologies and process options are then used to develop specific remedial alternatives for the WVIA MRS.

## 2.4 Screening of General Response Actions

This section evaluates GRAs that were assembled for the WVIA to meet the RAOs. The GRAs that are applicable to sites with munitions generally include No Action, LUCs, surface removal, subsurface removal, or a combination of these. The No Action GRA does not adequately meet the RAOs and is used solely for comparison, as required by the NCP in 40 CFR 300.430(e)(6).

The GRAs can be implemented through different remedial technologies and process options, defined as follows:

- Remedial technologies are the general categories of remedies: Detection, Removal, Disposal, and Access Restriction.
- Process options are specific categories of remedies within each remedial technology, and are used to implement each remedial technology.

The GRAs that apply to MEC contamination and will be further developed for the WVIA MRS are as follows:

- **No Action** – The NCP requires the No Action GRA to be considered as a baseline for comparative purposes. The WVIA MRS is currently surrounded by a fence with posted warning signs up to the 600-700 feet elevation. The no action alternative assumes that the current fence and warning signs will be left in place and future maintenance of the fence/signs will be done under the existing program (that is, under a current budget/plan and no additional costs will be involved). Therefore, this alternative assumes no additional cost.
- **LUCs** - This GRA includes access restrictions and educational programs. Access restrictions may include installing and maintaining fencing around controlled areas, posting warning signs prohibiting entry, or implementing zoning, planning or deed restrictions. As part of this alternative, administrative controls and deed restrictions would be implemented that could include stipulation that property could be used only for surface activities or light agricultural use, as appropriate. Zoning/planning could be implemented to control the designated land use (residential, agricultural, etc.). Deed restrictions could also include stipulation that UXO technician support would be required for grading or other construction activities. Educational programs would be tailored to community needs and could include public meetings, distribution of fact sheets, exhibits, videos, and educational signage at the MRS.
- **Surface Clearance** - This GRA would involve removal of MEC from the ground surface in the selected area. Metal detectors would be used to provide instrument assistance in identifying metal in the loose leaf litter. Handheld tools would be used to assist in removal of visible items.
- **Subsurface Clearance** - This GRA would involve removal of MEC in subsurface soil. Metal detectors would be used to identify anomalies potentially representing subsurface MEC. Handheld tools would be used in removing the

source of the anomalies. Mechanical excavation is not feasible throughout most of the project area due to steep slopes and heavy vegetation.

Based on the RI findings, the detection process option of time domain electromagnetic induction (EM61-MK2) for both surface clearance (as an instrument aid) and subsurface clearance is not technically implementable at WVIA MRS. The steep and slippery slopes, and dense vegetation (resulting in poor satellite signal reception) make the use of EM61-MK2A equipment logistically challenging, impractical, and unsafe. For the WVIA site, analog geophysics (using a metal detector, which is easily hand-carried) is a better technology because operators can more easily gain access to the site, vegetation removal is minimized, and site coverage is more complete. Therefore, the use of the EM61-MK2 detector is eliminated from further consideration.

## 3.0 Development of Remedial Alternatives

According to EPA guidance (EPA, 1988), general remedial alternatives for the WVIA MRS were developed by combining the remedial technologies and representative process options that were identified in Section 2.4. The objective of alternatives development is to provide an appropriate range of remedial alternatives and sufficient information with which to adequately analyze and compare them in Section 4.0.

The remedial alternatives for the MRS are designed to reduce overall unacceptable risks. The alternatives are described in the following sections in terms of their objectives and anticipated implementation measures and maintenance activities. General assumptions for each alternative are listed in Section 3.1 below, and alternatives are evaluated for each specific response action area in Section 3.2. Additional assumptions related to cost estimates are included in Appendix B.

**Accessible Land.** Accessible land was defined during the RI as land with slopes of up to 30 degrees. However, based on the field supervisors' professional judgment and site-specific knowledge acquired during the SI and RI fieldwork, accessible areas are now considered to extend beyond the 30 degree slope limitation as estimated in Table 3-1.

**TABLE 3-1**  
 Response Action Areas

Response Action Area	Total Area (acres)	Accessible Area <sup>a</sup> (acres)	Inaccessible Area (acres)	Sensitive Cultural Sites (acres)
Southern Area	33.9	30.5	3.4 <sup>b</sup>	3.7
Northern Non-Target Area	105.8	2.9	102.9	0.3
Northern Target Area	47.3	17.5	29.8	0.2

For the purposes of technical and cost evaluation it is assumed that formerly inaccessible areas within the Southern Area may be partially accessible by UXO technicians using safety lines. However, detection equipment and other tools necessary to conduct MEC clearance cannot be safely used while descending or ascending steep slopes on a safety line. Therefore inaccessible areas within the Southern Area would be limited to visual surface sweeps only, with the possibility that the steepest slopes may not be reached at all. Judgment as to which slopes can be reached on a safety line would be up to the UXO Technician responsible for site safety. Inaccessible areas within the Northern areas of the site are considerably steeper than in the Southern Area and are considered too steep for even a visual surface sweep. It is also assumed that inaccessible areas (in both northern and southern areas of the site) do not require access controls because they are also inaccessible to the general public.

## 3.1 Remedial Alternatives

### 3.1.1 Alternative 1 – No Action

Under the no action remedial alternative, the current conditions at the WVIA would remain unchanged and the existing 6-foot chain-link fence that extends around the perimeter of the WVIA MRS up to approximately 600-700 feet elevation and the associated warning signs would remain in place. No capital cost is assumed for this alternative, but annual operations and maintenance costs are calculated over a 30-year period. A total of 96 hours per year is assumed for labor on fence and signage maintenance. An escort (one UXO Technician II or higher) for anomaly avoidance is assumed (total of 96 hours per year) for public access to cultural sites or for repair of fencing and signage.

### 3.1.2 Alternative 2 – LUCs

Under Alternative 2, LUCs would include fencing and/or signage. Warning signs would be installed to prohibit entrance to unauthorized personnel, warn of potential MEC hazards, and provide a telephone number to contact if potential MEC is observed. Fencing and signage would be installed around a selected area to tie into the existing fencing that currently extends to 600-700 foot elevations<sup>2</sup>.

Because of the dense vegetation and steep slopes prevalent at the WVIA MRS, inspection would need to be performed once per year to ensure that the fencing or signage is uncompromised and erosion has not exposed MEC causing potential migration of MEC to cleared areas. Breaks in the fence would need to be corrected quickly to prevent unauthorized entry. Following annual inspections and maintenance, annual reports would be completed describing the inspection results, needed maintenance or repairs, evaluation of erosion and potential migration of MEC, and assessment of the effectiveness of the barrier against trespass. Five-year reviews would be conducted to evaluate the implementation and performance of LUCs in order to determine if the remedy continues to be protective of human health and the environment.

The selected area would remain in government ownership. As a result, other process options such as deed restriction, zoning and planning would not apply to this remedial alternative. Upon request, the government would continue to provide UXO personnel escorts to the public for anomaly avoidance to access cultural sites (if applicable) within the selected area. Also, education support would be provided to inform and educate the public about the risk and control measures implemented at the WVIA MRS to minimize risk to human receptors.

These measures would avoid contact between potential human receptors and MEC, and would monitor potential MEC migration to areas not covered by LUCs, meeting the site-specific RAOs.

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<sup>2</sup> Throughout the document, fencing of a specific area is considered for different alternatives, as applicable. If the selected response action is the same for all response areas, no fence will need to be installed because all areas would need the same level of access control.

### **3.1.2.1 Assumptions**

The following assumptions are made for Alternative 2:

- Fencing would not be extended to elevations higher than the current 600-700 feet.
- An initial capital cost is assumed for tying into the existing fencing and adding 6-foot chain-link fence around the perimeter of the selected area.
- UXO Technician support would be required for anomaly avoidance during installation of fence. The minimum UXO Technician support team is assumed for subsurface construction, consisting of one UXO Technician III and one UXO Technician II, in accordance with USACE EP 75-1-2 requirements for construction sites with known or suspected MEC (USACE, August 1, 2004).
- An escort (one UXO Technician II or higher) for anomaly avoidance is also considered (total of 96 hours per year) for public access to cultural sites or for repair of fencing and signage.
- Costs include annual, long-term monitoring inspections as well as reporting and maintenance activities for 30 years, along with five-year reviews to evaluate the protectiveness of the remedy.

### **3.1.3 Alternative 3 – LUCs with Construction Support**

This alternative would include warning signage, administrative controls, deed restrictions, planning/zoning restrictions, and construction support. Warning signage would be installed around a selected area to warn against unauthorized entry, while existing fencing would be removed. UXO technicians would be required for construction support for any subsurface activities, such as digging or construction. Educational programs would be offered to make the public aware of site MEC hazards.

Because of the dense vegetation and steep slopes prevalent at the WVIA MRS, inspection and maintenance would need to be performed once per year to ensure that the signage is uncompromised and erosion has not exposed MEC causing potential migration of MEC to cleared areas. Any damaged or missing signs or other problems would need to be corrected quickly to minimize unauthorized entry. Following annual inspections and maintenance, annual reports would be completed describing the inspection results, needed maintenance or repairs, evaluation of erosion and potential migration of MEC, and assessment of the effectiveness of the barrier against trespass. Five-year reviews would be conducted to evaluate the implementation and performance of LUCs in order to determine if the remedy continues to be protective of human health and the environment.

These measures would mitigate the potential for contact between humans and MEC, assuming that signage and deed restrictions would be effective in preventing entry of unauthorized people. It would also monitor MEC migration through erosion or other transport to areas not covered by LUCs.

#### **3.1.3.1 Assumptions**

The following assumptions are made for Alternative 3:

- Fencing would be removed from the specific area where Alternative 3 is selected. However, if other areas within the WVIA MRS require a higher level of control, a fence may be needed to separate the area where Alternative 3 is selected and the remaining sections of the site.
- It is assumed that signage and deed restrictions would be effective in preventing unauthorized entry in the areas where LUC is selected.
- The minimum UXO Technician construction support team is assumed for subsurface construction, consisting of one UXO Technician III and one UXO Technician II in accordance with USACE EP 75-1-2 requirements for construction sites with known or suspected MEC (USACE, 2004).
- An escort (one UXO Technician II or higher) for anomaly avoidance is also considered (total of 96 hours per year) for construction support, public access to cultural sites, or for repair of fencing and signage.
- Costs include annual, long-term monitoring inspections as well as reporting and maintenance activities for 30 years along with five-year reviews to evaluate the protectiveness of the remedy.

### **3.1.4 Alternative 4 – Surface Clearance of Accessible Land with LUCs**

Surface clearance of MEC with metal detectors would be performed for all accessible areas (as defined in Section 3.0). Since no subsurface clearance for MEC would be performed, land use would be restricted to recreational use, with deed restrictions and planning/zoning. Any disturbance of subsurface soil (independent of depth) would require construction support. Educational programs would be implemented to educate the public and property owners regarding MEC and its hazards.

LUCs would include fencing, warning signage, deed restrictions, annual inspections, five-year reviews, and zoning and planning. Because of the dense vegetation and steep slopes prevalent at the WVIA MRS, inspection would need to be performed once per year to ensure that the fencing/signage is uncompromised and erosion has not exposed MEC causing potential migration of MEC to cleared areas. Any missing or damaged signs would need to be repaired quickly to minimize unauthorized entry. Following annual inspections and maintenance, annual reports would be completed describing the inspection results, needed maintenance or repairs, potential erosion phenomena, and assessment of the effectiveness of the LUCs against trespass. Five-year reviews would be conducted to evaluate the performance of LUCs and determine if the remedy is protective.

Surface clearance supported by LUCs would avoid contact between potential human receptors and MEC potentially remaining at the site and would monitor potential MEC migration to areas not covered by LUCs, meeting the site-specific RAOs.

#### **3.1.4.1 Assumptions**

The following assumptions are made for Alternative 4:

- Fencing would not be extended to elevations higher than the current 600-700 feet.

- An initial capital cost is assumed for tying into the existing fencing and adding 6-foot chain-link fence around the perimeter of the selected area.
- Recreational activities are assumed to be limited to the surface (no subsurface soil disturbance).
- Vegetation within six inches of the ground surface would be removed in the selected area, but would be limited to brush, vines, and tree limbs that prevent safe movement of personnel and visual access to the ground surface.
- Surface clearance of MEC would be completed by one or more 6-person teams each consisting of one UXO Technician III, two UXO Technicians II, and three UXO Technicians I using metal detectors (or equivalent) to aid in identifying metallic items on the ground surface in the loose leaf litter. The teams would be supervised by a Senior UXO Supervisor, one UXO Safety Officer, and one UXO Quality Control Specialist.
- MEC and MPPEH would be disposed by blowing in place or consolidated shots, if multiple items are found and are determined safe to move. If a demolition event is required, pre- and post-detonation samples will be collected and analyzed for metals and explosives residues.
- The extent of completed surface clearance would be surveyed. Escorts for anomaly avoidance would be provided for survey, vegetation removal, and soil sampling (if required).
- Areas previously surface cleared during the RI will be cleared again.
- A UXO Technician construction support team is assumed for subsurface construction, consisting of one UXO Technician III and one UXO Technician II in accordance with USACE EP 75-1-2 requirements for construction sites with known or suspected MEC (USACE, 2004).
- An escort (one UXO Technician II or higher) for anomaly avoidance is also considered (total of 96 hours per year) for construction support, public access to cultural sites, or for repair of fencing and signage.
- Costs include annual, long-term monitoring inspections as well as reporting and maintenance activities for 30 years along with five-year reviews to evaluate the protectiveness of the remedy.

### **3.1.5 Alternative 5 – Surface and Subsurface Clearance of Accessible Land with LUCs**

Surface and subsurface removal of MEC using metal detectors would be performed for all accessible areas (as defined in Section 3.0). Subsurface removal of MEC would be performed to a removal depth of 2 feet.

LUCs would include fencing and signage, deed restrictions, annual inspections, and zoning and planning, as described in Section 3.1.4. Deed restrictions and zoning/planning would



specify whether residential, agricultural, or recreational use is allowed. Deed restrictions would specify that construction support is needed for construction or grading operations extending at depths greater than 2 feet bgs in the selected area. Educational programs would be implemented to educate the public and property owners regarding MEC hazards.

Surface and subsurface clearance supported by LUCs would avoid contact between potential human receptors and MEC potentially remaining at the site and would monitor potential MEC migration to areas not covered by LUCs, meeting the site-specific RAOs.

### 3.1.5.1 Assumptions

The following assumptions are made for Alternative 5:

- All assumptions listed for Alternative 4 would apply.
- Depth of clearance should be limited to 2 feet bgs for several reasons:
  - U.S. Army Engineer and Support Center, Huntsville (USAESCH) calculated penetration depths of various munitions in several soil types based on weight and muzzle velocity of projectiles. Their calculations showed that maximum penetration into clay soils would be 0.2 feet bgs for M9 rifle grenades, 0.8 feet bgs for 2.36-inch rocket, and 1.7 feet bgs for the 3.5-inch rocket. Field actions at Fort Ord showed that actual penetration depths were much more shallow than calculated. See *“Penetration of Projectiles into Earth (An Analysis of UXO Clearance Depths at Ft. Ord)”* (USAESCH, Sep 1997). Since the soils on the slopes of WVIA are silty clay, penetration depths are predicted at much less than 2 feet bgs at WVIA targets.
  - One MEC and one MPPEH were found during the RI fieldwork at approximately 1 inch bgs. Only MDAS was found deeper, ranging from 1 inch to 24 inches bgs.
  - The same USACE tables indicate that a magnetometer can detect a rifle grenade to 1.7 feet bgs, a 2.36-inch rocket to 1.9 feet bgs, and a 3.5-inch rocket to 3.2 feet bgs. Therefore a magnetometer would be able to detect all the target items to their maximum penetration depth.
  - Clearance below the 2-foot depth would be costly, with no value added because MEC items would not be expected to be found below that depth. Costs saved on clearing below 2 feet are better applied towards more lateral coverage of the site.
- Surface and subsurface clearance operations would be conducted at the same time.
- Surface and subsurface clearance of MEC would be completed by one or more 6-person teams each consisting of one UXO Technician III, two UXO Technicians II, and three UXO Technicians I using metal detectors (or equivalent). The teams would be supervised by a Senior UXO Supervisor, one UXO Safety Officer, and one UXO Quality Control Specialist.

## 3.2 Response Action Areas and Selected Remedial Alternatives

The MECHA conducted during the RI identified three response action areas that are characterized by different physical characteristics and different MEC hazards (Figure 3-1). Remedial alternatives for each response action area are therefore evaluated separately. The likely future land use resulting from these actions are also provided.

### 3.2.1 Southern Area

The southernmost part of the site (approximately 34 acres south of the division line shown in Figure 3-1), was extensively assessed during the SI and RI investigations, surveying all accessible areas (including 2.92 acres of transects). Although no evidence of MEC or MPPEH was observed<sup>3</sup>, this area was never cleared and alternatives involving surface and/or subsurface clearance would confirm the absence of MEC and MPPEH through analog metal detector screening.

This area includes the Waikane Stream, approximately 30.5 acres of accessible land and about 3.4 acres of inaccessible land (Table 3-1). Most of the valley's cultural sites are in this area. The following remedial action alternatives were selected for further analysis in Section 4 for the Southern Area:

- **Alternative 1(SA): No Action.** Under this alternative, the current fence and warning signage would remain and continue to be maintained under the current maintenance and escort program.
- **Alternative 2(SA): LUCs.** The LUC alternative includes removing the existing fence, providing signage, deed restrictions, educational programs, annual inspections, and construction support (if intrusive activities are planned).
- **Alternative 3(SA): Surface clearance of accessible land with LUCs.** The surface clearance considers clearance of MEC from the ground surface in accessible areas (approximately 30.5 acres). MEC clearance in inaccessible areas may be possible using safety line, but would be limited to visual sweeps. Deed restrictions and zoning and planning would be used to limit use/disturbance of subsurface soil and access to areas outside of the cleared sections. Construction support would be required for any planned excavation. Fencing and signage would be installed to prevent entry from uncleared areas (for example, fence separating the Southern Area from northern areas) and annual inspections would be conducted to assess conditions of fence, erosion, and potential migration of MEC from areas that have not been cleared. Educational programs would also be implemented. This alternative results in land use limited to recreational.
- **Alternative 4(SA): Surface and subsurface clearance of accessible land with LUCs.** This alternative involves surface and subsurface clearance of MEC to 2 feet bgs from all

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<sup>3</sup> Three items identified as MDAS were found south of the division line during the SI and removed during the RI. They are assumed to have been carried out from the north side of the stream by trespassers. Two items, 3.5-inch practice rockets, were found leaning against the fence along the access road. One item, a practice rifle grenade, was found leaning against a tree, next to an abandoned bus. None of these three items were embedded in the topsoil or vegetation, all were above the vegetation deadfall, and all pointed in a direction incompatible with impact from the firing area.

accessible areas (approximately 30.5 acres). Visual sweeps of MEC in inaccessible areas (3.4 acres) may be possible using safety ropes, but technicians would not be able to safely use detection equipment or other work tools while descending or ascending a slope on a safety line. Some of the steepest slopes may not be reached at all. The judgment as to which slopes can be reached on a safety rope would be up to the UXO technician responsible for site safety. Potential migration of MEC from northern areas because of erosion would be assessed annually as part of the LUC program that would be in place for the northern areas.

### 3.2.2 Northern Non-Target Area

The Northern Non-Target Area (105.8 acres north of the division line shown in Figure 3-1), was assessed during the SI and RI investigations and appeared to contain few MEC items. A moderate explosive hazard was assigned to this area through the MECHA conducted during the RI. Low potential explosive hazard conditions would result if surface or surface/subsurface clearance alternatives are proposed. LUCs would not significantly reduce the hazard level of the site compared to current conditions because the site is already fenced and access to the site area is limited.

This area has the steepest terrain and was largely inaccessible to investigation. Only about 2.9 acres of Northern Non-Target Area are considered accessible (Table 3-1). The following remedial action alternatives were selected and will be further analyzed in Section 4 for the Northern Non-Target Area:

- **Alternative 1(NNTA): No Action.** Under this alternative, the current fence and signage would remain and continue to be maintained under the current maintenance program.
- **Alternative 2(NNTA): LUCs.** The LUC alternative includes fencing and signage, educational programs, and considers construction support only for fence maintenance and repairs that disturb the ground surface. Fencing would separate Northern Non-Target Area from the Southern Area (and possibly from the Northern Target Area), tying into the existing fence at the eastern and western boundaries. Annual inspections would be conducted to assess fence conditions and erosion/potential migration of MEC. Educational programs would be offered to make the public more aware of site MEC hazards. UXO escorts would be required for the public to access the area.
- **Alternative 3(NNTA): LUCs with construction support.** This alternative includes signage, deed restrictions, planning/zoning, and construction support (construction in this area would be unlikely because all accessible areas within the Northern Non-Target Area are mauka of the Forest Reserve Line)<sup>4</sup>. No fence would be installed to separate the Northern Non-Target Area from other areas. Annual inspections would be conducted to assess erosion and potential migration of MEC. Construction support would be provided for any activity involving soil disturbance, such as digging or construction. Educational programs would be offered to make the public aware of site MEC hazards. Land use restrictions would be documented in the MCBH Master Plan.

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<sup>4</sup> Per Hawaii Administrative Rule (HAR)§ 13-104, construction activities in Forest Reserve land are prohibited unless authorized by the Department of Land and Natural Resources.

- **Alternative 4(NNTA): Surface clearance of accessible land with LUCs.** This alternative would consist of surface clearance of accessible areas (as defined in Section 3.0) only and implementation of deed restrictions and zoning. Inaccessible areas are too steep in this area for use of tools while on a safety line, and these areas would be assumed as also inaccessible to future land users. Land use would be restricted to recreational. Land use controls would be accomplished through fencing, signage, deed restriction, and zoning/planning. A fence would not separate this area from the Southern Area. A new fence would be built to separate the Northern Non-Target Area from other non-cleared areas (as applicable, depending on selected remedial alternatives), but it would not be extended at elevations higher than the existing ones. Annual inspections would be conducted to assess the conditions of the fence and to evaluate if erosion could cause potential exposure/migration of MEC. Construction support would be required for any planned excavation. Educational programs would also be implemented.
- **Alternative 5(NNTA): Surface and subsurface clearance of accessible land with LUCs.** This alternative involves surface and subsurface clearance of MEC to 2 feet bgs in the accessible areas (as defined in Section 3.0) within the Northern Non-Target Area. Land use would be recreational use, and construction support would be required for future excavations in excess of the 2-foot clearance. All accessible areas within the northern Non-Target Area are within Forest Reserve land and any construction activity conducted in this part of the site would also require authorization from the Department of Land and Natural Resources (DLNR). A new fence would be built to separate the Northern Non-Target Area from other non-cleared areas (as applicable, depending on selected remedial alternatives), but it would not be extended at elevations higher than the existing ones. Annual inspections would be conducted to assess the conditions of the fence and to evaluate potential erosion problems. Educational programs would also be implemented.

### 3.2.3 Northern Target Area

The Northern Target Area of the site (approximately 47 acres north of the division line shown in Figure 3-1), was assessed during the SI and RI investigations to contain the highest density of MEC items. A moderate to high explosive hazard level was assigned to this area through the MECHA conducted during the RI. Moderate potential explosive hazard conditions would result if surface or surface/subsurface clearance alternatives are proposed. Land use controls would not significantly reduce the hazard level of the site compared to current conditions because the site is already fenced and access to the site area is limited.

This area has steep terrain, with only about 17.5 acres considered accessible (Table 3-1). The following remedial action alternatives were selected and will be further analyzed in Section 4 for the Northern Target Area:

- **Alternative 1(NTA): No Action.** Under this alternative, the current fence would remain in place, no additional maintenance of the fence or signage would be performed.
- **Alternative 2(NTA): LUCs.** The LUC alternative includes signage and fencing around the Northern Target Area. The alternative includes construction support only for fence

construction, maintenance, and repair. Annual inspections would be conducted to evaluate conditions of fence and assess if erosion could cause potential exposure or migration of MEC. Educational programs would be implemented to educate the public of the risks posed by residual MEC in and around this area.

- **Alternative 3(NTA): LUCs with construction support.** This alternative includes signage, deed restrictions, and provides construction support if intrusive activities are planned. No fence would be installed to separate the Northern Target Area from other areas and current fencing would be removed. Annual inspections would be conducted to assess if erosion could cause potential exposure/migration of MEC. Land use restrictions would be documented in the MCBH Master Plan. Construction support would be needed for any excavation activity. Educational programs would also be implemented.
- **Alternative 4(NTA): Surface clearance of accessible land with LUCs.** This alternative would consist of surface clearance of accessible areas (as defined in Section 3.0) within the Northern Target Area and implementation of deed restrictions and zoning. Annual inspections would be conducted to evaluate conditions of fence and assess if erosion could cause potential exposure or migration of MEC. Land use would be restricted to recreational. The fence currently existing at the site would be removed. Construction support would be required for any planned excavation. Educational programs would also be implemented.
- **Alternative 5(NTA): Surface and subsurface clearance of accessible land with LUCs.** This alternative involves surface and subsurface clearance of MEC in accessible areas (as defined in Section 3.0) within the Northern Target Area. Maximum depth of clearance would be 2 feet bgs. The fence currently existing at the site would be removed. Construction support would be required for excavations beyond 2 feet bgs anywhere within the Northern Target Area. Educational programs would also be implemented.

## 4.0 Detailed Analysis of Remedial Alternatives

A detailed analysis of the remedial alternatives for the WVIA MRS has been conducted using the standard criteria specified in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA, 1988). These criteria are described in Section 4.1. In Section 4.2, the alternatives presented in Section 3.2 are evaluated individually against the criteria for each response action area. The alternatives are then compared with one another in Section 4.3, and a recommended remedial alternative is identified for each response action area in Section 4.4. The results of this detailed analysis of alternatives will support the selection of a remedial action for the WVIA MRS and provide the foundation for the Proposed Plan and Decision Document for the site.

Nine CERCLA evaluation criteria are categorized in NCP 40 CFR Section 300.430(e)(9)(iii) as follows:

**Threshold Criteria** are requirements that each alternative must meet to be eligible for selection as the preferred alternative. There is little flexibility in meeting the threshold criteria—the alternative must meet them or it is unacceptable. The two threshold criteria are defined as:

- 1- Overall Protection of Human Health and the Environment
- 2- Compliance with ARARs

**Balancing Criteria** are used to weigh the tradeoffs among alternatives. They are the main technical criteria used in the detailed evaluation and comparative analysis of the alternatives. The balancing criteria are defined as:

- 3- Long-Term Effectiveness and Permanence
- 4- Reduction of Mobility, Toxicity, or Volume through Treatment
- 5- Short-Term Effectiveness
- 6- Implementability
- 7- Cost

**Modifying Criteria** consist of state/agency acceptance and community acceptance. These criteria may be used to modify aspects of the preferred alternative. Modifying criteria are generally evaluated after public comment on the FS Report. Accordingly, only the seven threshold and primary balancing criteria were used in the detailed analysis phase of the draft FS Report.

- 8- State/Agency Acceptance
- 9- Community Acceptance

Public and regulator comments received from review of the draft FS Report are addressed in Appendix C of this final report. The actions taken on these comments are considered as application of the modifying criteria and are reflected in the final recommendations contained in Section 4.4 Recommendations for Remedial Actions.

## **4.1 Description of Evaluation Criteria**

### **4.1.1 Criterion 1—Overall Protection of Human Health and the Environment**

This criterion is used to assess how each alternative provides and maintains adequate protection of human health and the environment. The alternatives are assessed to determine if they can adequately protect human health and the environment from unacceptable risks posed by MEC at the site in both the short and long term. A qualitative evaluation of whether the alternative would reduce the MEC hazard is also provided. This criterion is also used to evaluate how unacceptable risks would be eliminated, reduced, or controlled through engineering, LUCs, or other remedial activities.

### **4.1.2 Criterion 2—Compliance with ARARs**

This criterion is used to evaluate compliance of each remedial alternative with federal and territorial ARARs, or whether invoking waivers to specific ARARs is adequately justified. The ARARs are identified based on the type of hazardous substances present, waste characteristics, physical site characteristics, and other appropriate factors. Chemical-specific, location-specific, and action-specific ARARs for the WVIA MRS are listed in Tables A-1, A-2, and A-3 of Appendix A, respectively. After the Proposed Plan and Decision Document is approved and a detailed remedial design for the WVIA MRS is completed, the ARARs will be revisited.

### **4.1.3 Criterion 3—Long-Term Effectiveness and Permanence**

This criterion addresses the long-term effectiveness of each alternative and assesses the results of the remedial action in terms of the risks remaining after the RAOs have been met. In particular, this criterion assesses the effectiveness of controls that are applied to manage the risks posed by potential MEC remaining at the site. A brief discussion on how the alternative would address potential erosion is also included.

### **4.1.4 Criterion 4—Reduction of Toxicity, Mobility, or Volume Through Treatment**

This criterion assesses each alternative against the statutory preference that treatment be used to reduce the principle threats of MEC, to provide irreversible reduction of MEC, or to reduce the total volume of MEC-impacted media. Factors of this criterion that are evaluated include the following:

- The treatment process to be employed
- The amount of MEC destroyed or treated
- The degree of reduction in mobility or volume of MEC expected
- The degree to which treatment would be irreversible

### **4.1.5 Criterion 5—Short-Term Effectiveness**

This criterion addresses the period of time needed to achieve protection and any adverse impacts of the remedial alternative during the construction and implementation phase. Factors evaluated include protection of workers and the community during the remedial action, environmental impacts resulting from implementation of the remedial action, and the time needed to implement the proposed alternative.

#### **4.1.6 Criterion 6—Implementability**

This criterion evaluates the technical and administrative feasibility of implementing each remedial alternative and the availability of required services and materials during implementation. Factors of technical feasibility include the following:

- Construction and operational difficulties
- Reliability of the technology
- Ease of undertaking additional removal actions
- Ability to monitor the effectiveness of the remedy

Administrative feasibility includes the ability to obtain required permits as well as the availability of necessary services, materials, specialists, and equipment.

#### **4.1.7 Criterion 7—Costs**

This criterion assesses the costs of the remedial action alternative based on present worth. To estimate the present value of the alternative cost, a discount rate of 2.3 percent has been used, which is the most recent rate published by the Office of Management and Budget ([http://www.whitehouse.gov/omb/circulars/a094/a94\\_appx-c/](http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c/)). The discount rate, which is similar to an interest rate, is used to account for the time value of money over 30 years. A dollar is worth more today than in the future because, if invested in an alternative use today, the dollar could earn a return (that is, interest).

The cost of a remedial action alternative includes capital costs and operations and maintenance (O&M) costs over the period of time deemed appropriate and practicable for the selected remedial alternative. Capital costs include expenditures for labor, equipment, and materials to install or conduct the remedial action. O&M costs include labor and associated maintenance costs expended over time.

#### **4.1.8 Criterion 8 – State/Agency Acceptance**

This criterion evaluates the technical and administrative issues and concerns that the State of Hawaii and other agencies or stakeholders may have regarding each of the alternatives. State/agency acceptance is addressed in Section 4.4 of this report.

#### **4.1.9 Criterion 9—Community Acceptance**

This criterion evaluates the issues and concerns the public may have regarding each of the alternatives. Adjacent landowners include Kualoa Ranch and SMF Enterprises, Inc (which own undeveloped forest to the north, south, and west), the City and County of Honolulu (which have designated the area as the Waikane Nature Preserve) and the Roberts family (which owns a parcel adjacent to the southern border of the project site). Non-contiguous coastal lands to the east of the site include a mix of residential and recreational properties.

Community acceptance is discussed in Section 4.4 of this report. Public and community comments are addressed in Appendix C.



## 4.2 Individual Analysis of Alternatives

This section presents an analysis and evaluation of the remedial alternatives developed for the different response action areas of the WVIA MRS. The alternatives were evaluated against the threshold and balancing criteria described above in Section 4.1. The modifying criteria are not evaluated in this FS and will be addressed in the Decision Document, once public comments on the FS and Proposed Plan are received.

### 4.2.1 Southern Area

The southernmost part of the site encompasses 34 acres of land along Waikane Stream and south of the division line shown in Figure 3-1. This area was extensively assessed during the SI and RI investigations. Although no evidence of MEC or MPPEH was observed<sup>5</sup>, this area was never cleared and alternatives involving surface and subsurface clearance were proposed in order to eliminate any doubt of the existence of MEC. The following remedial action alternatives were selected and are analyzed below against the threshold and balancing criteria.

- Alternative 1(SA) - No Action
- Alternative 2(SA) - LUCs
- Alternative 3(SA) - Surface clearance (of accessible land) with LUCs
- Alternative 4(SA) - Surface and subsurface clearance (of accessible land) with LUCs

The area addressed by each remedial action alternative within the Southern area is shown in Table 4-1.

**TABLE 4-1**  
 Areas of Response Actions - Southern Area

No.	Alternative Action Description	Response Action Area (acres)		
		LUC	Surface Clearance	Subsurface Clearance
1	No Action	NA	NA	NA
2	LUCs	33.9	NA	NA
3	Surface Clearance of Accessible Land with LUCs	33.9	30.5	NA
4	Surface and Subsurface Clearance of Accessible Land with LUCs	33.9	30.5	30.5

#### 4.2.1.1 Alternative 1(SA) — No Action

Alternative 1(SA) represents a no action scenario. Under this alternative, no new active control, remediation, or management would be performed (see Sections 3.1.1 and 3.2.1 for

<sup>5</sup> Three items, found south of the division line during the SI and removed during the RI, are assumed to have been carried out from the north side of the stream by trespassers. Two items, 3.5-inch practice rockets, were found leaning against the fence along the access road. One item, a practice rifle grenade, was found leaning against a tree, next to an abandoned bus. None of these three items were embedded in the topsoil or vegetation, all were above the vegetation deadfall, and all pointed in a direction incompatible with impact from the firing area

more details on the No Action alternative). However, it is assumed that the current fence and warning signs will be left in place and maintenance will be implemented under the existing program.

#### **4.2.1.1.1 Overall Protection of Human Health and the Environment**

Since the current fence and warning signs would be left in place and maintained, Alternative 1(SA) is considered to meet the criteria for overall protection of human health. However, this alternative would not meet the RAO of protecting human health and the environment by reducing MEC hazards.

#### **4.2.1.1.2 Compliance with ARARs**

Alternative 1(SA) complies with the ARARs because the current fence would remain in place and maintained under current maintenance programs.

#### **4.2.1.1.3 Long-Term Effectiveness and Permanence**

Alternative 1(SA) would provide limited long-term effectiveness or permanence because current operations limit access to the site. The risk of human exposure would remain constant with time because the fence and warning signs would remain in place. Additionally, no inspections would be conducted to evaluate if erosion could potentially cause migration of MEC from northern areas.

#### **4.2.1.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 1(SA) includes no treatment actions that would reduce the mobility or volume of MEC at the site.

#### **4.2.1.1.5 Short-Term Effectiveness**

Alternative 1(SA) involves no action and would provide some protectiveness in the short-term because of the presence of current fence and signs. Because no remedial action would be implemented, there would be no impact to workers, the community, or the environment.

#### **4.2.1.1.6 Implementability**

Alternative 1(SA) would result in no technical or administrative feasibility issues, and requires no services or equipment because no action would be taken.

#### **4.2.1.1.7 Costs**

Alternative 1(SA) monitoring costs are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$850,000**.

### **4.2.1.2 Alternative 2(SA) — Land Use Controls**

A detailed description of Alternative 2(SA) is presented in Sections 3.1.2 and 3.2.1.

#### **4.2.1.2.1 Overall Protection of Human Health and the Environment**

Alternative 2(SA) would provide protection to humans. Although it would not reduce the residual risk posed to human health by the potential presence of MEC, the current fence would be removed (or possibly moved to the boundary with the northern areas, new signs would be installed, and deed restrictions, educational programs, and construction support

would be implemented. This approach deters contact between the source (MEC potentially present in the Southern Area) and human receptors, assuming the controls are properly implemented and obeyed.

#### **4.2.1.2.2 Compliance with ARARs**

Alternative 2(SA) could achieve action-specific and location-specific ARARs.

#### **4.2.1.2.3 Long-Term Effectiveness and Permanence**

Alternative 2(SA) would provide long-term effectiveness and permanence, as long as the controls prevent contact between humans and MEC potentially present in the Southern Area. A 30-year O&M period is assumed for the purpose of this FS that includes community education, O&M of fencing and signage, annual inspections to assess the condition of the fence and erosion phenomena, UXO technician escort for anomaly avoidance for access to the Southern Area, and Five-Year Reviews. Although the alternative would provide some long-term effectiveness, potential risk would remain within the Southern Area.

#### **4.2.1.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 2(SA) includes no treatment actions that would reduce the mobility or volume of MEC in the Southern Area.

#### **4.2.1.2.5 Short-Term Effectiveness**

Alternative 2(SA) would provide some protectiveness to human receptors and would have no adverse impacts to the environment in the short-term. The possibility of contact between humans and MEC would be minimized by maintaining the access controls currently in place for the WVIA MRS, while installing the warning signs around the Southern Area. During installation and maintenance of fencing and signage, protectiveness of workers would be implemented by construction support.

#### **4.2.1.2.6 Implementability**

Alternative 2(SA) would be technically and administratively feasible. LUCs could be implemented because equipment, materials, and personnel are readily available. However, UXO technician construction support would be required for the entire area during fencing and signage installation.

#### **4.2.1.2.7 Costs**

The costs to implement Alternative 2(SA) are detailed in Appendix B. The estimated total present worth to implement Alternative 2(SA) over a 30-year period is **\$1,310,000**.

### **4.2.1.3 Alternative 3(SA) — Surface Clearance of Accessible Land with LUCs**

A detailed description of Alternative 3(SA) is presented in Sections 3.1.4 and 3.2.1.

#### **4.2.1.3.1 Overall Protection of Human Health and the Environment**

Alternative 3(SA) would be protective of human health and the environment because surface removal of detected MEC would be performed in the Southern Area. Construction support by UXO Technicians would be provided for any excavation in the area as an

additional measure to prevent human exposure to MEC potentially present in the subsurface soil.

#### **4.2.1.3.2 Compliance with ARARs**

Alternative 3(SA) would achieve action-specific and location-specific ARARs if surface clearance and potential disposal actions are conducted according to federal and state requirements.

#### **4.2.1.3.3 Long-Term Effectiveness and Permanence**

Alternative 3(SA) would provide long-term effectiveness and permanence because MEC potentially present in the area on the ground surface would be removed from accessible areas.

Potential subsurface MEC may continue to pose potential hazards. Although there is little to no potential for subsurface MEC in the Southern Area, the remedy relies on strict observance of deed and zoning/planning restrictions to recreational uses (that is, no disturbance of subsurface soil and utilization of UXO technicians for construction support). A 30-year O&M period is assumed for the purpose of this FS and includes community education, annual inspections to assess the condition of the fence and erosion phenomena, and construction support in the Southern Area. This alternative would meet the RAOs by minimizing unacceptable risks posed by exposure to MEC and supporting future recreational land use.

#### **4.2.1.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 3(SA) includes surface removal of detected MEC/MPPEH in accessible areas of the Southern Area. This would significantly reduce mobility and volume of MEC potentially present in the Southern Area.

#### **4.2.1.3.5 Short-Term Effectiveness**

Alternative 3(SA) provides little risk to human health if safety exclusion zones are observed for the surface clearance and strict health and safety measures are followed to protect workers from potential MEC on the surface in the Southern Area. Some risk to workers could also be present from MEC potentially found in this area and detonated in place or in consolidated shots. Also this risk would be minimized by safety exclusion zones and strict health and safety measures.

#### **4.2.1.3.6 Implementability**

Alternative 3(SA) would be technically and administratively feasible. Surface clearance could be implemented in accessible areas of the Southern Area, though specialized equipment and trained personnel (UXO technicians) would need to be mobilized. Household dump sites are plentiful throughout the Southern Area, containing metal scrap that must be sifted through to determine if MEC/MPPEH is present. Clearance activities would be complicated in some sections of the Southern Area, where steep slopes and rocky terrain are safety hazards for the site workers, and would make the use of specialized equipment difficult. However, safety lines could be used to conduct visual sweeps of MEC along these sections of the Southern Area.

#### **4.2.1.3.7 Costs**

The costs to implement Alternative 3(SA) are detailed in Appendix B. The estimated total present worth to implement Alternative 3(SA) over a 30-year period is **\$2,270,000**.

#### **4.2.1.4 Alternative 4(SA) — Surface and Subsurface Clearance of Accessible Land with LUCs**

A detailed description of Alternative 4(SA) is presented in Sections 3.1.6 and 3.2.1. This alternative assumes that LUCs are required.

##### **4.2.1.4.1 Overall Protection of Human Health and the Environment**

Alternative 4(SA) would be protective of human health and the environment because surface and subsurface removal to 2 feet bgs over accessible land within this area would significantly reduce MEC. Although the results of the RI indicated that there was no evidence of MEC in the Southern Area, this assessment was mainly based on visual surveys and no clearance was conducted in this area, except for 2.92 acres in intrusive transects and grids. As an additional means to prevent human exposure to potential MEC, construction support by UXO Technicians would be provided for any excavation extending at depths greater than 2 feet bgs within the southern Area,.

##### **4.2.1.4.2 Compliance with ARARs**

Alternative 4(SA) would achieve action-specific and location-specific ARARs if surface and subsurface clearances and potential disposal actions are conducted according to federal and State requirements.

##### **4.2.1.4.3 Long-Term Effectiveness and Permanence**

Alternative 4(SA) would provide long-term effectiveness and permanence since potential MEC present on the ground surface and down to 2 feet bgs would be removed from accessible areas within the Southern Area. Though there is little to no potential for MEC in the Southern Area, the remedial alternative provides for construction support in non-cleared areas and for excavations deeper than 2 feet bgs.

A 30-year O&M period is assumed that includes community education and construction support in the Southern Area, annual inspections to assess the condition of the fence and erosion phenomena, and five-year reviews. This alternative would meet the RAOs by minimizing unacceptable risks posed by exposure to MEC and supporting future recreational land use.

##### **4.2.1.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 4(SA) includes surface and subsurface (to 2 feet bgs) removal of detected MEC/MPPEH. This would reduce the mobility and volume of MEC potentially present in the Southern Area.

##### **4.2.1.4.5 Short-Term Effectiveness**

Alternative 4(SA) provides little risk to human health after safety exclusion zones are observed for the surface clearance and strict health and safety measures are followed to protect workers from potential MEC on the surface and subsurface in the Southern Area. Some risk to workers could also be present from MEC potentially found in this area and

detonated in place or in consolidated shots. Also this risk would be minimized by safety exclusion zones and strict health and safety measures.

#### 4.2.1.4.6 Implementability

Alternative 4(SA) would be technically and administratively feasible. Surface and subsurface clearance can be implemented in accessible areas (as defined in Section 3.0) though specialized equipment and trained personnel (UXO technicians) would need to be mobilized. Household dump sites are plentiful throughout the Southern Area, containing metal scrap that must be sifted through to determine if MEC/MPPEH is present. Clearance activities would be complicated in some sections of the Southern Area, where steep slopes and rocky terrain are unacceptable safety hazards for the site workers, and would make the use of specialized equipment difficult (especially for subsurface clearance). Along these sections, visual sweeps of MEC could be conducted using safety lines, but some of the steepest slopes may not be reached at all.

#### 4.2.1.4.7 Costs

The costs to implement Alternative 4(SA) are detailed in Appendix B. The estimated total present worth to implement Alternative 4(SA) over a 30-year period is **\$5,060,000**.

### 4.2.2 Northern Non-Target Area

The Northern Non-Target Area consists of approximately 106 acres of steep, rocky, and densely vegetated land (Figure 3-1) where low to moderate explosive hazards have been assessed during the RI. The following remedial action alternatives were selected and are analyzed below against the threshold and balancing criteria:

- Alternative 1(NNTA) - No Action
- Alternative 2(NNTA) - LUCs
- Alternative 3(NNTA) - LUCs with construction support
- Alternative 4(NNTA) - Surface clearance (of accessible land) with LUCs
- Alternative 5(NNTA) - Surface and subsurface clearance (of accessible land) with LUCs

The area within the Northern Non-Target Area addressed by each remedial action alternative is provided in Table 4-2.

**TABLE 4-2**  
 Areas of Response Actions - Northern Non-Target Area

No.	Alternative Action Description	Response Action Area (acres)		
		LUC	Surface Clearance	Subsurface Clearance
1	No Action	NA	NA	NA
2	LUCs	105.8	NA	NA
3	LUCs with Construction Support	105.8	NA	NA
4	Surface Clearance of Accessible Land with LUCs	105.8	2.9	NA
5	Surface and Subsurface Clearance of Accessible Land with LUCs	105.8	2.9	2.9

#### **4.2.2.1 Alternative 1(NNTA) — No Action**

Alternative 1(NNTA) represents a no action scenario. Under this alternative, no new active control, remediation, or management would be performed. However, it is assumed that the current fence and warning signs will be left in place and maintenance will be continued under the existing program. As required by the NCP, this alternative is included in this evaluation as a baseline for comparison with the other alternatives.

##### **4.2.2.1.1 Overall Protection of Human Health and the Environment**

Since the current fence and warning signs would be left in place and maintained, Alternative 1(NNTA) is considered to meet the criteria for overall protection of human health. However, this alternative would not meet the RAO of protecting human health and the environment by reducing MEC hazards.

##### **4.2.2.1.2 Compliance with ARARs**

Alternative 1(NNTA) would comply with the ARARs because the current fence would remain in place and maintained under current maintenance programs.

##### **4.2.2.1.3 Long-Term Effectiveness and Permanence**

Alternative 1(NNTA) would provide limited long-term effectiveness or permanence because no remedial actions would be performed. Risk of human exposure would remain constant.

##### **4.2.2.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 1(NNTA) includes no treatment actions that would reduce the mobility or volume of MEC at the site.

##### **4.2.2.1.5 Short-Term Effectiveness**

Alternative 1(NNTA) involves no action and would provide limited protectiveness in the short-term because of the presence of current fence and signs. Because no remedial action would be taken, there would be no impact to workers, the community, or the environment.

##### **4.2.2.1.6 Implementability**

Alternative 1(NNTA) would result in no technical or administrative feasibility issues, and requires no services or equipment because no action would be taken.

##### **4.2.2.1.7 Costs**

Alternative 1(NNTA) O&M costs are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$850,000**.

#### **4.2.2.2 Alternative 2(NNTA) — LUCs**

A detailed description of Alternative 2(NNTA) is presented in Sections 3.1.2 and 3.2.2.

##### **4.2.2.2.1 Overall Protection of Human Health and the Environment**

Alternative 2(NNTA) would provide protection to humans. Although it would not reduce the residual risk posed to human health by the potential presence of MEC (that is, the MECHA score would remain the same), fencing and signs would be installed and properly

maintained in the future to separate the Northern Non-Target Area from other areas. Additionally, educational programs would be implemented and annual inspections would be conducted to assess condition of fence and erosion phenomena potentially causing MEC exposure/migration. This would theoretically represent an effective control measure to avoid contact between the source (MEC potentially present in the Northern Non-Target Area) and human receptors. However, it is implied that the controls are properly implemented and obeyed.

#### **4.2.2.2.2 Compliance with ARARs**

Alternative 2(NNTA) could achieve action-specific and location-specific ARARs.

#### **4.2.2.2.3 Long-Term Effectiveness and Permanence**

Alternative 2(NNTA) would provide long-term effectiveness and permanence, as long as the fence, signs, and other controls would prevent contact between humans and MEC potentially present in the Northern Non-Target Area. The remedy relies on exposure control provided by fencing and signage. A 30-year O&M period is assumed for the purpose of this FS that includes O&M of fencing and signage, community education, five-year reviews, and UXO technician escort for anomaly avoidance during access and fence maintenance. No construction support would be provided for potential future intrusive operations. Although the alternative would provide some long-term effectiveness, potential risk would remain within the Northern Non-Target Area.

#### **4.2.2.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 2(NNTA) includes no treatment actions to reduce the mobility or volume of MEC at the site.

#### **4.2.2.2.5 Short-Term Effectiveness**

Alternative 2(NNTA) would provide some protectiveness to human receptors and would have no adverse impacts to the environment in the short-term. The possibility of contact between humans and MEC would be minimized by maintaining the access controls currently in place for the WVIA MRS, while installing the fence and signage between the Northern Non-Target Area and other areas (as applicable). During installation and maintenance of fencing and signage, protectiveness of workers would be implemented by MEC avoidance support.

#### **4.2.2.2.6 Implementability**

Alternative 2(NNTA) would be technically and administratively feasible. LUCs could be easily implemented because equipment, materials, and personnel are readily available, although UXO technician construction support would be required. Fence installation activities would be complicated in limited sections of the Northern Non-Target Area, where steep slopes and rocky terrain would make fence installation and maintenance difficult.

#### **4.2.2.2.7 Costs**

The costs to implement Alternative 2(NNTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$1,510,000**.



### **4.2.2.3 Alternative 3(NNTA) — LUCs with Construction Support**

A detailed description of Alternative 3(NNTA) is presented in Sections 3.1.3 and 3.2.2.

#### **4.2.2.3.1 Overall Protection of Human Health and the Environment**

Alternative 3(NNTA) would provide protection to humans. Although it would not reduce the residual risk posed to human health by the potential presence of MEC (that is, the MECHA score would not change), warning signs would be installed and properly maintained in the future; additionally, educational programs and construction support would be implemented. This would theoretically represent an effective control measure to avoid contact between the source (MEC potentially present in the Northern Non-Target Area) and human receptors. However, this implies that the controls are properly implemented and obeyed.

#### **4.2.2.3.2 Compliance with ARARs**

Alternative 3(NNTA) could achieve action-specific and location-specific ARARs.

#### **4.2.2.3.3 Long-Term Effectiveness and Permanence**

Alternative 3(NNTA) would provide long-term effectiveness and permanence, as long as the signs and other controls prevent contact between humans and MEC potentially present in the Northern Non-Target Area. The remedy relies on exposure control provided by signage, and construction support. A 30-year O&M period is assumed for the purpose of this FS and includes O&M of signage, community education, five-year reviews, and UXO technician escort for anomaly avoidance during access and signage maintenance. Annual inspections would be conducted to assess erosion phenomena potentially causing MEC exposure/migration. Construction support would also be provided for intrusive activities potentially conducted in this area in the future (these would be unlikely and would require special permits/authorization by the DLNR because all accessible areas are within the Forest Reserve line). Although the alternative would provide some long-term effectiveness, potential risk would remain within the Northern Non-Target Area.

#### **4.2.2.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 3(NNTA) includes no treatment actions that would reduce the mobility or volume of MEC at the site.

#### **4.2.2.3.5 Short-Term Effectiveness**

Alternative 3(NNTA) would provide some protectiveness to human receptors and would have no adverse impacts to the environment in the short-term. During installation and maintenance of signage, workers would be protected by construction support.

#### **4.2.2.3.6 Implementability**

Alternative 3(NNTA) would be technically and administratively feasible. LUCs could be easily implemented because equipment, materials, and personnel are readily available. UXO technician and specialized equipment for construction support would be required. Clearance activities would be complicated in limited sections of the Northern Non-Target Area, where steep slopes and rocky terrain make the use of specialized equipment difficult.

#### **4.2.2.3.7 Costs**

The costs to implement Alternative 3(NNTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$1,630,000**.

#### **4.2.2.4 Alternative 4(NNTA) — Surface Clearance of Accessible Land with LUCs**

A detailed description of Alternative 4(NNTA) is presented in Sections 3.1.4 and 3.2.2.

##### **4.2.2.4.1 Overall Protection of Human Health and the Environment**

Alternative 4(NNTA) would be protective of human health and the environment because surface removal of MEC would be performed in accessible areas of the Northern Non-Target Area, resulting in a reduction of MEC hazards (that is, lower MECHA score compared to current conditions). LUCs would be implemented to address the limited hazards that would remain from MEC items potentially present in the subsurface soil. LUCs would include construction support by UXO technicians that would be provided for any future excavation in the Northern Non-Target Area, as an additional measure to prevent human exposure to potential MEC.

##### **4.2.2.4.2 Compliance with ARARs**

Alternative 4(NNTA) could achieve action-specific and location-specific ARARs.

##### **4.2.2.4.3 Long-Term Effectiveness and Permanence**

Alternative 4(NNTA) would provide long-term effectiveness and permanence for recreational use since potential MEC present on the ground surface would be removed from accessible land in the Northern Non-Target Area.

Potential subsurface MEC may continue to pose limited hazards, which would be mitigated by the implementation of LUCs. Since there is potential for subsurface MEC, the remedy relies on strict observance of deed and zoning/planning restrictions to recreational uses that do not disturb the subsurface soil and utilization of UXO technicians for construction support for any planned excavation.

This alternative would meet the RAOs by minimizing unacceptable risks posed by exposure to MEC in accessible areas and supporting future light agricultural and recreational land use. A 30-year O&M period is assumed for the purpose of this FS and includes O&M of fence/signage, community education, five-year reviews, and construction support in the Northern Non-Target Area. Annual inspections would be conducted to assess condition of fence and erosion phenomena potentially causing MEC exposure/migration.

##### **4.2.2.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 4(NNTA) includes surface removal of detected MEC/MPPEH in accessible areas of the Northern Non-Target Area. This would reduce mobility and volume of MEC potentially present in this area.

##### **4.2.2.4.5 Short-Term Effectiveness**

Alternative 4(NNTA) provides little risk to human health if safety exclusion zones are observed for the surface clearance and strict health and safety measures are followed to protect workers from potential MEC on the surface in the Northern Non-Target Area.

However, moderate risk to workers could be present from MEC potentially found in this area and detonated in place or in consolidated shots. Also this risk would be minimized by safety exclusion zones and strict health and safety measures.

#### **4.2.2.4.6 Implementability**

Alternative 4 (NNTA) would be technically and administratively feasible, but only in accessible areas (as defined in Section 3.0). Specialized equipment and trained personnel (UXO technicians) would need to be mobilized. Clearance activities would be complicated in most sections of the Northern Non-Target Area, where steep slopes and rocky terrain make the use of specialized equipment difficult if not impossible.

#### **4.2.2.4.7 Costs**

The costs to implement Alternative 4(NNTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$2,300,000**.

#### **4.2.2.5 Alternative 5 (NNTA) — Surface and Subsurface Clearance of Accessible Land with LUCs**

A detailed description of Alternative 5(NNTA) is presented in Section 3.1.6 and 3.2.2.

##### **4.2.2.5.1 Overall Protection of Human Health and the Environment**

Alternative 5 (NNTA) would be protective of human health and the environment because surface and subsurface removal (to a 2-foot depth) of detected MEC would be performed on accessible land of the Northern Non-Target Area. This would result in a reduction of MEC hazards (that is, a lower MECHA score compared to current conditions). LUCs would be implemented to address the limited hazards that would remain from MEC items potentially present at depths greater than 2 feet bgs. Construction support by UXO technicians would be provided for any future excavation deeper than 2 feet bgs, as an additional measure to prevent human exposure to potential MEC.

##### **4.2.2.5.2 Compliance with ARARs**

Alternative 5 (NNTA) could achieve action-specific and location-specific ARARs.

##### **4.2.2.5.3 Long-Term Effectiveness and Permanence**

Alternative 5(NNTA) would provide long-term effectiveness and permanence since potential MEC present on the ground surface and up to 2-feet bgs would be removed over accessible land of the Northern Non-Target Area.

Since there is potential for residual MEC hazards, the remedy relies on strict observance of deed and zoning/planning restrictions to recreational uses, and utilization of UXO technicians for construction support for any planned excavations deeper than 2 feet bgs.

This alternative would meet the RAOs by minimizing unacceptable risks posed by exposure to MEC and supporting future recreational land use. The remedial alternative provides for construction support for excavations deeper than two feet over a 30-year O&M period and includes LUCs to address potential risks remaining after the RAOs are met. Annual inspections would be conducted to assess condition of fence and erosion phenomena potentially causing MEC exposure/migration.

#### 4.2.2.5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 5(NNTA) includes surface and subsurface removal (to 2 feet bgs) of detected MEC/MPPEH in accessible areas of the Northern Non-Target Area that would reduce the volume of potential MEC at the site. In addition, it would reduce the potential for transport of MEC outside the Northern Non-Target Area through soil erosion, storm water runoff, or movement by site visitors.

#### 4.2.2.5.5 Short-Term Effectiveness

Alternative 5(NNTA) provides little risk to human health after safety exclusion zones are observed for the surface and subsurface clearance and strict health and safety measures are followed to protect workers from potential MEC in the Northern Non-Target Area. Some risk to workers could also be present from MEC potentially found in this area and detonated in place or in consolidated shots. Also this risk would be minimized by safety exclusion zones and strict health and safety measures.

#### 4.2.2.5.6 Implementability

Alternative 5(NNTA) would be technically and administratively feasible, but only in accessible areas (defined in Section 3.0). Specialized equipment and trained personnel (UXO technicians) would need to be mobilized. Clearance activities would be complicated in most sections of the Northern Non-Target Area, where steep slopes and rocky terrain make the use of specialized equipment difficult if not impossible.

#### 4.2.2.5.7 Costs

The costs to implement Alternative 5(NNTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$2,610,000**.

### 4.2.3 Northern Target Area

The Northern Target Area consists of approximately 47 acres of steep, rocky, and densely vegetated land (Figure 3-1) where moderate to high explosive hazards have been assessed during the RI. The following remedial action alternatives were selected and are analyzed below against the threshold and balancing criteria:

- Alternative 1(NTA) - No Action
- Alternative 2(NTA) - LUCs
- Alternative 3(NTA) - LUCs with construction support
- Alternative 4(NTA) - Surface clearance (of accessible land) with LUCs
- Alternative 5(NTA) - Surface and subsurface clearance (of accessible land) with LUCs

The area within Northern Target Area addressed by each remedial action alternative is shown in Table 4-3.

**TABLE 4-3**  
 Areas of Response Actions - Northern Target Area

No.	Alternative Action Description	LUC	Response Action Area (acres)	
			Surface Clearance	Subsurface Clearance

1	No Action	NA	NA	NA
2	LUCs	47.3	NA	NA
3	LUCs with Construction Support	47.3	NA	NA
4	Surface Clearance of Accessible Land with LUCs	47.3	17.5	NA
5	Surface and Subsurface Clearance of Accessible Land with LUCs	47.3	17.5	17.5

#### 4.2.3.1 Alternative 1(NTA) — No Action

Alternative 1(NTA) represents a no action scenario with no changes to the current conditions at the WVIA. Under this alternative, no new active control, remediation, or management would be performed. However, it is assumed that the current fence and warning signs will be left in place and maintenance will be done under the existing program. As required by the NCP, this alternative is included in this evaluation as a baseline for comparison with the other alternatives.

##### 4.2.3.1.1 Overall Protection of Human Health and the Environment

Since the current fence and warning signs would be left in place and maintained, Alternative 1(NTA) is considered to meet the criteria for overall protection of human health. However, the alternative does not satisfy the RAO of protecting human health and the environment by reducing MEC hazards. Compared to current conditions, MEC HA score would remain unchanged.

##### 4.2.3.1.2 Compliance with ARARs

Alternative 1(NTA) would comply with the ARARs because the current fence would remain in place and maintained under current maintenance programs.

##### 4.2.3.1.3 Long-Term Effectiveness and Permanence

Alternative 1(NTA) would provide limited long-term effectiveness or permanence because no remedial actions would be performed. The risk of human exposure would be unchanged from the current conditions.

##### 4.2.3.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1(NTA) includes no treatment actions that would reduce the mobility or volume of MEC in the Target Area.

##### 4.2.3.1.5 Short-Term Effectiveness

Alternative 1(NTA) involves no action and would provide no protectiveness in the short-term. Because no remedial action would be taken, there would be no impact to workers, the community, or the environment.

##### 4.2.3.1.6 Implementability

Alternative 1(NTA) would result in no technical or administrative feasibility issues, and requires no services or equipment because no action would be taken.

#### **4.2.3.1.7 Costs**

Alternative 1(NTA) monitoring costs are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$850,000**.

#### **4.2.3.2 Alternative 2(NTA) — LUCs**

A detailed description of Alternative 2(NTA) is presented in Sections 3.1.2 and 3.2.3.

##### **4.2.3.2.1 Overall Protection of Human Health and the Environment**

Alternative 2(NTA) would provide protection to humans. Although it would not reduce the residual risk posed to human health by the potential presence of MEC (that is, MECHA score would remain the same), fencing and signs would be installed and properly maintained in the future; additionally, educational programs and MEC avoidance support (for maintenance only) would be implemented. This alternative deters contact between the source (MEC potentially present in the Northern Target Area) and human receptors, assuming that the controls are properly implemented and obeyed.

##### **4.2.3.2.2 Compliance with ARARs**

Alternative 2(NTA) could achieve action-specific and location-specific ARARs.

##### **4.2.3.2.3 Long-Term Effectiveness and Permanence**

Alternative 2(NTA) would provide long-term effectiveness and permanence, as long as the fence, signs, and other controls prevent contact between humans and MEC potentially present in the Northern Target Area. A 30-year O&M period is assumed for the purpose of this FS that includes O&M of fencing and signage, community education, five-year reviews, and UXO technician escort for anomaly avoidance during access and fence maintenance. Annual inspections would also be conducted to assess condition of fence and erosion phenomena potentially causing MEC exposure/migration. No construction support would be provided for potential future intrusive operations. Although the alternative provides some long-term effectiveness, potential risk would remain within the Northern Target Area.

##### **4.2.3.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 2(NTA) includes no treatment actions to reduce the mobility or volume of MEC at the site.

##### **4.2.3.2.5 Short-Term Effectiveness**

Alternative 2(NTA) would provide some protectiveness to human receptors and would have no adverse impacts to the environment in the short-term. The possibility of contact between humans and MEC would be minimized by maintaining the access controls currently in place for the WVIA MRS, while installing the fence and signage around the Northern Target Area. During installation and maintenance of fencing and signage, protectiveness of workers would be implemented by MEC avoidance support.

##### **4.2.3.2.6 Implementability**

Alternative 2(NTA) would be technically and administratively feasible. LUCs could be easily implemented because equipment, materials, and personnel are readily available, although UXO technician construction support would be required.

#### **4.2.3.2.7 Costs**

The costs to implement Alternative 2(NTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$1,470,000**.

#### **4.2.3.3 Alternative 3(NTA) — LUCs with Construction Support**

A detailed description of Alternative 3(NTA) is presented in Sections 3.1.3 and 3.2.3.

##### **4.2.3.3.1 Overall Protection of Human Health and the Environment**

Alternative 3(NTA) would provide protection to humans. Although it would not reduce the residual risk posed to human health by the potential presence of MEC (that is, MECHA score would remain the same), signs would be installed and properly maintained in the future; additionally, educational programs and construction support would be implemented. This alternative deters contact between the source (MEC potentially present in the Northern Target Area) and human receptors, assuming that the controls are properly implemented and obeyed.

##### **4.2.2.3.2 Compliance with ARARs**

Alternative 3(NTA) could achieve action-specific and location-specific ARARs.

##### **4.2.2.3.3 Long-Term Effectiveness and Permanence**

Alternative 3(NTA) would provide long-term effectiveness and permanence, as long as the signs and other controls prevent contact between humans and MEC potentially present in the Northern Non-Target Area. The remedy relies on exposure control provided by signage and construction support. A 30-year O&M period is assumed for the purpose of this FS that includes community education, O&M of signage, Five-Year Reviews, and UXO technician escort for anomaly avoidance for access and fence maintenance. Annual inspections would be conducted to assess erosion phenomena potentially causing MEC exposure/migration. Construction support would also be provided for intrusive activities potentially conducted in this area in the future. Although the alternative would provide some long-term effectiveness, potential risk would remain within the Northern Non-Target Area.

##### **4.2.2.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 3(NTA) includes no treatment actions that would reduce the mobility or volume of MEC at the site.

##### **4.2.2.3.5 Short-Term Effectiveness**

Alternative 3(NTA) would provide some protectiveness to human receptors and would have no adverse impacts to the environment in the short-term. The possibility of contact between humans and MEC would be minimized by maintaining the access controls currently in place for the WVIA MRS, while installing the fence and signage between the Northern Target Area and other areas (as applicable). During installation and maintenance of signage, protectiveness of workers would be implemented by construction support.

#### **4.2.2.3.6 Implementability**

Alternative 3(NTA) would be technically and administratively feasible. LUCs could be easily implemented because equipment, materials, and personnel are readily available. UXO technician and specialized equipment for construction support would be required.

#### **4.2.2.3.7 Costs**

The costs to implement Alternative 3(NTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$1,840,000**.

#### **4.2.3.4 Alternative 4(NTA) — Surface Clearance of Accessible Land with LUCs**

A detailed description of Alternative 4(NTA) is presented in Sections 3.1.4 and 3.2.3.

##### **4.2.3.4.1 Overall Protection of Human Health and the Environment**

Alternative 4(NTA) would be protective of human health and the environment because surface removal of detected MEC would be performed in accessible areas of the Northern Target Area. Compared to current conditions, MEC hazards would be reduced. LUCs would be implemented to address the hazards that would remain from MEC items potentially present in subsurface soil. Construction support by UXO technicians would be provided for any future excavation in the Northern Target Area, as an additional measure to prevent human exposure to potential MEC.

##### **4.2.3.4.2 Compliance with ARARs**

Alternative 4(NTA) could achieve action-specific and location-specific ARARs.

##### **4.2.3.4.3 Long-Term Effectiveness and Permanence**

Alternative 4(NTA) would provide long-term effectiveness and permanence for recreational use since MEC potentially present on the ground surface would be removed from accessible land in the Northern Target Area.

Potential subsurface MEC may continue to pose limited hazards, which would be mitigated by the implementation of LUCs. Since there is potential for subsurface MEC, the remedy relies on strict observance of deed and zoning/planning restrictions to recreational uses that do not disturb the ground surface and utilization of UXO technicians for construction support for any planned excavations.

This alternative would meet the RAOs by minimizing unacceptable risks posed by exposure to MEC in accessible areas and supporting future recreational land use. A 30-year O&M period is assumed for the purpose of this FS and includes signs maintenance, community education, five-year reviews, and construction support in the Northern Target Area. Annual inspections would also be conducted to assess erosion phenomena potentially causing MEC exposure/migration.

##### **4.2.3.4.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 4(NTA) includes surface removal of detected MEC/MPPEH in accessible areas of the Northern Target Area. This would significantly reduce mobility and volume of MEC potentially present in this area.



#### **4.2.3.4.5 Short-Term Effectiveness**

Alternative 4(NTA) provides little risk to human health if safety exclusion zones are observed for the surface clearance and strict health and safety measures are followed to protect workers from potential MEC on the surface in the Northern Target Area. However, moderate risk to workers could be present from MEC potentially found in this area and detonated in place or in consolidated shots. Also this risk would be minimized by safety exclusion zones and strict health and safety measures.

#### **4.2.3.4.6 Implementability**

Alternative 4(NTA) would be technically and administratively feasible, but only in accessible areas (as defined in Section 3.0). Specialized equipment and trained personnel (UXO technicians) would need to be mobilized. Clearance activities would be complicated in some sections of the Northern Target Area, where steep slopes and rocky terrain would make the use of specialized equipment difficult if not impossible.

#### **4.2.3.4.7 Costs**

The costs to implement Alternative 4(NTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$2,960,000**.

#### **4.2.3.5 Alternative 5(NTA) — Surface and Subsurface Clearance of Accessible Land with LUCs**

A detailed description of Alternative 5(NTA) is presented in Sections 3.1.6 and 3.2.3.

##### **4.2.3.5.1 Overall Protection of Human Health and the Environment**

Alternative 5(NTA) would be protective of human health and the environment because surface and subsurface removal (to a 2-foot depth) of detected MEC would be performed in accessible areas of the Northern Target Area. Compared to current conditions, MEC hazards would be reduced. LUCs would be implemented to address the hazards remaining from MEC items potentially present at depths greater than 2 feet bgs. Construction support by UXO technicians would be provided for any future excavation deeper than 2 feet bgs, as an additional measure to prevent human exposure to potential MEC.

##### **4.2.3.5.2 Compliance with ARARs**

Alternative 5(NTA) could achieve action-specific and location-specific ARARs.

##### **4.2.3.5.3 Long-Term Effectiveness and Permanence**

Alternative 5(NTA) would provide long-term effectiveness and permanence since potential MEC present on the ground surface and up to 2 feet bgs would be removed over accessible land of the Northern Target Area.

MEC potentially remaining at depths greater than 2 feet bgs may continue to pose potential hazards and would be mitigated by LUCs. Since there is potential for residual MEC hazards, the remedy relies on strict observance of deed and zoning/planning restrictions to recreational uses and utilization of UXO technicians for construction support for any planned excavations deeper than 2 feet bgs.

This alternative would meet the RAOs by minimizing unacceptable risks posed by exposure to MEC. The remedial alternative provides construction support for excavations deeper

than two feet over a 30-year O&M period and includes LUCs and five-year reviews to address potential risks remaining after the RAOs are met. Annual inspections would also be conducted to assess erosion phenomena potentially causing MEC exposure/migration.

#### **4.2.3.5.4 Reduction of Toxicity, Mobility, and Volume through Treatment**

Alternative 5(NTA) includes surface and subsurface removal (to 2 feet bgs) of detected MEC/MPPEH in accessible areas of the Northern Target Area that would reduce the volume of potential MEC at the site. In addition, it would reduce the potential for transport of MEC outside the Northern Target Area through soil erosion, storm water runoff, or movement by site visitors.

#### **4.2.3.5.5 Short-Term Effectiveness**

Alternative 5(NTA) provides little risk to human health after safety exclusion zones are observed for the surface and subsurface clearance and strict health and safety measures are followed to protect workers from potential MEC in the Northern Target Area. Some risk to workers could also be present from MEC potentially found in this area and detonated in place or in consolidated shots. Also this risk would be minimized by safety exclusion zones and strict health and safety measures.

#### **4.2.3.5.6 Implementability**

Alternative 5(NTA) would be technically and administratively feasible, but only in accessible areas (defined in Section 3.0). Specialized equipment and trained personnel (UXO technicians) would need to be mobilized. Clearance activities would be complicated in some sections of the Northern Target Area, where steep slopes and rocky terrain would make the use of specialized equipment difficult if not impossible.

#### **4.2.3.5.7 Costs**

The costs to implement Alternative 5(NTA) are detailed in Appendix B. The estimated total present worth to implement this alternative over a 30-year period is **\$5,130,000**.

## **4.3 Comparative Analysis of Alternatives**

This section presents a comparative analysis of the remedial alternatives against one another for the threshold and balancing evaluation criteria that are applicable to the WVIA MSR. The comparative analysis is conducted for each response action area and indicates the advantages and disadvantages of each alternative relative to the others to then recommend the most appropriate remedial alternative for the site. Summaries of the comparative analyses against different criteria are provided in tables below, where alternatives are compared against a relative scoring system that includes five categories (from the most favorable, "5", to the least favorable, "1"). A comprehensive comparative table is also provided to select the most cost-effective alternative for each response action area.

### **4.3.1 Southern Area**

The comparison of the different remedial alternatives evaluation against the threshold and balancing criteria for the Southern Area is discussed below.

### 4.3.1.1 Overall Protection of Human Health and the Environment

Comparison of different alternatives against this criterion is summarized in Table 4-4 below. Alternative 1(SA) would least meet the criteria for overall protection of human health and the environment. Alternative 2(SA) would not reduce the residual risk posed to human health by the potential presence of MEC, but signs, educational programs, and construction support would theoretically represent an effective control measure to avoid contact between the source and human receptors. Alternatives 3(SA) and 4(SA) would both be protective of human health since surface (for both alternatives) and subsurface (only Alternative 4) clearance of MEC would be conducted in accessible areas and MEC potentially remaining in inaccessible areas would be addressed through LUCs.

### 4.3.1.2 Compliance with ARARs

Comparison of different alternatives against ARARs is summarized in Table 4-4 below. If properly implemented, all alternatives would meet the ARARs. Alternative 1(SA) would meet the ARARs because current fence would be kept in place and maintained under current maintenance programs.

**TABLE 4-4**

Comparative Analysis - Threshold Criteria, Southern Area

Criteria		Remedial Alternative			
		No Action	LUCs	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Threshold Criteria	Overall Protection of Human Health and the Environment	Yes	Yes	Yes	Yes
	Compliance with ARARs	Yes	Yes	Yes	Yes

**Notes:**

Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative. There is no flexibility in meeting the threshold criteria: the alternative must meet them or is unacceptable.

### 4.3.1.3 Long-Term Effectiveness and Permanence

Comparison of different alternatives against this criterion is summarized in Table 4-5 below. Alternative 1(SA) would provide limited long-term effectiveness or permanence because, although no active remedial/control actions would be performed, the current fence/signs would remain in place. Alternative 2(SA) would provide long-term effectiveness and permanence as long as the signs and other controls prevent contact between humans and MEC potentially present in the area. However, this alternative would not meet the RAO of supporting future land use.

Alternative 3(SA) would provide long-term effectiveness and permanence by removing potential MEC in accessible areas from the ground surface. Relatively higher score is assigned to Alternative 4(SA) in Table 4-5 because MEC is removed to a depth of 2 feet bgs.

LUCs and construction support would manage possible hazards posed by MEC potentially remaining at the site at depths greater than 2 feet bgs and in inaccessible areas.

**TABLE 4-5**

Comparative Analysis – Long Term Effectiveness and Permanence, Southern Area

Criteria	Remedial Alternative			
	No Action	LUCs	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Long-Term Effectiveness and Permanence	1	2	4	5

**Notes:**

**Relative scoring system:** “5” Best - The alternative is the most favorable for this criterion

“1” Worst – The alternative is the least favorable for this criterion

**4.3.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment**

Comparison of different alternatives against this criterion is summarized in Table 4-6 below. Only Alternatives 3(SA) and 4(SA) include removal actions that would reduce the volume, and therefore mobility, of MEC potentially remaining in accessible land of the Southern Area. Alternative 4(SA) would be the most favorable alternative in reducing MEC volumes and is assigned a relatively higher score in Table 4-6 because a potentially larger quantity of MEC could be removed during subsurface clearance.

**TABLE 4-6**

Comparative Analysis – Reduction of Toxicity, Mobility, or Volume, Southern Area

Criteria	Remedial Alternative			
	No Action	LUCs	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Reduction of Toxicity, Mobility, or Volume	1	1	4	5

**4.3.1.5 Short-Term Effectiveness**

Comparison of different alternatives against this criterion is summarized in Table 4-7 below. All alternatives would provide protectiveness to humans in the short-term, assuming that engineered controls currently in place would be effective in preventing contact between humans and MEC. Although health and safety measures and environmental controls are implemented to reduce the hazards associated with MEC detonation and removal, the

exposure of workers to MPPEH hazards and the environment to MEC releases means that Alternatives 3(SA) and 4(SA) are less favorable and are assigned lower relative scores in Table 4-7.

**TABLE 4-7**  
 Comparative Analysis – Short Term Effectiveness, Southern Area

Criteria	Remedial Alternative			
	No Action	LUCs	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Short-Term Effectiveness	4	4	3	2

**4.3.1.6 Implementability**

Comparison of different alternatives against this criterion is summarized in Table 4-8 below. Alternative 1(SA) would result in no technical or administrative feasibility issues and requires no services or equipment because no additional action would be taken. Alternative 2(SA) would be technically and administratively feasible and could be easily implemented because no clearance would be involved.

Alternatives 3(SA) and 4(SA) would also be technically and administratively feasible. However, specialized equipment and trained personnel (UXO technicians) would need to be used and their work would be complicated by steep slopes and thick vegetation present in some sections of the Southern Area. Alternative 4(SA) is assigned a lower score because it is the hardest alternative to implement technically.

**TABLE 4-8**  
 Comparative Analysis - Implementability, Southern Area

Criteria	Remedial Alternative			
	No Action	LUCs	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Implementability	5	4	3	2

**4.3.1.7 Cost**

Comparison of costs between alternatives is shown in Table 4-9 below. Alternative 1(SA) (No Action) is estimated at \$850,000 present worth over a 30-year period to maintain the current fencing and signage. Alternative 2(SA) (LUCs) is estimated at a present worth of \$1,310,000 over a 30-year period. The estimated total present worth to implement Alternative 3(SA) (Surface Clearance of Accessible Land with LUCs) over a 30-year period is estimated at \$2,270,000, which is higher than alternative 2(SA) because surface clearance of

MEC would be conducted over all accessible areas and surface visual sweeps would be performed in inaccessible areas. The total present worth to implement Alternative 4(SA) (Surface and Subsurface Clearance of Accessible Land with LUCs) over a 30-year period is estimated at **\$5,060,000**, which is the highest cost because it would include the highest level of MEC clearance (surface and subsurface).

**TABLE 4-9**  
 Alternatives Cost Analysis - Southern Area

No.	Alternative Action Description	Cost (USD)		
		Capital	Periodic+O&M	Total
1	No Action	\$0	\$ 850,000	\$ 850,000
2	LUCs	\$80,000	\$1,230,000	\$1,310,000
3	Surface Clearance with LUCs	\$1,040,000	\$1,230,000	\$2,270,000
4	Surface and Subsurface Clearance with LUCs	\$3,585,000	\$1,475,000	\$5,060,000

**Notes:**

Periodic and O&M costs are estimated over 30 years  
 LUC = land use control

O&M = operation and maintenance  
 USD = United States dollars

**4.3.1.8 Scoring Results – Southern Area**

Alternative 3(SA) - Surface Clearance of Accessible Land with LUCs (the estimated area of accessible land is 30.5 acres) is the alternative that appears most favorable for the Southern Area. The overall comparison of the alternatives is provided in Table 4-10, where the No Action alternative scores equally as high as alternative 3(SA). This is due to the fact that in the No Action condition access to the site is restricted, providing protection for the public from potential explosive hazards. However, the No Action alternative does not meet the project RAOs and so must be dismissed as unrealistic. Alternative 3(SA) meets the RAOs by minimizing unacceptable risks posed by exposure to MEC, preventing migration of MEC to accessible areas, restoring the accessible land to recreational use, and supporting access to cultural sites.

**TABLE 4-10.**  
 Summary of Comparative Analysis - Southern Area

Criteria	Remedial Alternative			
	No Action	LUCs	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Threshold Criteria	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
Balancing Criteria	1	2	4	5
	1	1	4	5
	4	4	3	2
	5	4	3	2
	5	4	2	1
	16	15	16	15
	\$850,000	\$1,310,000	\$2,270,000	\$5,060,000

**Relative Rating System** (compares alternatives relative to each other against criteria):

- 5 Best - The alternative is the most favorable for this criterion
- 4 Better - The alternative is more favorable for this criterion
- 3 Average - The alternative is moderately favorable for this criterion
- 2 Worse - The alternative is less favorable for this criterion
- 1 Worst - The alternative is the least favorable for this criterion

### 4.3.2 Northern Non-Target Area

The comparison of the different remedial alternatives evaluation against the threshold and balancing criteria for the Northern Non-Target Area is discussed below.

#### 4.3.2.1 Overall Protection of Human Health and the Environment

Comparison of different alternatives against this criterion is summarized in Table 4-11 below. Alternative 1(NNTA) would be least protective of human health and the environment. Alternatives 2(NNTA) and 3(NNTA) would not reduce the residual risk posed to human health by the potential presence of MEC, but the fence and/or signs, deed restrictions, educational programs, and construction support (only for Alternative 3[NNTA]) if properly implemented and obeyed would represent an effective control measure to avoid contact between MEC and human receptors.

Alternatives 4(NNTA) and 5(NNTA) would both be protective of human health since surface (for both alternatives) and subsurface (only Alternative 5[NNTA]) clearance of MEC would be conducted on accessible land and MEC potentially remaining in the subsurface (Alternative 4[NNTA]) at depths greater than 2 feet bgs (Alternative 5[NNTA]) would be addressed through LUCs.

#### 4.3.2.2 Compliance with ARARs

Comparison of different alternatives against ARARs is summarized in Table 4-11 below. If properly implemented, all alternatives would meet the ARARs.

**TABLE 4-11**

Comparative Analysis - Threshold Criteria, Northern Non-Target Area

Criteria		Remedial Alternative				
		No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Threshold Criteria	Overall Protection of Human Health and the Environment	Yes	Yes	Yes	Yes	Yes
	Compliance with ARARs	Yes	Yes	Yes	Yes	Yes

**Notes:**

Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative. There is no flexibility in meeting the threshold criteria: the alternative must meet them or is unacceptable.

#### 4.3.2.3 Long-Term Effectiveness and Permanence

Comparison of different alternatives against this criterion is summarized in Table 4-12 below. Alternative 1(NNTA) would provide limited long-term effectiveness or permanence



because no remedial actions would be performed and recreationists and potential future construction workers would be exposed to MEC hazards. Alternatives 2(NNTA) and 3(NNTA) would provide long-term effectiveness and permanence as long as the fence or signs, and other controls are properly implemented, maintained and obeyed.

Alternative 4(NNTA) would provide long-term effectiveness and permanence because potential MEC in accessible areas would be removed from the ground surface. Relatively higher score is assigned to Alternative 5(NNTA) in Table 4-12 because potential MEC would also be removed from subsurface soil down to 2 feet bgs. LUCs and construction support would be provided to manage possible hazards posed by MEC potentially remaining at the site at depths greater than 2 feet bgs.

**TABLE 4-12**

Comparative Analysis – Long Term Effectiveness and Permanence, Northern Non-Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Long-Term Effectiveness and Permanence	1	2	2	4	5

**Notes:**

**Relative scoring system:** “5” Best - The alternative is the most favorable for this criterion

“1” Worst – The alternative is the least favorable for this criterion

**4.3.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment**

Comparison of different alternatives against this criterion is summarized in Table 4-13 below. Only Alternatives 4(NNTA) and 5(NNTA) include removal actions that would reduce the volume, and therefore mobility, of MEC potentially remaining in the accessible land of the Northern Non-Target Area. Alternative 5(NNTA) would be the most favorable alternative in reducing MEC volumes and is assigned the highest score in Table 4-13 because a potentially larger volume of MEC could be removed during subsurface clearance.

**TABLE 4-13**

Comparative Analysis - Reduction of Toxicity, Mobility, or Volume, Northern Non-Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Reduction of Toxicity, Mobility, or Volume	1	1	1	4	5

#### 4.3.2.5 Short-Term Effectiveness

Comparison of different alternatives against this criterion is summarized in Table 4-14 below. All alternatives would provide protectiveness to humans in the short-term, assuming that engineered controls currently in place would be effective in preventing contact between humans and MEC. Alternatives 4(NNTA) and 5(NNTA) would be less favorable and are assigned relatively lower scores in Table 4-14 because of the potential impacts to humans and the environment that could occur during MEC detonation and removal. However, if safety exclusion zones are observed and strict health and safety measures are followed, the exposure of workers to MEC hazards would be significantly mitigated.

**TABLE 4-14**

Comparative Analysis – Short Term Effectiveness, Northern Non-Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Short-Term Effectiveness	4	4	4	3	2

#### 4.3.2.6 Implementability

Comparison of different alternatives against this criterion is summarized in Table 4-15 below. Alternative 1(NNTA) would result in no technical or administrative feasibility issues and requires no services or equipment because no action would be taken.

Alternative 2(NNTA) would be technically and administratively feasible and could be easily implemented because no clearance would be involved. The same would apply for Alternative 3(NNTA), except that clearance activities could be needed during UXO technician support for construction activities potentially conducted in the future.

Alternatives 4(NNTA) and 5(NNTA) are assigned lower scores respectively because they are the hardest alternatives to implement technically. Specialized equipment and trained personnel (UXO technicians) are needed and their work is complicated by steep slopes, rocky terrain, and thick vegetation that are characteristic of the Northern Non-Target Area.

**TABLE 4-15**

Comparative Analysis – Implementability, Northern Non-Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Implementability	5	4	4	3	2

#### 4.3.2.7 Cost

Comparison of costs between alternatives is shown in Table 4-16. Alternative 1(NNTA) (No Action) is estimated at **\$850,000** present worth over a 30-year period to maintain the current fencing and signage. Alternative 2(NNTA) (LUCs) and Alternative 3(NNTA) (LUCs with Construction Support) are estimated at a present worth of **\$1,510,000** and **\$1,630,000**, respectively over a 30-year period. The estimated total present worth to implement Alternative 4(NNTA) (Surface Clearance of Accessible Land with LUCs) over a 30-year period is estimated at **\$2,300,000**, which is higher than previous alternatives because surface clearance would be conducted in accessible areas. The total present worth to implement Alternative 5(NNTA) (Surface and Subsurface Clearance of Accessible Land with LUCs) over a 30-year period is estimated at **\$2,610,000**, which is the highest because it includes the highest level of clearance (surface and subsurface).

Alternatives Cost Analysis - Northern Non-Target Area

No.	Alternative Action Description	Cost (USD)		
		Capital	Periodic+O&M	Total
1	No Action	\$0	\$ 850,000	\$ 850,000
2	LUCs	\$280,000	\$1,230,000	\$1,510,000
3	LUCs with Construction Support	\$400,000	\$1,230,000	\$1,630,000
4	Surface Clearance of Accessible Land with LUCs	\$825,000	\$1,475,000	\$2,300,000
5	Surface and Subsurface Clearance of Accessible Land with LUCs	\$1,135,000	\$1,475,000	\$2,610,000

**Notes:**

Periodic and O&M costs are estimated over 30 years  
 LUC = land use control

O&M = operation and maintenance  
 USD = United States dollars

#### 4.3.2.8 Scoring Results – Northern Non-Target Area

Alternative 4(NNTA) - Surface Clearance of Accessible Land with LUCs (the estimated area of accessible land is 2.9 acres) is the alternative that appears most favorable for the Northern Non-Target Area. This alternative meets the RAOs by minimizing unacceptable risks posed by exposure to MEC, preventing migration of MEC to accessible areas, restoring the accessible land to agricultural/recreational use. The overall comparison of the alternatives is provided in Table 4-17, where the No Action alternative scores equally as high as alternative 4(NNTA). This is due to the fact that in the No Action condition access to the site is restricted, providing protection for the public from potential explosive hazards. However, the No Action alternative does not meet the project RAOs and so must be dismissed as unrealistic.

**TABLE 4-17**  
 Summary of Comparative Analysis - Northern Non-Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Threshold Criteria	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
Balancing Criteria	1	2	2	4	5
	1	1	1	4	5
	4	4	4	3	2
	5	4	4	3	2
	5	4	3	2	1
Relative Overall Rating	16	15	14	16	15
Estimated Cost of Alternative	\$850,000	\$1,510,000	\$1,630,000	\$2,300,000	\$2,610,000

**Relative Rating System** (compares alternatives relative to each other against criteria):

- 5 Best - The alternative is the most favorable for this criterion
- 4 Better - The alternative is more favorable for this criterion
- 3 Average - The alternative is moderately favorable for this criterion
- 2 Worse - The alternative is less favorable for this criterion
- 1 Worst - The alternative is the least favorable for this criterion

### 4.3.3 Northern Target Area

The comparison of the different remedial alternatives evaluation against the threshold and balancing criteria for the Northern Target Area is discussed below.

#### 4.3.3.1 Overall Protection of Human Health and the Environment

Comparison of different alternatives against this criterion is summarized in Table 4-18 below. Alternative 1(NTA) would be least protective of human health and the environment. Alternatives 2(NTA) and 3(NTA) would not reduce the residual risk posed to human health by the potential presence of MEC, but the fence (only for Alternative 2[NTA]), signs, deed restrictions, educational programs, and construction support (only for Alternative 3[NTA]), if properly implemented and obeyed, would represent an effective control measure to avoid contact between MEC and human receptors.

Alternatives 4(NTA) and 5(NTA) would be protective of human health since surface (for both alternatives) and subsurface (only Alternative 5[NTA]) clearance of MEC would be conducted on accessible land; and LUCs would address MEC potentially remaining in the subsurface (Alternative 4[NTA]) at depths greater than 2 feet bgs (Alternative 5[NTA]).

#### 4.3.3.2 Compliance with ARARs

Comparison of different alternatives against ARARs is summarized in Table 4-18 below. If properly implemented, all alternatives would meet the ARARs.

**TABLE 4-18**

Comparative Analysis - Threshold Criteria, Northern Target Area

Criteria		Remedial Alternative				
		No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Threshold Criteria	Overall Protection of Human Health and the Environment	Yes	Yes	Yes	Yes	Yes
	Compliance with ARARs	Yes	Yes	Yes	Yes	Yes

#### 4.3.3.3 Long-Term Effectiveness and Permanence

Comparison of different alternatives against this criterion is summarized in Table 4-19 below. Alternative 1(NTA) would be limited to current fencing/signage because no remedial actions would be performed. Alternatives 2(NTA) and 3(NTA) would provide long-term effectiveness and permanence as long as the fence (only for Alternative 2[NTA]), signs, and other controls are properly implemented, maintained and obeyed.

Alternative 4(NTA) would provide long-term effectiveness and permanence because potential MEC in accessible areas would be removed from the ground surface. The highest score is assigned to Alternative 5(NTA) in Table 4-19 because MEC would also be removed from subsurface soil down to 2 feet bgs over a larger area. LUCs and construction support would manage possible hazards posed by MEC for the two clearance alternatives.

**TABLE 4-19.** Comparative Analysis – Long Term Effectiveness & Permanence, Northern Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Long-Term Effectiveness & Permanence	1	2	2	4	5

#### 4.3.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Comparison of different alternatives against this criterion is summarized in Table 4-20 below. Only Alternatives 4(NTA) and 5(NTA) include removal actions that would reduce the volume, and therefore mobility, of MEC potentially remaining in the accessible land of the Northern Target Area. Alternative 5(NTA) would be the most favorable alternative in reducing MEC volumes and is assigned a relatively higher score in Table 4-20 because a potentially larger volume of MEC could be removed during subsurface clearance of accessible areas.

**TABLE 4-20**  
 Comparative Analysis – Long Term Effectiveness & Permanence, Northern Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Reduction of Toxicity, Mobility, or Volume	1	1	2	4	5

#### 4.3.3.5 Short-Term Effectiveness

Comparison of different alternatives against this criterion is summarized in Table 4-21 below. All alternatives would provide protectiveness to humans in the short-term, assuming that engineered controls currently in place would be effective in preventing contact between humans and MEC. Alternatives 4(NTA) and 5(NTA) would be less favorable and are assigned relatively lower scores in Table 4-21 because of the potential impacts to humans and the environment that could occur during MEC detonation and removal. However, if safety exclusion zones are observed and health and safety measures are followed, the exposure of workers to MEC hazards would be significantly mitigated.

**TABLE 4-21** Comparative Analysis – Short Term Effectiveness, Northern Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Short-Term Effectiveness	4	4	3	2	1

#### 4.3.3.6 Implementability

Comparison of different alternatives against this criterion is summarized in Table 4-22 below. Alternative 1(NTA) would result in no technical or administrative feasibility issues and requires no services or equipment because no action would be taken. Alternative 2(NTA) would be technically and administratively feasible and could be easily implemented because no clearance would be involved. The same would apply for Alternative 3(NTA), except that clearance activities could be needed during UXO technician support for construction activities potentially conducted in the future.

Alternatives 4(NTA) and 5(NTA) are assigned lower scores because they are the hardest alternatives to implement technically. Specialized equipment and trained personnel (UXO technicians) would be needed and their work would be complicated by steep slopes, rocky terrain, and thick vegetation that are characteristic of the Northern Target Area.

**TABLE 4-22** Comparative Analysis – Implementability, Northern Target Area

Criteria	Remedial Alternative				
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs
Implementability	5	4	4	3	1

#### 4.3.3.7 Cost

Comparison of costs between alternatives is summarized in Table 4-23 below. Alternative 1(NTA) (No Action) is estimated at **\$850,000** present worth over a 30-year period to maintain the current fencing and signage. Alternative 2(NTA) (LUCs) and Alternative 3(NTA) (LUCs with Construction Support) are estimated at a present worth of **\$1,470,000** and **\$1,840,000**, respectively, over a 30-year period. The estimated total present worth to implement Alternative 4(NTA) (Surface Clearance of Accessible Land with LUCs) over a 30-year period is estimated at **\$2,960,000**, which is higher than previous alternatives because Alternative 4(NTA) includes surface clearance of accessible land. The total present worth to implement Alternative 5(NTA) (Surface and Subsurface Clearance of Accessible Areas with LUCs) over a 30-year period is estimated at **\$5,130,000**, which is the highest because surface and subsurface clearance would be conducted in all accessible areas.

**TABLE 4-23**

Alternatives Cost Analysis - Northern Target Area

No.	Alternative Action Description	Cost (USD)		
		Capital	Periodic+O&M	Total
1	No Action	\$0	\$ 850,000	\$ 850,000
2	LUCs	\$240,000	\$1,230,000	\$1,470,000
3	LUCs with Construction Support	\$360,000	\$1,480,000	\$1,840,000
4	Surface Clearance of Accessible Land with LUCs	\$1,485,000	\$1,475,000	\$2,960,000
5	Surface and Subsurface Clearance of Accessible Land with LUCs	\$3,655,000	\$1,475,000	\$5,130,000

**Notes:**

Periodic and O&M costs are estimated over 30 years  
 LUC = land use control

O&M = operation and maintenance  
 USD = United States dollars

#### 4.3.3.8 Scoring Results – Northern Target Area

Alternative 4(NTA) - Surface Clearance of Accessible Land with LUCs (the estimated area of accessible land is 17.5 acres, which include the cultural sites within the Northern Target Area), is the alternative that appears most favorable for the Northern Target Area. This alternative meets the RAOs by minimizing unacceptable risks posed by exposure to MEC, preventing migration of MEC to accessible areas, restoring the accessible land to recreational use, and supporting access to cultural sites. The overall comparison of the alternatives is provided in Table 4-24. In this case the No Action alternative scores higher than alternative 4(NTA). However, the No Action alternative does not meet the project RAOs and so must be dismissed as unrealistic.



**TABLE 4-24**  
 Summary of Comparative Analysis - Northern Target Area

Criteria	Remedial Alternative					
	No Action	LUCs	LUCs with Construction Support	Surface Clearance of Accessible Land with LUCs	Surface and Subsurface Clearance of Accessible Land with LUCs	
Threshold Criteria	Overall Protection of Human Health and the Environment	Yes	Yes	Yes	Yes	
	Compliance with ARARs	Yes	Yes	Yes	Yes	
	Long-Term Effectiveness and Permanence	1	2	2	4	5
Balancing Criteria	Reduction of Toxicity, Mobility, or Volume	1	1	2	4	5
	Short-Term Effectiveness	4	4	3	2	1
	Implementability	5	4	4	3	1
	Comparative Cost	5	4	3	2	1
Relative Overall Rating		16	15	14	15	13
Estimated Cost of Alternative		\$850,000	\$1,470,000	\$1,840,000	<b>\$2,960,000</b>	\$5,130,000

**Relative Rating System** (compares alternatives relative to each other against criteria):

5	Best - The alternative is the most favorable for this criterion	2	Worse - The alternative is less favorable
4	Better - The alternative is more favorable for this criterion	1	Worst - The alternative is the least favorable
3	Average - The alternative is moderately favorable		

## 4.4 Recommended Remedial Action Alternatives

Based on the comparative analysis, surface clearance with LUCs scored as the most favorable alternative for the threshold and balancing criteria in all three sectors. The next step in the process is application of modifying criteria based on public and stakeholder comments generated during review of the draft FS Report (see Appendix C for comments and responses). The following recommendations are structured to address the public and stakeholder comments and to better satisfy the RAOs at the WVIA MRS (See Figure 4-1):

### Southern Area

Alternative 3(SA) - Surface Clearance of Accessible Land with LUCs (30.5 acres) is recommended. However, if any MEC item is discovered on the ground surface during the surface clearance, subsurface clearance to a maximum depth of 2 feet should be conducted within a 50-foot radius from the MEC item. Upon completion of the surface removal, the chain-link fence along the southern, western, and eastern boundaries of the Southern Area could be removed. A new chain-link fence should be erected along the boundary between the Southern Area and the two Northern Areas, and a 10-foot buffer strip should be subsurface cleared along the south side of the fence. Clearance of the buffer strip is intended to detect MEC that may have migrated towards Waikane Stream from the target areas through soil erosion.

Future land use status in the Southern Area would depend on whether the above remedial action reveals MEC in the area. If MEC is found during the remedial action, consideration may be given to shifting the boundary to include MEC areas in the northern areas. If no MEC is found, application should be made to Department of Defense to certify the land suitable for unrestricted use. If unrestricted land use cannot be obtained in the Southern Area, construction support can be requested to allow soil disturbance activities to occur below the maximum clearance depth. This recommendation best meets the RAOs in the Southern Area by ensuring the reduction of MEC hazards, restoring the area to unrestricted land use, and providing access to cultural sites.

### Northern Non-Target Area

LUCs are recommended. Public comments show general agreement that this area is almost entirely inaccessible, and that funds should not be spent on MEC clearance for this area. This area would be considered suitable only for forest reserve use after completion of the remedial action.

### Northern Target Area

Alternative 4(NTA) - Surface Clearance of Accessible Land with LUCs (17.5 acres) is recommended. In addition, 8-foot wide corridors leading from Waikane Stream to Kamaka Shrine and Waikane Spring should be defined and fenced off from the rest of the target area. Subsurface clearance should be conducted along the corridors and around the two sites. All detectable metallic anomalies should be excavated to a depth of 2 feet to determine their nature. Removal of MEC from the surface of all accessible areas of Northern Target Area does not make the areas suitable for agricultural use, and these areas should be restricted to

forest reserve. The cleared corridor would be freely accessed through the Southern Area and would be considered suitable for cultural and recreational use after completion of the remedial action.

### Land Use Controls

The Northern Target and Northern Non-Target Area would be combined into a single area. Land Use Controls should apply to the entire 187 acres and should include: construction of the fence between Southern Area and the northern area; notification letters to local landowners, an educational program to inform the community of risks and mitigation measures; and removal of the current fence bounding the Southern Area.

### Summary

These alternatives taken together meet the RAOs by: removing risks through removal of MEC and preventing migration of MEC to accessible areas; supporting agricultural use in the Southern Area, recreational use in the Northern Areas, and access to all significant cultural sites. Overall cost of **\$4,810,000** assumes that all three areas are addressed under a single contract.

Based on the information available at this time, the Marine Corps believes the Recommended Alternatives would be protective of human health and the environment, would comply with ARARs, would be cost effective, and would utilize permanent solutions and removal technologies to the maximum extent practicable. Because it would treat the source materials constituting principal threats, the remedy would also meet the statutory preference for a remedy that involves treatment as a principal element.

The Recommended Alternatives also best address the concerns of the community for future land use by providing the potential for unrestricted land use in the Southern Area with free and safe access to sites of cultural significance in the Northern area. If unrestricted land use cannot be attained in the Southern Area, construction support can be requested to allow soil disturbance activities to occur below the maximum clearance depth.

The final selection and schedule for implementation of the remedial alternative depends on the regulatory agencies and community acceptance of the proposed remedial action, the approval of the Proposed Plan and Decision Document, and the availability of government funding.

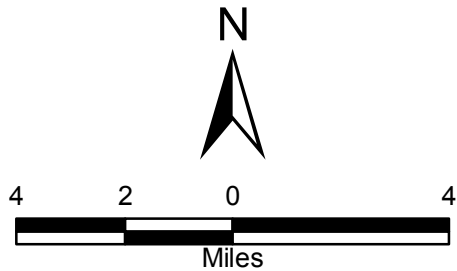
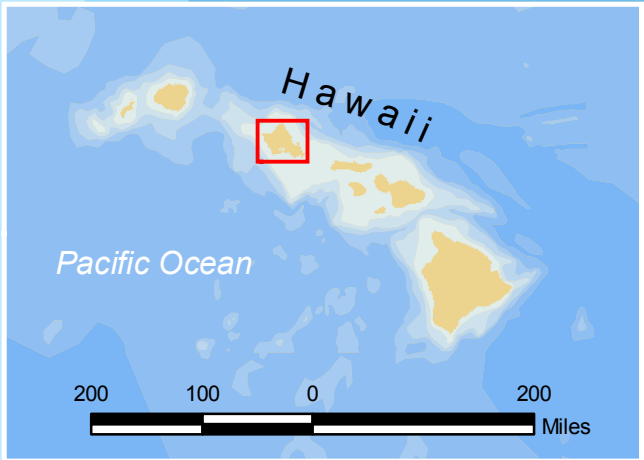
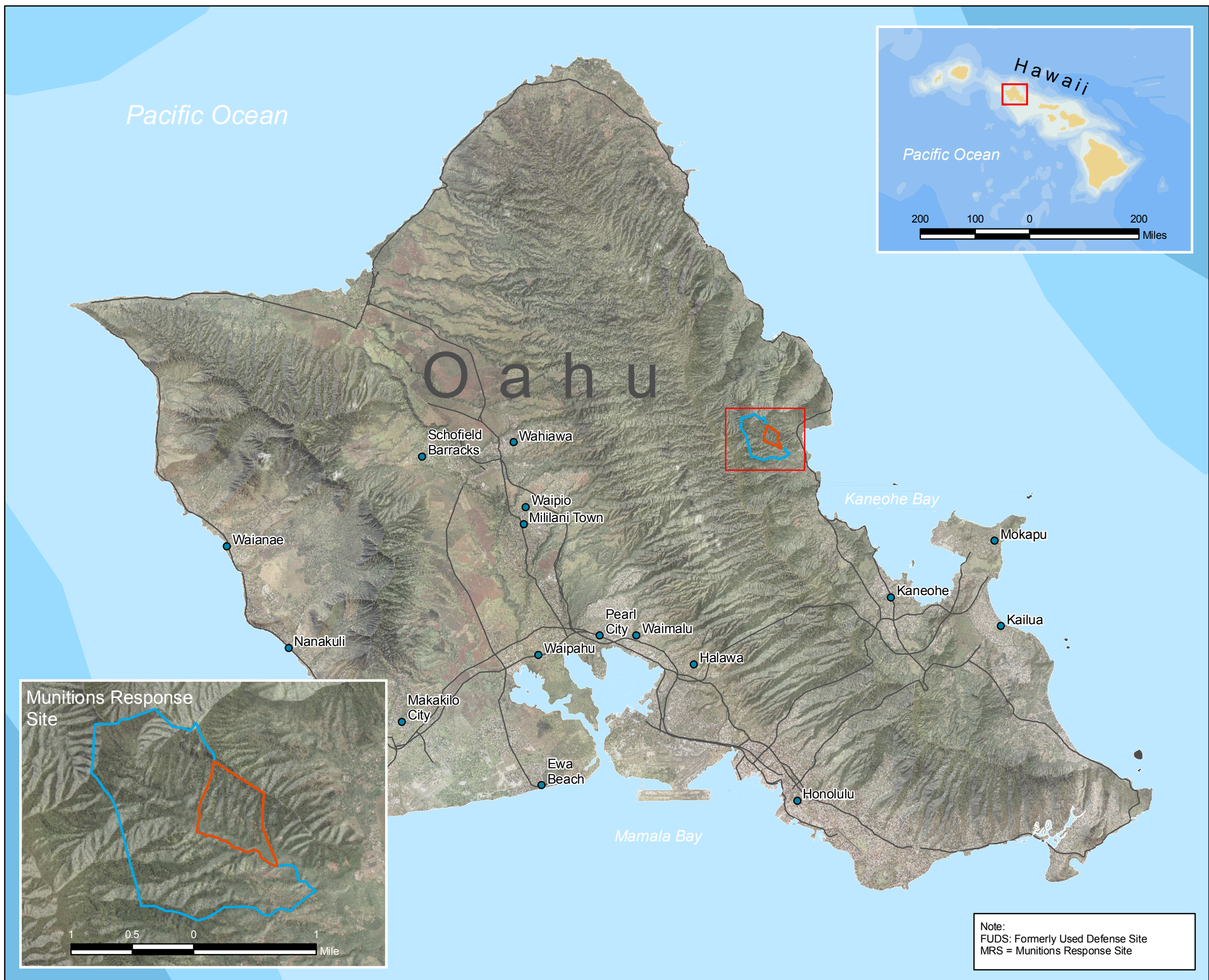
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## **FIGURES**

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Data is projected to the State Plane Coordinate System:  
Hawaii 3 Zone, NAD83, Units in Feet.

## Figure 1-1 Site Location

Waikane Valley Impact Area  
Koolaupoko District, O'ahu, Hawai'i

### Legend

- City
- Major Road
- Waikane MRS Boundary
- Waikane FUDS Boundary
- Ocean



Drawn By: RM	Scale: 1 inch = 4 miles	Rev. 1
Checked By: SC	Date Drawn: 07/19/10	
Submitted By: JC	Revision Date: 10/04/10	

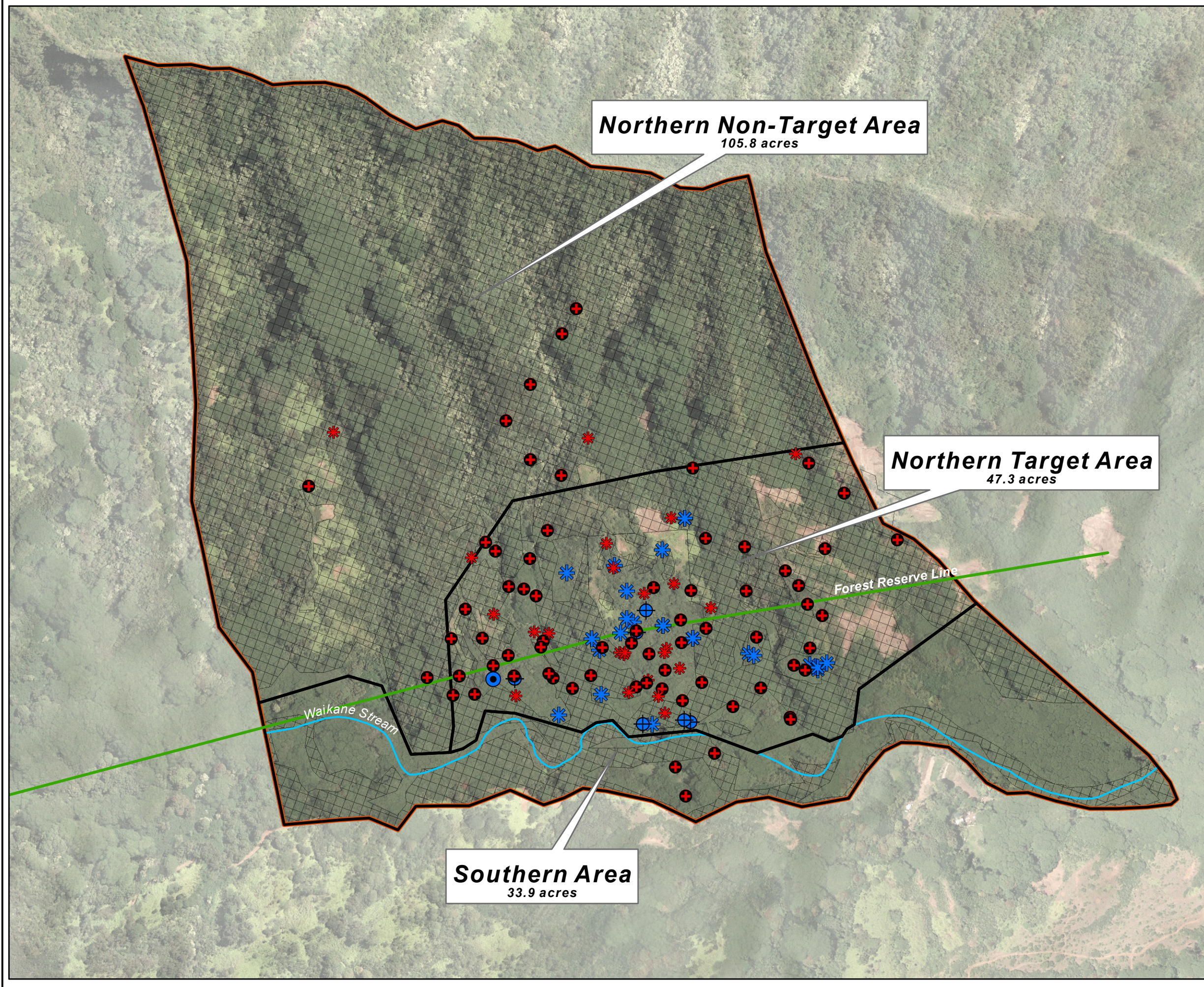
Note:  
FUDS: Formerly Used Defense Site  
MRS = Munitions Response Site



Path:



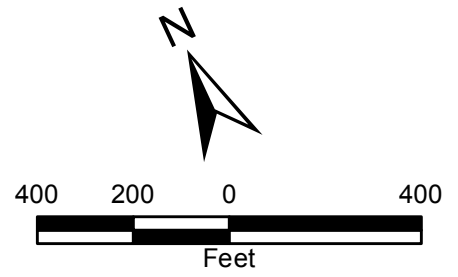




**Northern Non-Target Area**  
105.8 acres

**Northern Target Area**  
47.3 acres

**Southern Area**  
33.9 acres



Data is projected to the State Plane Coordinate System:  
Hawaii 3 Zone, NAD83, Units in Feet.

## Figure 1-2

### Areas Defined for Feasibility Study

Waikane Valley Impact Area  
Koolaupoko District, O'ahu, Hawai'i

#### Legend

- 2010 RI MEC Items**
- DMM
  - MPPEH
  - MEC (UXO)
- 2008 SI MEC Items**
- MEC (UXO) Point
  - Munitions Debris Point
  - > 30 Degree Slope Area
  - < 30 Degree Slope Area
  - Waikane MRS Boundary
  - Forest Reserve Line
  - Waikane Stream



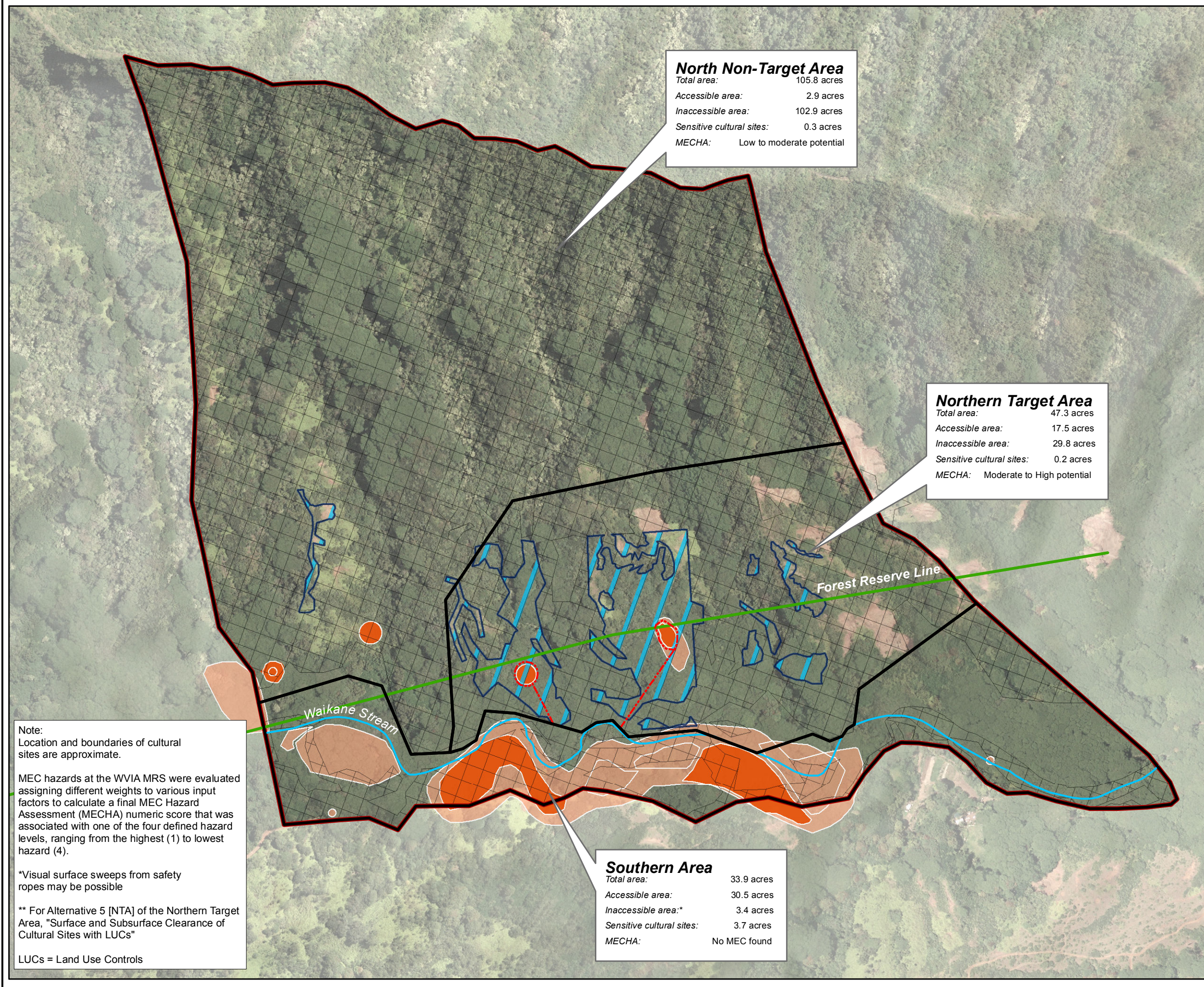
Drawn By: RM	Scale: 1 inch = 400 feet	Rev: 1
Checked By: SC	Date Drawn: 07/19/10	
Submitted By: JC	Revision Date: 10/04/10	



Path:







**North Non-Target Area**  
 Total area: 105.8 acres  
 Accessible area: 2.9 acres  
 Inaccessible area: 102.9 acres  
 Sensitive cultural sites: 0.3 acres  
 MECHA: Low to moderate potential

**Northern Target Area**  
 Total area: 47.3 acres  
 Accessible area: 17.5 acres  
 Inaccessible area: 29.8 acres  
 Sensitive cultural sites: 0.2 acres  
 MECHA: Moderate to High potential

**Southern Area**  
 Total area: 33.9 acres  
 Accessible area: 30.5 acres  
 Inaccessible area: 3.4 acres  
 Sensitive cultural sites: 3.7 acres  
 MECHA: No MEC found

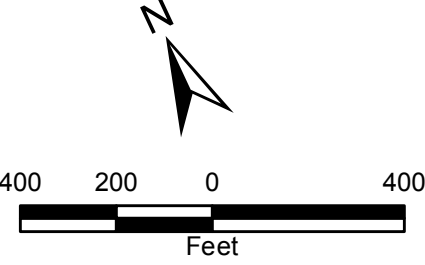
Note:  
 Location and boundaries of cultural sites are approximate.

MEC hazards at the WVIA MRS were evaluated assigning different weights to various input factors to calculate a final MEC Hazard Assessment (MECHA) numeric score that was associated with one of the four defined hazard levels, ranging from the highest (1) to lowest hazard (4).

\*Visual surface sweeps from safety ropes may be possible

\*\* For Alternative 5 [NTA] of the Northern Target Area, "Surface and Subsurface Clearance of Cultural Sites with LUCs"

LUCs = Land Use Controls



Data is projected to the State Plane Coordinate System:  
 Hawaii 3 Zone, NAD83, Units in Feet.

## Figure 3-1 Response Action Areas

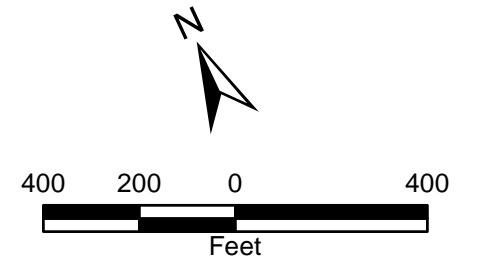
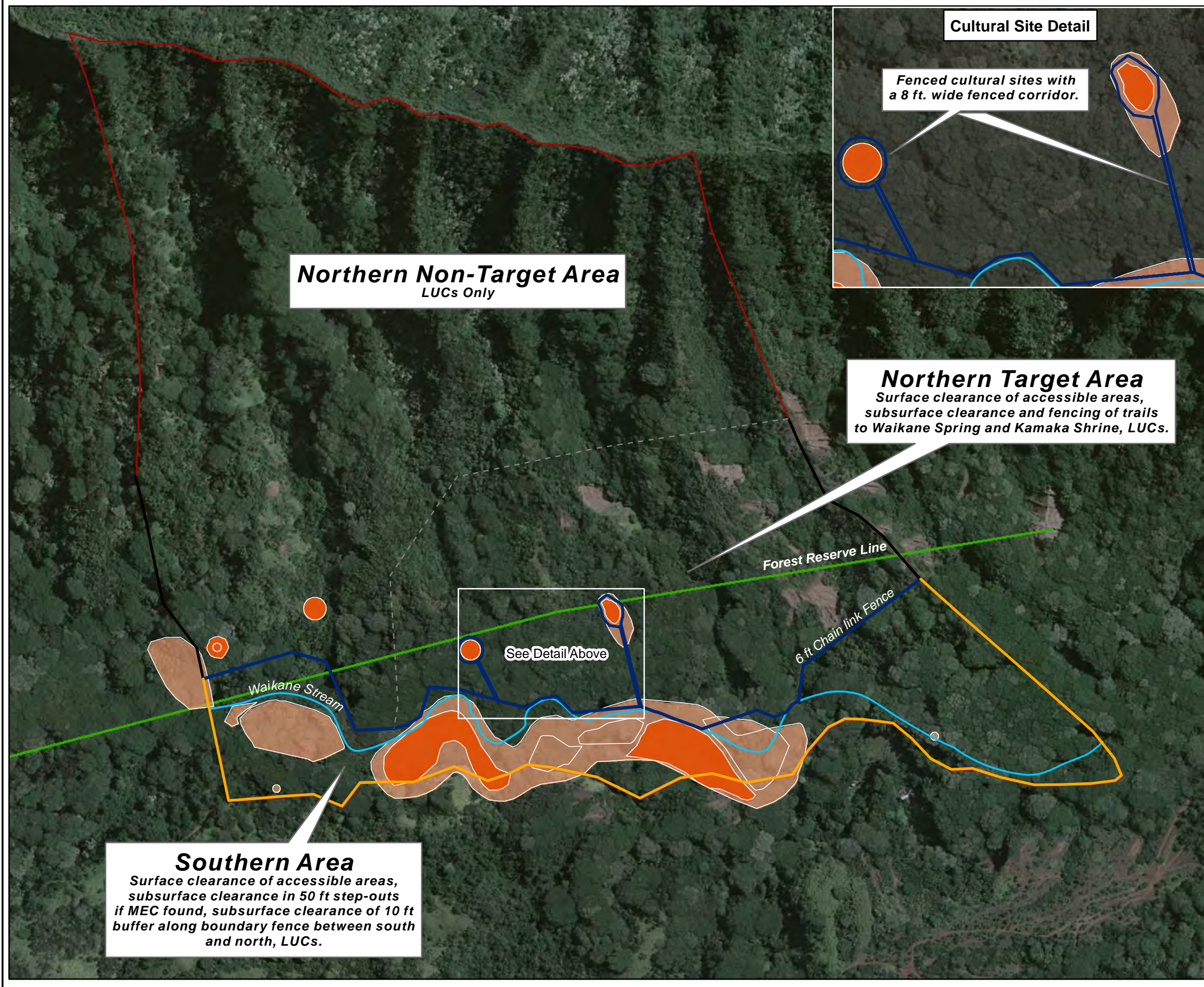
Waikane Valley Impact Area  
 Koolaupoko District, O'ahu, Hawai'i

### Legend

- Sensitive Cultural Site
- Cultural Site
- Cleared, < 30 Degree Slope Area
- < 30 Degree Slope Area
- > 30 Degree Slope Area
- Waikane MRS Boundary
- Forest Reserve Line
- Sensitive Cultural Site and Access Corridors Fence\*\*
- Waikane Stream

Drawn By: RM	Scale: 1 inch = 400 feet	Rev: 1	
Checked By: SC	Date Drawn: 07/19/10		
Submitted By: JC	Revision Date: 10/04/10		
	Path:		





Data is projected to the State Plane Coordinate System:  
Hawaii 3 Zone, NAD83, Units in Feet.

## Figure 4-1 Recommended Remedial Alternatives

Waikane Valley Impact Area  
Koolaupoko District, O'ahu, Hawai'i

### Legend

- Waikane Stream
- Forest Reserve Line
- Northern Target And Non-Target Area Boundary
- 6 ft Chain Link Fence To Be Installed
- Existing Fence To Be Removed
- Existing Fence To Remain
- Cultural Site
- Sensitive Cultural Site
- Waikane MRS Boundary

USA  
*Environmental, Inc.*

Drawn By: RM	Scale: 1 inch = 400 feet	Rev: 2
Checked By: SC	Date Drawn: 07/19/10	
Submitted By: JC	Revision Date: 12/1/2011	

Path:



## **APPENDIX A**

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### **Tables**

**TABLE A-1**  
 Potential Chemical-Specific ARARs and TBCs  
 Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii

Requirement	Citation	Description	Analysis	ARAR/TBC Determination	Comments
<b>Federal</b>					
Clean Air Act National Ambient Air Quality Standards (NAAQS)	42 USC 7409 40 CFR 50	Establishes numerical ambient air quality standards for carbon monoxide, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, lead, and hydrogen sulfide	As ambient standards, the contribution, if any of remedial activities to meeting or exceeding the standards' concentrations versus the contributions of area or regional sources cannot be determined. The standards themselves do not apply to individual sources	Not an ARAR	
Regional Screening Levels	EPA User's Guide and Background Technical Document for EPA Region 9 Preliminary Remediation Goals Table	Provides conservative, risk-based, chemical-specific screening action levels designed to protect human and ecological receptors	Document not promulgated, but is a user's guide and technical reference which can be considered a TBC.	TBC	Risk evaluation has determined that no chemical risks exist at the site.
Sediments	NOAA Sediment Quality Guidelines	Guidelines for interpreting chemical data from sediment analyses	Document not promulgated, but is a technical reference which can be considered a TBC	TBC	Risk evaluation has determined that no chemical risks exist at the site.
Sediments	EPA Region III Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks	Developed to be used to evaluate Superfund sampling data. Provides chemical-specific benchmark values to protect ecological receptors in freshwater sediments	Document not promulgated, but is a technical reference which can be considered a TBC	TBC	Risk evaluation has determined that no chemical risks exist at the site.

**TABLE A-1**  
 Potential Chemical-Specific ARARs and TBCs  
 Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii

Requirement	Citation	Description	Analysis	ARAR/TBC Determination	Comments
<b>State</b>					
Air Quality	Hawaii Administrative Rules (HAR) Title 11, Chapter 59: Ambient Air Quality Standards	Establishes numerical ambient air quality standards for carbon monoxide, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, lead, and hydrogen sulfide.	As ambient standards, the contribution, if any of remedial activities to meeting or exceeding the standards' concentrations versus the contributions of area or regional sources cannot be determined. The standards themselves do not apply to individual sources	Not an ARAR	
Water Quality	Hawaii Administrative Rule (HAR) Title 11, Chapter 54: Water Quality Standard	Establishes a series of classifications and water quality standards for surface water and groundwater used to protect the public health or welfare and enhance water quality.	Surface water bodies are present and the underlying aquifer is considered a potential drinking water source.	ARAR	Site activities will be conducted in a manner that is protective of surface water and groundwater.
Environmental Action Levels	State of Hawaii Department of Health (HDOH) Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater, Volume 1 and Volume 2: Background Documentation for the Development of Tier 1 Environmental Screening Levels, Appendix 1	Provides chemical-specific environmental screening criteria and action levels designed to protect human and ecological receptors	Document is not promulgated, but is a user's guide and technical reference which can be considered a TBC	TBC	

**TABLE A-2**  
 Potential Location-Specific ARARs and TBCs  
 Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii

Requirement	Citation	Description	Analysis	ARAR/TBC Determination	Comments
<b>Federal</b>					
Clean Water Act (CWA)	33 USC 1251 et seq. 40 CFR 100-149	Establishes standards governing all untreated waters including marine, coastal, estuarine, fresh surface water, and groundwater. Establishes the program, framework and federal water quality standards. Additional substantive and potentially more stringent requirements/criteria will be established via State statutes and regulations. Waters are present within the site.		ARAR	Any MEC response action at this site will minimize impacts on surface water and groundwater.
CWA (Section 404)	33 USC 1251 et seq. 40 CFR 230 33 CFR 323	Requires a permit from the Army for construction activities in wetlands and alternative analysis to ensure selection of the least damaging practical alternative.	Consists of non-substantive procedural requirements.	Not an ARAR	No wetlands have been identified at the site.
Protection of Wetlands	Executive Order 11990	Restricts federal activities when alterations of wetlands may occur.		Not an ARAR	No wetlands have been identified at the site.
Floodplain Management	Executive Order 11988	Restricts activities within the 100-year floodplain.	Floodplains associated with Waikane Stream are present at the site.	ARAR	MEC response alternatives do not involve alteration of Waikane Stream.

**TABLE A-2**  
 Potential Location-Specific ARARs and TBCs  
*Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii*

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Native American Graves Protection and Repatriation Regulations	43 CFR 10.4 (c) and (d)	Requires consultation with Native Hawaiian organization to determine disposition of objects discovered.	Applicable if human remains are found during the remedial action.	ARAR	If human remains are found, proper disposition will be coordinated.
National Historic Preservation Act	16 USC 470 36 CFR 800	Provides for the recovery and preservation of historical and archaeological significant artifacts.	Various culturally significant sites exist within the MRS, including a site listed on the National Register of Historic Places.	ARAR	Archaeological monitoring would be conducted during remedial actions to prevent disturbance and possible discovery of significant archaeological artifacts.
Protection of Archaeological Resources	43 CFR 7.4 (a), 7.5 (b)(1)	Requires protection of archaeological resources if discovered.	Applicable if remedial activities uncover or disturb cultural resources. Various culturally significant sites are known to exist within the MRS.	ARAR	May not excavate, remove, damage, or otherwise alter or deface such resource unless by permit or exception.
Endangered Species Act	16 USC 1531-1543	Prohibits actions that jeopardize the continued existence of any listed species, results in the destruction or adverse modification of designated critical habitat of such species, or results in a "taking" of any listed species.	Applicable if listed species or critical habitat is identified. No federally listed threatened or endangered plant or animal species are known to exist on site. Though typical nesting habitat for the threatened Newell's Shearwater was found on a portion of the site, there are no known nesting colonies of this species on Oahu	ARAR	If listed species are identified, appropriate mitigative measures will be implemented.

**TABLE A-2**  
 Potential Location-Specific ARARs and TBCs  
 Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Migratory Bird Treaty Act	16 USC 703-712	Prohibits the taking, possessing, buying, selling, or bartering of any migratory bird, including feathers or other parts, nest eggs, or products, except as allowed by regulations.	Migratory birds are known to pass over the area, although no nesting habitats are believed to exist on site.	ARAR	
Fish & Wildlife Coordination Act	16 USC 661 et seq.	Provides that Federal agencies should consult with appropriate agency to develop protective measures for affected fish and wildlife.	The statute sections do not define a specific standard of control or a substantive requirement, criterion or limitation.	Not an ARAR	
Magnuson-Stevens Fishery Conservation and Management Act (1996)	16 USC 1851 et seq.	Requires project activities to minimize adverse effects on fish habitat.	Location-specific	ARAR	Activities will be managed to minimize adverse effects to fish, habitat, and water quality.
Bald and Golden Eagle Protection Act	16 USC 668-668(d)	Requires project activities to protect and preserve eagle habitat.	Bald and golden eagles are not found in Hawai'i.	Not an ARAR	

**TABLE A-2**  
 Potential Location-Specific ARARs and TBCs  
*Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii*

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Coastal Zones	16 USC 1456(c) 15 CFR 930.30 - 33, 36(a), 39(b-d)	Requires federal actions or activities conducted within or affecting a coastal zone be consistent with the State's coastal program. Coastal zone management objectives include the protection of valuable coastal ecosystems from disruption and minimizing adverse impacts on all coastal ecosystems. Where national defense or other over-riding national interests are concerned, they must at least be consistent "to the maximum extent practicable."	The MRS is not located within the coastal zone.	Not an ARAR	
Marine Mammal Protection Act	16 USC 1361 50 CFR 12	Requires project activities to protect marine mammals.	The site is not in a coastal zone and does not encompass marine waters.	Not an ARAR	
<b>State</b>					
Burial Sites and Human Remains	HAR Title 13, Chapter 300: Rules of Practice and Procedure Relating to Burial Sites and Human Remains	Governs practice and procedure relating to the proper care and protection of burial sites/human skeletal remains fifty years or older	Applicable if human remains are found during the remedial action.	ARAR	
Historic Preservation	Hawaii Revised Statutes (HRS) Chapter 6E.	Requires action to be taken to locate, identify, evaluate, and protect cultural resources.	Several culturally significant sites were found within the MRS during previous investigations.	ARAR	Statute suspended until 30 June 2016 by Governor's Proclamation dated 14 June 2011.



**TABLE A-2**  
 Potential Location-Specific ARARs and TBCs  
 Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii

Requirement	Citation	Description	Analysis	ARAR/TBC Determination	Comments
Protection of Caves	HRS Chapter 6D	Protects caves and contents	Applicable if cave(s) discovered during site clearing activities. Caves are not expected within the areas where remedial actions would be conducted.	TBC	Statute suspended until 30 June 2016 by Governor's Proclamation dated 14 June 2011.
Endangered Species	HRS Title 12, Chapter 195D-4 HAR Title 13, Chapter 124	Prohibits any taking, transport or commerce in designated species. Further outlines conservation programs that mandate continued research on listed species.	Applicable if listed species or critical habitat is identified. No federally listed threatened or endangered plant or animal species are known to exist on site. Though typical nesting habitat for the threatened Newell's Shearwater was found on a portion of the site, there are no known nesting colonies of this species on Oahu	TBC	Statute suspended until 30 June 2016 by Governor's Proclamation dated 14 June 2011.
Forest Reservations, Water Development, Zoning	HRS Chapter 183.	Regulates activities in forested land and watersheds.	Forested lands and surface water (Waikane Stream) are found on site.	Not an ARAR	Statute suspended until 30 June 2016 by Governor's Proclamation dated 14 June 2011.
Coastal Zones	HRS Title 13, Chapter 205A: Coastal Zone Management.	Provides for the protection of coastal resources.	The MRS is not located within the coastal zone.	Not an ARAR	Statute suspended until 30 June 2016 by Governor's Proclamation dated 14 June 2011.

**TABLE A-3**  
 Potential Action-Specific ARARs and TBCs  
*Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii*

Requirement	Citation	Description	Analysis	ARAR/TBC Determination	Comments
<b>Federal</b>					
RCRA Subpart M (Military Munitions Rule)	62 Federal Register 6622 40 CFR 266 Subpart M	Identifies when military munitions become a solid waste, and, if these wastes are hazardous, the management standards that apply.	This is a procedural requirement, and does not provide site-specific criteria.	TBC	Substantive requirements for managing recovered munitions will be implemented during remedial actions.
Open Burning/Open Detonation (Treatment) of Waste Explosives	40 CFR 265.370 and 265.382 (Subpart X)	Requirements for treatment of explosives through burning	Applies to the treatment of explosives through burning or detonation. Open burning/open detonation is considered "treatment in miscellaneous units." This is a procedural requirement, and does not provide site-specific criteria.	TBC	Substantive requirement, such as those pertaining to required separation distances will be implemented during the remedial action.
Explosives Storage	27 CFR 555 Subpart K 40 CFR 264 Subpart EE	Provides standards for the storage of explosive materials.	Provides specific requirements for storing explosive materials that may be pertinent to MEC response actions. This is a procedural requirement, and does not provide site-specific criteria.	TBC	Substantive requirements for storage of explosives (as appropriate) will be implemented during the remedial action.
Hazardous Waste Management	42 USC 6921 et seq. 40CFR 261 (especially 261.23), 262, 264, 266, 268	Provides for processes and procedures for identifying and managing solid and hazardous wastes	Applicable to characterization of solid waste and management of hazardous waste generated during the remedial action. This is a procedural requirement, and does not provide site-specific criteria.	Not an ARAR	Any waste produced during the remedial action will be characterized.

**TABLE A-3**  
**Potential Action-Specific ARARs and TBCs**  
**Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii**

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Oil Pollution Prevention	40 CFR 112	Governs storage of oil or fuels in amounts greater than 1320 gallons, if stored in containers 55 gallons or larger	Includes substantive requirements pertaining to containers storing fuels in amounts greater than 1320 gallons. The regulation includes non-substantive requirements (e.g., preparation of plans) that are not required to met.	TBC	If oil is used in the cited quantity during the remediation to fuel generators or for other uses, then the design and management requirements of this rule would apply.
Transportation	49 CFR Parts 100-199, specifically Part 107 Subpart G; Parts 171, 172.101, 700, and 704, and 173	Regulates transport of hazardous substances, including explosives and other MEC. Provides packaging, marking and labeling, handling, and training requirements.	Applicable if hazardous materials are transported on site. This is a procedural requirement, and does not provide site-specific criteria.	Not an ARAR	Transportation of MEC for off-site disposal will be conducted in accordance with applicable regulations.
Ammunition and Explosives Safety Standards	Department of the Navy OP5, "Ammunition and Explosives Ashore"; NOSSAINT 8020.15C, "Explosives Safety Review, Oversight, and Verification of Munitions Responses"	Set explosives safety standards to protect human health and the environment.	Not promulgated; provide specific requirements for managing munitions and explosives that pertain to MEC response actions.	TBC	Specific requirements for safe removal and management of MEC must be adhered to.
Detonation-in-Place	HNC-ED-CS-98-7, "Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions"	Identifies specific criteria for the use of sandbag mitigation during intentional detonations of MEC.	Provides specific technical requirements that may be pertinent to MEC disposal.	TBC	If sandbag mitigation is deemed appropriate during MEC disposal, the specific requirements contained herein must be adhered to.

**TABLE A-3**  
**Potential Action-Specific ARARs and TBCs**  
**Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii**

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Explosives Storage	Bureau of Alcohol, Tobacco, and Firearms Publication 5400.7, "Federal Explosives Laws and Regulations" 40 CFR 264 Subpart EE	Provides standards for the storage of explosive materials.	Provides specific requirements for storing explosive materials that may be pertinent to MEC response actions.	TBC	If explosives and/or MEC are stored on-site during the remedial action, the specific requirements contained herein will be adhered to.
Material Potentially Presenting an Explosives Hazard	DoD Instruction 4140.62, "Management and Disposition of Material Potentially Presenting an Explosive Hazard (MPPEH)"	Identifies procedures for inspecting and certifying the safety status of material potentially presenting an explosive hazard	Provides specific technical requirements pertinent to managing MPPEH during MEC response actions.	TBC	MPPEH generated during the remedial action will be managed in accordance with the procedures identified herein.
	DoD Manual 6055.09-M, <i>DoD Ammunition and Explosives Safety Standards</i> , February 29, 2008. Administratively Reissued August 4, 2010.	Provides protection criteria to minimize serious injury, loss of life, and damage to property from military munitions and MEC (e.g., explosives safety quantity distances).	Applies to the selection of remedial alternatives for the site.	TBC	Remedial activities will be implemented in accordance with the explosives safety measures contained herein.
Construction Support	U.S. Army Corps of Engineers EP 75-1-2, "Munitions and Explosives of Concern (MEC) Support During Hazardous, Toxic, and Radioactive Waste (HTRW) and Construction Activities	Outlines requirements for support of future construction activities on the site	Applies to remedial alternatives in which land transfer is accomplished.	TBC	

**TABLE A-3**  
 Potential Action-Specific ARARs and TBCs  
*Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii*

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Navy Environmental Guidance	OPNAVINST 5090.1B, "Navy Environmental and Natural Resources Program Manual"	Navy guidance manual on environmental and natural resources operations.	TBC for operations that may affect the environment or natural resources.	TBC	
<b>State</b>					
Fugitive Dust	HRS Title 19, Chapter 342B-11 and 34 HAR Title 11, Chapter 60.1-33: Air Pollution Control	Requires mitigation of fugitive dust visible beyond the property line through implementation of best practical operation or treatment.	Applies to dust produced during vegetation and munitions clearing activities.	ARAR	
Waters of the State	HAR Title 12, Chapter 174C HRS § 342D-50	Provides for the protection and improvement of the quality of waters of the state and to provide that no substance be discharged into such waters without first receiving the necessary treatment or other corrective action. Designates both surface and groundwater.	Applicable to any actions taken during the remedial action that may result in discharges to surface water or groundwater.	ARAR	
Storm water	HAR Title 11, Chapter 55	Defines effluent limitations and other requirements for construction activities that would normally require NPDES permitting by virtue of disturbing more than 1 acre of land.	Stormwater discharge requirements are applicable due to the size of the area proposed to be disturbed in some of the remedial alternatives.	ARAR	

**TABLE A-3**  
**Potential Action-Specific ARARs and TBCs**  
**Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii**

Requirement	Citation	Description	Analysis	ARAR/TBC Determination	Comments
Storm water	HAR Title 11, Chapter 55, Appendix C: NPDES General Permit Authorizing Discharges of Storm Water Associated with Construction Activity	Specifies development of an erosion and sediment control plan, plans for minimizing discharge and erosion during and after construction, and other general provisions including best management practices, storm water controls, and monitoring.	An NPDES permit is not required for on-site activities; however, the requirements and best management practices associated with this general permit are relevant and appropriate for some of the proposed remedial alternatives and should be adhered to. The requirements for state waters with total maximum daily loads (TMDL) do not apply because TMDLs have not been established for Waikane Stream.	ARAR	
Grading, Excavation, Clearing, and Grubbing	HRS Title 12, Chapter 180C, Soil Erosion and Sediment Control Revised Ordinances of Honolulu (ROH) Chapter 14, Sections 13-16	Regulates grading, excavation, clearing, and grubbing activities for management of soil erosion and sediment control	All grading, excavation, clearing, and grubbing activities need to be conducted in accordance with these requirements. One aspect of this is the erosion control plan. HRS Title 12, Chapter 180C exempts federal lands from applicability under this statute, but the Honolulu regulation is nevertheless considered relevant and appropriate.	ARAR	

**TABLE A-3**  
**Potential Action-Specific ARARs and TBCs**  
**Feasibility Study, Waikane Valley Impact Area Munitions Response Site, Kaneohe, Oahu, Hawaii**

<b>Requirement</b>	<b>Citation</b>	<b>Description</b>	<b>Analysis</b>	<b>ARAR/TBC Determination</b>	<b>Comments</b>
Hazardous Waste Management	HRS Title 19, Chapter 342J: Hazardous Waste HAR Title 11, Chapters 260-266, 268, 270, 271, 28	Regulates waste management in Hawaii'i.	Applicable to characterization of solid waste and management of hazardous waste generated during the remedial action.	ARAR	Any waste produced during the remedial action must be characterized. Other requirements are applicable if hazardous wastes are produced during the remedial action.
Transportation of Hazardous Materials	HRS Title 17, Chapter 286, Part XII: Transportation of Hazardous Materials	Regulates transport of hazardous substances in Hawaii'i.	Applicable to any hazardous materials transported on-site during the remedial action.	ARAR	Transport of hazardous materials will be conducted in compliance with applicable regulations.
Litter Control	HAR Title 11, Chapter 68: Litter Control	Regulates handling of litter in Hawaii'i	Applicable to solid waste/litter generated during the remedial action.	ARAR	Any refuse produced during the remedial action must be properly disposed of in litter bags or receptacles.
Noise	HRS Title 19, Chapter 342F-30 HAR Title 11, Chapter 46: Noise Pollution Control	Defines maximum permissible sound levels to provide for the prevention, control and abatement of noise pollution from stationary noise sources and equipment related to agricultural, construction, and industrial activities.	Applicable to noise produced by detonation-in-place of MEC detected during any surface and/or subsurface cleaning activities.	ARAR	

## **APPENDIX B**

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### **Cost Estimate**



## Cost Assumptions

- 1 Quantities as shown on Figure 3-1, Response Action Areas, dated 10-04-2010
- 2 Site information in RI Report, Waikane Valley Impact Areas, July 26, 2011 NAVFAC
- 3 Project Management activities include planning, meetings, reports, etc.
- 4 Survey will be completed by a local firm.
- 5 Mob/demob includes travel for staff from mainland.
- 6 Standard intrusive investigation team includes UXOQCS, SUXOS, UXOHS, Site manager and 5 UXO Techs. Costs include 50 hour weeks, travel (FTR rates), equipment and supplies. Davis-Bacon wages.
- 7 Production on slopes greater than 30 degrees is one sixth of production on level terrain.
- 8 BIP costs include explosive delivery.
- 9 Mag and dig production is 1/2 acre per day.
- 10 Surface clearance MD per acre is 780 pounds/acre.
- 11 Subsurface clearance MD per acre is 42 pounds/acre.
- 12 Combined alternative subsurface clearance in Southern Area is assumed 20% of surface clearance
- 13 Fence demolition: remove posts along valley road, cut posts away from road, remove from site.

<b>COMPARISON OF TOTAL COST OF REMEDIAL ACTION ALTERNATIVES FOR WAIKANE VALLEY</b>										
<b>Site:</b> Waikane Valley Impact Area <b>Location:</b> Kaneohe, HI <b>Phase:</b> Feasibility Study			<b>Base Year:</b> 2011 <b>Date:</b> 12/27/2011							
	<b>All Sites</b>	<b>Combined Alternative</b>	<b>Southern Area - Alternative 2(SA)</b>	<b>Southern Area - Alternative 3(SA)</b>	<b>Southern Area - Alternative 4(SA)</b>	<b>Northern Target Area - Alternative 2(NTA)</b>	<b>Northern Target Area - Alternative 3(NTA)</b>	<b>Northern Target Area - Alternative 4(NTA)</b>	<b>Northern Target Area - Alternative 5(NTA)</b>	<b>Northern Non-Target Area - Alternative 2(NNTA)</b>
	<b>No Action</b>	<b>Surface Clearance with LUCs</b>	<b>Land Use Controls</b>	<b>Surface Clearance with Land Use Controls</b>	<b>Surface, Subsurface Clearance with Land Use Controls</b>	<b>Land Use Controls</b>	<b>Land Use Controls with Construction Support</b>	<b>Surface Clearance with Land Use Controls</b>	<b>Surface/Subsurface Clearance (All Accessible Land) with Land Use Controls</b>	<b>Land Use Controls</b>
<b>Total Project Duration (Years)</b>	30	30	30	30	30	30	30	30	30	30
<b>Capital Cost</b>	\$0	\$3,338,551	\$81,943	\$1,043,709	\$3,581,452	\$236,798	\$362,148	\$1,489,534	\$3,652,479	\$275,970
<b>Operations and Maintenance Cost</b>	\$39,722	\$65,718	\$144,316	\$144,316	\$155,718	\$144,316	\$155,718	\$155,718	\$155,718	\$144,316
<b>Total Present Value of Alternative</b>	\$850,000	\$4,810,000	\$1,310,000	\$2,270,000	\$5,060,000	\$1,470,000	\$1,840,000	\$2,960,000	\$5,130,000	\$1,510,000

0

Northern Non-Target Area - Alternative 3(NNTA)	Northern Non-Target Area - Alternative 4(NNTA)	Northern Non-Target Area - Alternative 5(NNTA)
Land Use Controls with Construction Support	Surface Clearance with Land Use Controls	Surface/Subsurface Clearance (of Accessible Land) with Land Use Controls
30	30	30
\$401,320	\$823,828	\$1,133,079
\$144,316	\$155,718	\$155,718
\$1,630,000	\$2,300,000	\$2,610,000

Quantities												
Item Description	Combined Areas	Southern Area	Southern Area	Southern Area	Northern Target Area	Northern Target Area	Northern Target Area	Northern Target Area	Northern Non-Target Area	Northern Non-Target Area	Northern Non-Target Area	Northern Non-Target Area
	Recommended Alternative	Alternative 2	Alternative 3	Alternative 4	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 2	Alternative 3	Alternative 4	Alternative 5
		Land Use Controls	Surface Clearance with Land Use Controls	Surface, Subsurface Clearance with Land Use Controls	Land Use Controls	Land Use Controls with Construction Support	Surface Clearance with Land Use Controls	Surface/Subsurface Clearance (All Accessible Land) with Land Use Controls	Land Use Controls	Land Use Controls with Construction Support	Surface Clearance with Land Use Controls	Surface/Subsurface Clearance (of Accessible Land) with Land Use Controls
Fence, if required	4500	0	0	0	3600	3600	3600	7500	4500	4500	4500	4500
Fence, Waikane Stream to cultural sites	1200											
Fence, Southern Area demolition	5800											
Areas, acres												
<30 degree slope	33.3	0	18.7	18.7	0	0	14.6	14.6	0	0	2.4	2.4
>30 degree slope	48.0	0	15.3	15.3	0	0	32.7	32.7	0	0	103.4	103.4
Surface Clearance												
<30 degree slope	33.3	0	18.7	18.7	0	0	14.6	14.6	0	0	2.4	2.4
>30 degree slope (60% of <30 degree slope)	14.7	0	11.8	11.8	0.0	0.0	2.9	2.9	0.0	0.0	0.5	0.5
Subsurface Clearance												
<30 degree slope	5.74	0	18.7	18.7	0	0	0	14.6	0	0	0	2.4
>30 degree slope (60% of <30 degree slope)	3.6	0	11.8	11.8	0	0.0	0.0	2.9	0	0.0	0.0	0.5
Surface Clearance, MD/Acre, lbs	200	0	0	0	0	200	200	200	0	200	200	200
Total MD, lbs, Surface Clearance	3,504	0	0	0	0	0	3,504	3,504	0	0	576	576
SubSurface Clearance, MD/Acre, lbs	42	0	0	0	0	42	42	42	0	42	42	42
Total MD, lbs, SubSurface Clearance	736	0	0	0	0	0	0	736	0	0	0	121
Cultural sites, acres	10.6			9.4				1.2				0.5
Trails from Waikane Stream to cultural sites AC	2					10.5 acres cleared in RI		10.5 acres cleared in RI			0.5 acres cleared in RI	

**Combined Alternative  
Surface Clearance with LUCs**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** All Areas  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 12/27/2011

**Description:** This alternative consists of 100% surface clearance of accessible land in Southern Area and Northern Target Area; Removal of existing fence from Southern Area; Installation of fencing between the Southern and Northern Areas; Subsurface clearance of a 10-foot wide buffer strip along the south side of the fence; Subsurface clearance of 50-foot step-outs if MEC found in Southern Area surface clearance; extension of fencing from Waikane Stream to Waikane Spring & Kamaka Shrine, and subsurface clearance of the corridors; Land Use Controls.

**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Deed Restriction Zoning	1	LS	\$10,000	\$10,000	
Fence demolition	5800	LS	\$5	\$29,000	
Fence, Waikane Stream to cultural sites	1200	LS	\$35	\$42,000	
Fence, warning signs between South/North Areas	4500	LF	\$25	\$112,500	
<b>SUBTOTAL</b>				<u>\$193,500</u>	
<b>Clearance Activities</b>					
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000	
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,000.00	\$4,000	
Explosive Safety Submission	1	LS	\$10,000.00	\$10,000	
Permits	1	LS	\$1,000.00	\$1,000	
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000	
SOPs and AHAs	1	LS	\$20,000.00	\$20,000	
Site Visit	1	LS	\$15,000.00	\$15,000	
Mobilization/Survey	1	LS	\$17,000.00	\$17,000	
Mob/Demob Analog Magnetometer Man Portable Team	1	LS	\$25,000.00	\$25,000	5 person team 10% productivity increase due to gentler slopes
Surface Clearance, < 30 degree slope	33.3	AC	\$7,650.00	\$254,745	
Surface Clearance, > 30 degree slope	14.7	AC	\$13,000.00	\$191,360	
Visual Sweep > 30 degree slope	3.4	AC	\$17,000.00	\$57,800	Visual Inspection, access by ropes only
Analog Magnetometer mag & dig	9.3	AC	\$65,000.00	\$604,500	Assumes 20% of Southern Area's surface clearance area
Guarding Recovered MEC, MPPEH	1	DY	\$1,500.00	\$1,500	
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200	
MD Recovery, Storage and Disposal	4,240	LBS	\$3.00	\$12,720	
MEC Escort - Survey, Brush Clearing, etc.	80	DY	\$2,000.00	\$160,000	
Anomaly Investigation	500	EA	\$15.00	\$7,500	
BIP	20	EA	\$6,500.00	\$130,000	
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000	
Final Report	1	LS	\$30,000.00	\$30,000	
Pre-Post BIP Sampling	20	EA	\$10,000.00	\$200,000	

Site boundary survey	1	LS	\$30,000	\$30,000	
<b>SUBTOTAL</b>				<u>\$1,824,325</u>	
Contingency	25%		\$2,017,825	\$504,456	10% Scope + 15% Bid
<b>SUBTOTAL</b>				<u>\$504,456</u>	
Project management	6%		\$2,522,281	\$151,337	USEPA 2000, p. 5-13, \$500K - \$2M
Remedial design workplan	12%		\$2,522,281	\$302,674	USEPA 2000, p. 5-13, \$500K - \$2M
Construction Management	8%		\$2,522,281	\$201,782	USEPA 2000, p. 5-13, \$500K - \$2M
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate
<b>SUBTOTAL</b>				<u>\$665,793</u>	
Hawaii GET	4.72%		\$ 3,188,074	\$ 150,477	
	0%		\$ -	\$ -	
<b>SUBTOTAL</b>				<u>\$ 150,477</u>	
<b>TOTAL CAPITAL COST</b>				<b>\$ 3,338,551</b>	

**OPERATIONS AND MAINTENANCE COST**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>					
Labor	96	HR	\$80	\$7,680	CH2M Est.
Educational Program	80	HR	\$80	\$6,400	CH2M Est.
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
Misc	1	LS	\$100	\$100	CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
<b>SUBTOTAL</b>				<u>\$23,820</u>	
<b>Environmental Sampling</b>					
Pre-Post BIP Sampling	0	LS	\$0.00	\$0	
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical
Lab Analysis	1	LS	\$1,200.00	\$1,200	CCI Historical
Data Validation	8	HR	\$100.00	\$800	CCI Historical
Reports	1	EA	\$2,500.00	\$2,500	CCI Historical
Misc	1	LS	\$500.00	\$500	CCI Historical
<b>SUBTOTAL</b>				<u>\$5,000</u>	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<u><b>\$28,820</b></u>	
Mobilization/Demobilization	5%			\$1,441	
Subcontractor General Conditions	25%			\$7,205	
<b>SUBTOTAL</b>				<u><b>\$37,466</b></u>	
Contingency	25%			\$9,367	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<u><b>\$46,833</b></u>	
Escalation to Mid-Pt	4%			\$1,873	
Project Management	10%			\$4,683	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$9,367	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<u><b>\$62,756</b></u>	

<b>Taxes</b>					
	Hawaii GET	4.72%	\$	62,756	\$ 2,962
		0%	\$	-	\$ -
	<b>SUBTOTAL</b>				<b>\$ 2,962</b>

<b>TOTAL O&amp;M</b>	<b>\$65,718</b>
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**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
			Total		\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$3,338,551	\$3,338,551	1.00	\$3,338,551	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$4,813,046	
<b>TOTAL PRESENT VALUE FOR COMBINED ALTERNATIVE</b>					<b>\$4,810,000</b>	

**SOURCE INFORMATION**

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- 2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- 2b. R.S. Means Company. 2007. 26th Edition.
- 2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
3. Historical CH2M HILL project cost information
4. Calculations using Historical CH2M HILL project cost information (separate worksheet)



**NO Action Alternative  
Maintain Existing Condition**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Southern Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 12/27/2011

**Description:** Current site fencing is inspected regularly, escorts are provided for access to cultural sites

**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Include Land Use Controls in Base General Plan	0	LS	\$10,000	\$0	
Warning signs at site entrances	0	EA	\$200	\$0	
<b>SUBTOTAL</b>				<u>\$0</u>	
<b>Other Costs</b>					
Site boundary survey	0	LS	\$30,000	\$0	
<b>SUBTOTAL</b>				<u>\$0</u>	
Contingency	25%		\$0	\$0	10% Scope + 15% Bid
<b>SUBTOTAL</b>				<u>\$0</u>	
Project management	10%		\$0	\$0	USEPA 2000, p. 5-13, <\$100K
Remedial design workplan	20%		\$0	\$0	USEPA 2000, p. 5-13, <\$100K
Documentation of Closure Activities	0	LS	\$10,000	\$0	ROM estimate
<b>SUBTOTAL</b>				<u>\$0</u>	
Hawaii GET	4.72%		\$ -	\$ -	
	0%		\$ -	\$ -	
<b>SUBTOTAL</b>				<u>\$ -</u>	
<b>TOTAL CAPITAL COST</b>				<u>\$ -</u>	

**OPERATIONS AND MAINTENANCE COST**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>					
Labor	96	HR	\$80	\$7,680	CH2M Est.
Educational Program	0	HR	\$80	\$0	CH2M Est.

Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
Misc	1	LS	\$100	\$100	CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
<b>SUBTOTAL</b>				<u>\$17,420</u>	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<u>\$17,420</u>	
Mobilization/Demobilization	5%			\$871	
Subcontractor General Conditions	25%			\$4,355	
<b>SUBTOTAL</b>				<u>\$22,646</u>	
Contingency	25%			\$5,662	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<u>\$28,308</u>	
Escalation to Mid-Pt	4%			\$1,132	
Project Management	10%			\$2,831	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$5,662	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<u>\$37,932</u>	
<b>Taxes</b>					
Hawaii GET	4.72%		\$ 37,932	\$ 1,790	
	0%		\$ -	\$ -	
<b>SUBTOTAL</b>				<u>\$ 1,790</u>	
<b>TOTAL O&amp;M</b>				<u><b>\$39,722</b></u>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	0	LS	\$15,000	\$0	
5 year Review	10	0	LS	\$15,000	\$0	
5 year Review	15	0	LS	\$15,000	\$0	
5 year Review	20	0	LS	\$15,000	\$0	
5 year Review	25	0	LS	\$15,000	\$0	
5 year Review	30	0	LS	\$15,000	\$0	
				Total	\$0	
<b>TOTAL ANNUAL PERIODIC COST</b>					<u><b>\$0</b></u>	

Discount Rate 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
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CAPITAL COST	0	\$0	\$0	1.00	\$0
ANNUAL O&M COST - Cap	1 to 30	\$0	\$39,722	21.50	\$854,013
PERIODIC COST	5	\$0	\$0	0.89	\$0
PERIODIC COST	10	\$0	\$0	0.80	\$0
PERIODIC COST	15	\$0	\$0	0.71	\$0
PERIODIC COST	20	\$0	\$0	0.63	\$0
PERIODIC COST	25	\$0	\$0	0.57	\$0
PERIODIC COST	30	\$0	\$0	0.51	\$0
					\$854,013

<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 2(SA)</b>	<b>\$850,000</b>
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**SOURCE INFORMATION**

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- 2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- 2b. R.S. Means Company. 2007. 26th Edition.
- 2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
3. Historical CH2M HILL project cost information
4. Calculations using Historical CH2M HILL project cost information (separate worksheet)

Southern Area - Alternative 2(SA) Land Use Controls		COST ESTIMATE SUMMARY				
<b>Site:</b>	Waikane Valley	<b>Description:</b>				
<b>Location:</b>	Southern Area	The LUC alternative includes signage and educational programs, no intrusive activities are conducted within the area in the future UXO escort required for access.				
<b>Phase:</b>	Feasibility Study					
<b>Base Year:</b>	2011					
<b>Date:</b>	9/15/2011					
<b>CAPITAL COSTS</b>						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>Land Use Controls</b>						
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000		
Warning signs at site entrances	10	EA	\$200	\$2,000		
<b>SUBTOTAL</b>				<b>\$12,000</b>		
<b>Other Costs</b>						
Site boundary survey	1	LS	\$30,000	\$30,000		
<b>SUBTOTAL</b>				<b>\$30,000</b>		
Contingency	25%		\$42,000	\$10,500	10% Scope + 15% Bid	
<b>SUBTOTAL</b>				<b>\$10,500</b>		
Project management	10%		\$52,500	\$5,250	USEPA 2000, p. 5-13, <\$100K	
Remedial design workplan	20%		\$52,500	\$10,500	USEPA 2000, p. 5-13, <\$100K	
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate	
<b>SUBTOTAL</b>				<b>\$25,750</b>		
Hawaii GET	4.72%		\$ 78,250	\$ 3,693		
	0%		\$ -	\$ -		
<b>SUBTOTAL</b>				<b>\$ 3,693</b>		
<b>TOTAL CAPITAL COST</b>				<b>\$ 81,943</b>		
<b>OPERATIONS AND MAINTENANCE COST</b>						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>O&amp;M LUC</b>						
Labor	96	HR	\$80	\$7,680	CH2M Est.	
Educational Program	80	HR	\$80	\$6,400	CH2M Est.	
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance	
Misc	1	LS	\$100	\$100	CH2M HILL Allowance	
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.	

<b>Site:</b> Waikane Valley  <b>Location:</b> Southern Area <b>Phase:</b> Feasibility Study <b>Base Year:</b> 2011 <b>Date:</b> 9/15/2011	<b>Description:</b>  The LUC alternative includes signage and educational programs, no intrusive activities are conducted within the area in the future UXO escort required for access.
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SUBTOTAL				\$23,820	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$23,820</b>	
Mobilization/Demobilization	5%			\$1,191	
Subcontractor General Conditions	25%			\$5,955	
<b>SUBTOTAL</b>				<b>\$30,966</b>	
Contingency	25%			\$7,742	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<b>\$38,708</b>	
Escalation to Mid-Pt	4%			\$1,548	
Project Management	10%			\$3,871	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$7,742	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<b>\$51,868</b>	
<b>Taxes</b>					
Hawaii GET	4.72%	\$	51,868	\$	2,448
	0%	\$	-	\$	-
<b>SUBTOTAL</b>				<b>\$</b>	<b>2,448</b>
<b>TOTAL O&amp;M</b>				<b>\$54,316</b>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

<p><b>Site:</b> Waikane Valley</p> <p><b>Location:</b> Southern Area</p> <p><b>Phase:</b> Feasibility Study</p> <p><b>Base Year:</b> 2011</p> <p><b>Date:</b> 9/15/2011</p>	<p><b>Description:</b></p> <p>The LUC alternative includes signage and educational programs, no intrusive activities are conducted within the area in the future UXO escort required for access.</p>
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Discount Rate 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$81,943	\$81,943	1.00	\$81,943	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$54,316	21.50	\$1,167,772	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$1,311,314	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 2(SA)</b>					<b>\$1,310,000</b>	

**SOURCE INFORMATION**

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- 2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- 2b. R.S. Means Company. 2007. 26th Edition.
- 2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
3. Historical CH2M HILL project cost information
4. Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Southern Area - Alternative 3(SA)**  
**Surface Clearance with Land Use Controls**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Southern Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** 100% surface clearance of MEC from the ground surface of accessible land within the Southern Area with land use limited to light agricultural (i.e. grazing) or recreational use. Deed restrictions and zoning and planning would be used to limit access to the site these surface uses. Construction support would be required for any planned excavations. Educational programs would also be implemented.

**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Deed Restriction Zoning	1	LS	\$10,000	\$10,000	
Fence, warning signs separate three areas	0	LF	\$25	\$0	
<b>SUBTOTAL</b>				<b>\$10,000</b>	
<b>Clearance Activities</b>					
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000	
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,000.00	\$4,000	
Explosive Safety Submission	1	LS	\$10,000.00	\$10,000	
Permits	1	LS	\$1,000.00	\$1,000	
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000	
SOPs and AHAs	1	LS	\$20,000.00	\$20,000	
Site Visit	1	LS	\$15,000.00	\$15,000	
Mobilization/Survey	1	LS	\$17,000.00	\$17,000	
Mob/Demob Analog Magnetometer Man Portable Team	1	LS	\$25,000.00	\$25,000	5 person team
Surface Clearance, < 30 degree slope	18.7	AC	\$7,650.00	\$143,055	10% productivity increase due to gentler slopes
Surface Clearance, > 30 degree slope	11.8	AC	\$13,000.00	\$153,400	
Visual Sweep > 30 degree slope	3.4	AC	\$17,000.00	\$57,800	Visual Inspection, access by ropes only
Guarding Recovered MEC, MPPEH	1	DY	\$1,500.00	\$1,500	
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200	
MEC Escort - Survey, Brush Clearing, etc.	20	DY	\$2,000.00	\$40,000	
BIP	1	EA	\$6,500.00	\$6,500	
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000	
Final Report	1	LS	\$30,000.00	\$30,000	
Pre-Post BIP Sampling	1	EA	\$10,000.00	\$10,000	
Site boundary survey	1	LS	\$30,000	\$30,000	
<b>SUBTOTAL</b>				<b>\$616,455</b>	

**Southern Area - Alternative 3(SA)  
Surface Clearance with Land Use Controls**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Southern Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** 100% surface clearance of MEC from the ground surface of accessible land within the Southern Area with land use limited to light agricultural (i.e. grazing) or recreational use. Deed restrictions and zoning and planning would be used to limit access to the site these surface uses. Construction support would be required for any planned excavations. Educational programs would also be implemented.

Contingency	25%		\$626,455	\$156,614	10% Scope + 15% Bid
<b>SUBTOTAL</b>				<u>\$156,614</u>	
Project management	6%		\$783,069	\$46,984	USEPA 2000, p. 5-13, \$500K - \$2M
Remedial design workplan	12%		\$783,069	\$93,968	USEPA 2000, p. 5-13, \$500K - \$2M
Construction Management	8%		\$783,069	\$62,646	USEPA 2000, p. 5-13, \$500K - \$2M
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate
<b>SUBTOTAL</b>				<u>\$213,598</u>	
Hawaii GET	4.72%		\$ 996,667	\$ 47,043	
<b>SUBTOTAL</b>	0%		\$ -	<u>\$ -</u>	
<b>TOTAL CAPITAL COST</b>				<b>\$ 1,043,709</b>	

**OPERATIONS AND MAINTENANCE COST**

	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>						
	Labor	96	HR	\$80	\$7,680	CH2M Est.
	Educational Program	80	HR	\$80	\$6,400	CH2M Est.
	Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
	Misc	1	LS	\$100	\$100	CH2M HILL Allowance
	UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
	<b>SUBTOTAL</b>				<u>\$23,820</u>	
<b>Environmental Sampling</b>						
	Pre-Post BIP Sampling	0	LS	\$0.00	\$0	
	Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical
	Lab Analysis	0	LS	\$1,200.00	\$0	CCI Historical
	Data Validation	0	HR	\$100.00	\$0	CCI Historical
	Reports	0	EA	\$2,500.00	\$0	CCI Historical
	Misc	0	LS	\$500.00	\$0	CCI Historical



**Southern Area - Alternative 3(SA)**  
**Surface Clearance with Land Use Controls**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Southern Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** 100% surface clearance of MEC from the ground surface of accessible land within the Southern Area with land use limited to light agricultural (i.e. grazing) or recreational use. Deed restrictions and zoning and planning would be used to limit access to the site these surface uses. Construction support would be required for any planned excavations. Educational programs would also be implemented.

SUBTOTAL					\$0	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>					<b>\$23,820</b>	
Mobilization/Demobilization	5%				\$1,191	
Subcontractor General Conditions	25%				\$5,955	
<b>SUBTOTAL</b>					<b>\$30,966</b>	
Contingency	25%				\$7,742	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>					<b>\$38,708</b>	
Escalation to Mid-Pt	4%				\$1,548	
Project Management	10%				\$3,871	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%				\$7,742	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%				\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>					<b>\$51,868</b>	
<b>Taxes</b>						
Hawaii GET	4.72%		\$	51,868	\$	2,448
	0%		\$	-	\$	-
<b>SUBTOTAL</b>					<b>\$</b>	<b>2,448</b>
<b>TOTAL O&amp;M</b>					<b>\$54,316</b>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

**Southern Area - Alternative 3(SA)  
Surface Clearance with Land Use Controls**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Southern Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** 100% surface clearance of MEC from the ground surface of accessible land within the Southern Area with land use limited to light agricultural (i.e. grazing) or recreational use. Deed restrictions and zoning and planning would be used to limit access to the site these surface uses. Construction support would be required for any planned excavations. Educational programs would also be implemented.

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$1,043,709	\$1,043,709	1.00	\$1,043,709	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$54,316	21.50	\$1,167,772	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$2,273,080	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 3(SA)</b>					<b>\$2,270,000</b>	

**SOURCE INFORMATION**

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- 2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- 2b. R.S. Means Company. 2007. 26th Edition.
- 2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
3. Historical CH2M HILL project cost information
4. Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Southern Area - Alternative 4(SA)** **COST ESTIMATE SUMMARY**  
**Surface, Subsurface Clearance with Land Use Controls**

<b>Site:</b> Waikane Valley	<b>Description:</b>
<b>Location:</b> Southern Area	This alternative involves surface and subsurface clearance of MEC from accessible areas within the Southern Area to 2 feet bgs. Construction support would be required for any intrusive activity beyond 2 feet depth. Educational programs would also be implemented.
<b>Phase:</b> Feasibility Study	
<b>Base Year:</b> 2011	
<b>Date:</b> 9/15/2011	

CAPITAL COSTS						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>Land Use Controls</b>						
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000		
Fence, warning signs separate three areas	0	LF	\$25	\$0		
<b>SUBTOTAL</b>				<b>\$10,000</b>		
<b>Clearance Activities</b>						
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000		
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,000.00	\$4,000		
Explosive Safety Submission	1	LS	\$10,000.00	\$10,000		
Permits	1	LS	\$1,000.00	\$1,000		
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000		
SOPs and AHAs	1	LS	\$20,000.00	\$20,000		
Site Visit	1	LS	\$15,000.00	\$15,000		
Mobilization/Survey	1	LS	\$17,000.00	\$17,000		
Mob/Demob Analog Magnetometer Man Portable Team	1	LS	\$25,000.00	\$25,000		5 person team
Surface Clearance, < 30 degree slope	18.7	AC	\$7,650.00	\$143,055		10% productivity increase due to gentler slopes
Surface Clearance, > 30 degree slope	11.8	AC	\$13,000.00	\$153,400		
Visual Inspection, > 30 degree slope	3.4	AC	\$17,000.00	\$57,800		Visual Inspection, access by ropes only
Analog Magnetometer mag & dig	30.5	AC	\$52,000.00	\$1,586,000		20% productivity increase due to gentler slopes
Guarding Recovered MEC, MPPEH	1	DY	\$1,500.00	\$1,500		
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200		
MEC Escort - Survey, Brush Clearing, etc.	60	DY	\$2,000.00	\$120,000		
BIP	1	EA	\$6,500.00	\$6,500		
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000		
Final Report	1	LS	\$30,000.00	\$30,000		
Pre-Post BIP Sampling	1	EA	\$10,000.00	\$10,000		
Site boundary survey	1	LS	\$30,000	\$30,000		
<b>SUBTOTAL</b>				<b>\$2,282,455</b>		
Contingency	25%		\$2,292,455	\$573,114		10% Scope + 15% Bid
<b>SUBTOTAL</b>				<b>\$573,114</b>		
Project management	5%		\$2,865,569	\$143,278		USEPA 2000, p. 5-13, \$2 - \$10M
Remedial design workplan	8%		\$2,865,569	\$229,246		USEPA 2000, p. 5-13, \$2 - \$10M
Construction Management	6%		\$2,865,569	\$171,934		USEPA 2000, p. 5-13, \$2 - \$10M
Documentation of Closure Activities	1	LS	\$10,000	\$10,000		ROM estimate
<b>SUBTOTAL</b>				<b>\$554,458</b>		
Hawaii GET	4.72%		\$ 3,420,027	\$ 161,425		
<b>SUBTOTAL</b>	0%		\$ -	\$ -		
<b>TOTAL CAPITAL COST</b>				<b>\$ 3,581,452</b>		

OPERATIONS AND MAINTENANCE COST						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>O&amp;M LUC</b>						
Labor	96	HR	\$80	\$7,680		CH2M Est.
Educational Program	80	HR	\$80	\$6,400		CH2M Est.
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000		CH2M HILL Allowance
Misc	1	LS	\$100	\$100		CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640		CH2M Est.
<b>SUBTOTAL</b>				<b>\$23,820</b>		
<b>Environmental Sampling</b>						
Pre-Post BIP Sampling	0	LS	\$0.00	\$0		
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0		CCI Historical
Lab Analysis	1	LS	\$1,200.00	\$1,200		CCI Historical
Data Validation	8	HR	\$100.00	\$800		CCI Historical
Reports	1	EA	\$2,500.00	\$2,500		CCI Historical
Misc	1	LS	\$500.00	\$500		CCI Historical
<b>SUBTOTAL</b>				<b>\$5,000</b>		
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$28,820</b>		
Mobilization/Demobilization	5%			\$1,441		
Subcontractor General Conditions	25%			\$7,205		
<b>SUBTOTAL</b>				<b>\$37,466</b>		
Contingency	25%			\$9,367		10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<b>\$46,833</b>		
Escalation to Mid-Pt	4%			\$1,873		
Project Management	10%			\$4,683		USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$9,367		USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0		USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<b>\$62,756</b>		
<b>Taxes</b>						
Hawaii GET	4.72%		\$ 62,756	\$ 2,962		
<b>SUBTOTAL</b>	0%		\$ -	\$ -		
<b>TOTAL O&amp;M</b>				<b>\$65,718</b>		

Periodic Costs						
DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	10	1	LS	\$0	\$0	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	20	1	LS	\$0	\$0	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3%				Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.		
PRESENT VALUE ANALYSIS						
COST TYPE	YEAR	TOTAL COST	DISCOUNT PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$3,581,452	\$3,581,452	1.00	\$3,581,452	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	

**Southern Area - Alternative 4(SA)****COST ESTIMATE SUMMARY****Surface, Subsurface Clearance with Land Use Controls****Site:** Waikane Valley**Description:**

This alternative involves surface and subsurface clearance of MEC from accessible areas within the Southern Area to 2 feet bgs. Construction support would be required for any intrusive activity beyond 2 feet depth. Educational programs would also be implemented.

**Location:** Southern Area**Phase:** Feasibility Study**Base Year:** 2011**Date:** 9/15/2011

PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583
					\$5,055,947

**TOTAL PRESENT VALUE FOR ALTERNATIVE 4(SA)****\$5,060,000****SOURCE INFORMATION**

1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- 2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- 2b. R.S. Means Company. 2007. 26th Edition.
- 2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
3. Historical CH2M HILL project cost information
4. Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Northern Non-Target Area - Alternative 2(NNTA)****COST ESTIMATE SUMMARY****Land Use Controls****Site:** Waikane Valley**Description:** This alternative includes signage to separate the Northern Non-Target Area from the Southern Area. Educational programs would be offered to make the public more aware of site MEC hazards.**Location:** Non-Target Area**Phase:** Feasibility Study**Base Year:** 2011**Date:** 9/15/2011**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000	
Fence, warning signs	4500	LF	\$25	\$112,500	
<b>SUBTOTAL</b>				\$122,500	
<b>Other Costs</b>					
Site boundary survey	1	LS	\$30,000	\$30,000	
<b>SUBTOTAL</b>				\$30,000	
Contingency	25%		\$152,500	\$38,125	10% Scope + 15% Bid
<b>SUBTOTAL</b>				\$38,125	
Project management	8%		\$190,625	\$15,250	USEPA 2000, p. 5-13, \$200k - \$500k
Remedial design workplan	15%		\$190,625	\$28,594	USEPA 2000, p. 5-13, \$200k - \$500k
Construction Management	10%		\$190,625	\$19,063	USEPA 2000, p. 5-13, \$200k - \$500k
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate
<b>SUBTOTAL</b>				\$72,906	
Hawaii GET	4.72%		\$ 263,531	\$ 12,439	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
				\$ 12,439	
<b>TOTAL CAPITAL COST</b>				<b>\$ 275,970</b>	

**OPERATIONS AND MAINTENANCE COST**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>					
Labor	96	HR	\$80	\$7,680	CH2M Est.
Educational Program	80	HR	\$80	\$6,400	CH2M Est.
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
Misc	1	LS	\$100	\$100	CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
<b>SUBTOTAL</b>				\$23,820	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				\$23,820	
Mobilization/Demobilization	5%			\$1,191	
Subcontractor General Conditions	25%			\$5,955	
<b>SUBTOTAL</b>				\$30,966	
Contingency	25%			\$7,742	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				\$38,708	
Escalation to Mid-Pt	4%			\$1,548	
Project Management	10%			\$3,871	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$7,742	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				\$51,868	
<b>Taxes</b>					
Hawaii GET	4.72%		\$ 51,868	\$ 2,448	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
				\$ 2,448	
<b>TOTAL O&amp;M</b>				<b>\$54,316</b>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual &amp; periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	DISCOUNT PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$275,970	\$275,970	1.00	\$275,970	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$54,316	21.50	\$1,167,772	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$1,505,341	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 2(NNTA)</b>					<b>\$1,510,000</b>	

**SOURCE INFORMATION**

- United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- R.S. Means Company. 2007. 26th Edition.
- ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
- Historical CH2M HILL project cost information
- Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Northern Non-Target Area - Alternative 3(NNTA)**  
**Land Use Controls with Construction Support**
**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Non-Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** This alternative includes only signage, planning/zoning, and construction support. Construction support would be provided for any intrusive activities. Educational programs would be provided.

**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Planning, Zoning	1	LS	\$10,000	\$10,000	
Fence, warning signs separate three areas	4500	LF	\$25	\$112,500	
<b>SUBTOTAL</b>				\$122,500	
<b>Other Costs</b>					
Deed Restrictions	1	LS	\$20,000	\$20,000	
Construction support	400	HR	\$130	\$52,000	Two months
Site boundary survey	1	LS	\$30,000	\$30,000	
<b>SUBTOTAL</b>				\$102,000	
Contingency	25%		\$224,500	\$56,125	10% Scope + 15% Bid
<b>SUBTOTAL</b>				\$56,125	
Project management	8%		\$280,625	\$22,450	USEPA 2000, p. 5-13, \$200k - \$500k
Remedial design workplan	15%		\$280,625	\$42,094	USEPA 2000, p. 5-13, \$200k - \$500k
Construction Management	10%		\$280,625	\$28,063	USEPA 2000, p. 5-13, \$200k - \$500k
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate
<b>SUBTOTAL</b>				\$102,606	
Hawaii GET	4.72%		\$ 383,231	\$ 18,089	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
<b>TOTAL CAPITAL COST</b>				<b>\$ 401,320</b>	

**OPERATIONS AND MAINTENANCE COST**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>					
Labor	96	HR	\$80	\$7,680	CH2M Est.
Educational Program	80	HR	\$80	\$6,400	CH2M Est.
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
Misc	1	LS	\$100	\$100	CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
<b>SUBTOTAL</b>				\$23,820	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$23,820</b>	
Mobilization/Demobilization	5%			\$1,191	
Subcontractor General Conditions	25%			\$5,955	
<b>SUBTOTAL</b>				<b>\$30,966</b>	
Contingency	25%			\$7,742	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<b>\$38,708</b>	
Escalation to Mid-Pt	4%			\$1,548	
Project Management	10%			\$3,871	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$7,742	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<b>\$51,868</b>	
<b>Taxes</b>					
Hawaii GET	4.72%		\$ 51,868	\$ 2,448	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
<b>TOTAL O&amp;M</b>				<b>\$54,316</b>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5.  
This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	DISCOUNT PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$401,320	\$401,320	1.00	\$401,320	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$54,316	21.50	\$1,167,772	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$1,630,691	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 3(NNTA)</b>					<b>\$1,630,000</b>	

**SOURCE INFORMATION**

- United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- R.S. Means Company. 2007. 26th Edition.
- ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
- Historical CH2M HILL project cost information
- Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Northern Non-Target Area - Alternative 4(NNTA)**  
**Surface Clearance with Land Use Controls**

**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Non-Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** This alternative would consist of surface clearance of accessible areas and implementation of deed restrictions and zoning. Land use would be restricted to light agricultural or recreational uses (surface use only). Construction support would be required for any planned excavations. Educational programs would be implemented.

**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000	
Fence, warning signs separate three areas	4500	LF	\$25	\$112,500	
<b>SUBTOTAL</b>				<b>\$122,500</b>	
<b>Clearance Activities</b>					
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000	
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,000.00	\$4,000	
Explosive Safety Submission	1	LS	\$10,000.00	\$10,000	
Permits	1	LS	\$1,000.00	\$1,000	
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000	
SOPs and AHAs	1	LS	\$20,000.00	\$20,000	
Site Visit	1	LS	\$15,000.00	\$15,000	
Mobilization/Survey	1	LS	\$17,000.00	\$17,000	
Mob/Demob Analog Magnetometer Team	1	LS	\$25,000.00	\$25,000	5 person team
Surface Clearance, < 30 degree slope	2.4	AC	\$8,500.00	\$20,400	
Surface Clearance, > 30 degree slope	0.5	AC	\$13,000.00	\$6,240	
Guarding Recovered MEC, MPPEH	1	DY	\$1,500.00	\$1,500	
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200	
MD Recovery, Storage and Disposal	600	LBS	\$3.00	\$1,800	
MEC Escort - Survey, Brush Clearing, etc.	60	DY	\$2,000.00	\$120,000	
BIP	1	EA	\$6,500.00	\$6,500	
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000	
Final Report	1	LS	\$30,000.00	\$30,000	
Pre-Post BIP Sampling	1	EA	\$10,000.00	\$10,000	
Site boundary survey	1	LS	\$30,000	\$30,000	
<b>SUBTOTAL</b>				<b>\$370,640</b>	
Contingency	25%		\$493,140	\$123,285	10% Scope + 15% Bid
<b>SUBTOTAL</b>				<b>\$123,285</b>	
Project management	6%		\$616,425	\$36,986	USEPA 2000, p. 5-13, \$500K - \$2M
Remedial design workplan	12%		\$616,425	\$73,971	USEPA 2000, p. 5-13, \$500K - \$2M
Construction Management	8%		\$616,425	\$49,314	USEPA 2000, p. 5-13, \$500K - \$2M
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate
<b>SUBTOTAL</b>				<b>\$170,271</b>	
Hawaii GET	4.72%		\$ 786,696	\$ 37,132	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
<b>TOTAL CAPITAL COST</b>				<b>\$ 823,828</b>	

**OPERATIONS AND MAINTENANCE COST**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>					
Labor	96	HR	\$80	\$7,680	CH2M Est.
Educational Program	80	HR	\$80	\$6,400	CH2M Est.
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
Misc	1	LS	\$100	\$100	CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
<b>SUBTOTAL</b>				<b>\$23,820</b>	
<b>Environmental Sampling</b>					
Pre-Post BIP Sampling	0	LS	\$0.00	\$0	
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical
Lab Analysis	1	LS	\$1,200.00	\$1,200	CCI Historical Monthly
Data Validation	8	HR	\$100.00	\$800	CCI Historical
Reports	1	EA	\$2,500.00	\$2,500	CCI Historical
Misc	1	LS	\$500.00	\$500	CCI Historical
		EA	\$0.00	\$0	
<b>SUBTOTAL</b>				<b>\$5,000</b>	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$28,820</b>	
Mobilization/Demobilization	5%			\$1,441	
Subcontractor General Conditions	25%			\$7,205	
<b>SUBTOTAL</b>				<b>\$37,466</b>	
Contingency	25%			\$9,367	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<b>\$46,833</b>	
Escalation to Mid-Pt	4%			\$1,873	
Project Management	10%			\$4,683	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$9,367	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<b>\$62,756</b>	
<b>Taxes</b>					
Hawaii GET	4.72%		\$ 62,756	\$ 2,962	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
<b>TOTAL O&amp;M</b>				<b>\$65,718</b>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$823,828	\$823,828	1.00	\$823,828	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$2,298,323	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 4(NNTA)</b>					<b>\$2,300,000</b>	

Northern Non-Target Area - Alternative 4(NNTA) Surface Clearance with Land Use Controls		COST ESTIMATE SUMMARY
<b>Site:</b>	Waikane Valley	<b>Description:</b> This alternative would consist of surface clearance of accessible areas and implementation of deed restrictions and zoning. Land use would be restricted to light agricultural or recreational uses (surface use only). Construction support would be required for any planned excavations. Educational programs would be implemented.
<b>Location:</b>	Non-Target Area	
<b>Phase:</b>	Feasibility Study	
<b>Base Year:</b>	2011	
<b>Date:</b>	9/15/2011	
<b>SOURCE INFORMATION</b>		
<ol style="list-style-type: none"> <li>1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).</li> <li>2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)</li> <li>2b. R.S. Means Company. 2007. 26th Edition.</li> <li>2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.</li> <li>3. Historical CH2M HILL project cost information</li> <li>4. Calculations using Historical CH2M HILL project cost information (separate worksheet)</li> </ol>		



**Northern Non-Target Area - Alternative 5(NNTA) COST ESTIMATE SUMMARY**  
**Surface/Subsurface Clearance (of Accessible Land) with Land Use Controls**

**Site:** Waikane Valley **Description:** This alternative includes surface and subsurface clearance of MEC up to 2 feet below ground surface from accessible areas within the Northern Non-Target Area. Land use would be accompanied by deed restrictions and zoning/planning controls. Construction Support would be required for any intrusive activity beyond 2 feet bgs. Educational programs would also be implemented.

**Location:** Non-Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

CAPITAL COSTS						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>Land Use Controls</b>						
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000		
Fence, warning signs separate three areas	4500	LF	\$25	\$112,500		
<b>SUBTOTAL</b>				<b>\$122,500</b>		
<b>Clearance Activities</b>						
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000		
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,000.00	\$4,000		
Explosive Safety Submission	1	LS	\$10,000.00	\$10,000		
Permits	1	LS	\$1,000.00	\$1,000		
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000		
SOPs and AHAs	1	LS	\$20,000.00	\$20,000		
Site Visit	1	LS	\$15,000.00	\$15,000		
Mobilization/Survey	1	LS	\$17,000.00	\$17,000		
Mob/Demob Analog Magnetometer Team	1	LS	\$25,000.00	\$25,000	5 person team	
Surface Clearance, < 30 degree slope	2.4	AC	\$8,500.00	\$20,400		
Surface Clearance, > 30 degree slope	0.5	AC	\$13,000.00	\$6,240		
Analog Magnetometer mag & dig	2.9	AC	\$65,000.00	\$187,200		
Guarding Recovered MEC, MPPEH	1	DY	\$1,500.00	\$1,500		
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200		
MD Recovery, Storage and Disposal	700	LBS	\$3.00	\$2,100		
MEC Escort - Survey, Brush Clearing, etc.	60	DY	\$2,000.00	\$120,000		
BIP	1	EA	\$6,500.00	\$6,500		
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000		
Final Report	1	LS	\$30,000.00	\$30,000		
Pre-Post BIP Sampling	1	EA	\$10,000.00	\$10,000		
Site boundary survey	1	LS	\$30,000	\$30,000		
<b>SUBTOTAL</b>				<b>\$558,140</b>		
Contingency	25%		\$680,640	\$170,160	10% Scope + 15% Bid	
<b>SUBTOTAL</b>				<b>\$170,160</b>		
Project management	6%		\$850,800	\$51,048	USEPA 2000, p. 5-13, \$500K - \$2M	
Remedial design workplan	12%		\$850,800	\$102,096	USEPA 2000, p. 5-13, \$500K - \$2M	
Construction Management	8%		\$850,800	\$68,064	USEPA 2000, p. 5-13, \$500K - \$2M	
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate	
<b>SUBTOTAL</b>				<b>\$231,208</b>		
Hawaii GET	4.72%		\$ 1,082,008	\$ 51,071		
0%			\$ -	\$ -		
<b>SUBTOTAL</b>				<b>\$ 51,071</b>		
<b>TOTAL CAPITAL COST</b>				<b>\$ 1,133,079</b>		

OPERATIONS AND MAINTENANCE COST						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>O&amp;M LUC</b>						
Labor	96	HR	\$80	\$7,680	CH2M Est.	
Educational Program	80	HR	\$80	\$6,400	CH2M Est.	
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance	
Misc	1	LS	\$100	\$100	CH2M HILL Allowance	
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.	
<b>SUBTOTAL</b>				<b>\$23,820</b>		
<b>Environmental Sampling</b>						
Pre-Post BIP Sampling	0	LS	\$0.00	\$0		
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical	
Lab Analysis	1	LS	\$1,200.00	\$1,200	CCI Historical	Monthly
Data Validation	8	HR	\$100.00	\$800	CCI Historical	
Reports	1	EA	\$2,500.00	\$2,500	CCI Historical	
Misc	1	LS	\$500.00	\$500	CCI Historical	
		EA	\$0.00	\$0		
<b>SUBTOTAL</b>				<b>\$5,000</b>		
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$28,820</b>		
Mobilization/Demobilization	5%			\$1,441		
Subcontractor General Conditions	25%			\$7,205		
<b>SUBTOTAL</b>				<b>\$37,466</b>		
Contingency	25%			\$9,367	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11	
<b>SUBTOTAL</b>				<b>\$46,833</b>		
Escalation to Mid-Pt	4%			\$1,873		
Project Management	10%			\$4,683	USEPA 2000, p. 5-13, <\$100K	
Remedial Design	20%			\$9,367	USEPA 2000, p. 5-13, <\$100K	
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K	
<b>SUBTOTAL</b>				<b>\$62,756</b>		
<b>Taxes</b>						
Hawaii GET	4.72%		\$ 62,756	\$ 2,962		
0%			\$ -	\$ -		
<b>SUBTOTAL</b>				<b>\$ 2,962</b>		
<b>TOTAL O&amp;M</b>				<b>\$65,718</b>		

Periodic Costs						
DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	10	1	LS	\$0	\$0	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	20	1	LS	\$0	\$0	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

PRESENT VALUE ANALYSIS						
COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$1,133,079	\$1,133,079	1.00	\$1,133,079	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					<b>\$2,607,574</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

<b>Northern Non-Target Area - Alternative 5(NNTA)</b>		<b>COST ESTIMATE SUMMARY</b>	
<b>Surface/Subsurface Clearance (of Accessible Land) with Land Use Controls</b>			
<b>Site:</b>	Waikane Valley	<b>Description:</b>	This alternative includes surface and subsurface clearance of MEC up to 2 feet below ground surface from accessible areas within the Northern Non-Target Area. Land use would be accompanied by deed restrictions and zoning/planning controls. Construction Support would be required for any intrusive activity beyond 2 feet bgs. Educational programs would also be implemented.
<b>Location:</b>	Non-Target Area		
<b>Phase:</b>	Feasibility Study		
<b>Base Year:</b>	2011		
<b>Date:</b>	9/15/2011		
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 5(NNTA)</b>		<b>\$2,610,000</b>	
<b>SOURCE INFORMATION</b>			
<ol style="list-style-type: none"> <li>1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).</li> <li>2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)</li> <li>2b. R.S. Means Company. 2007. 26th Edition.</li> <li>2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.</li> <li>3. Historical CH2M HILL project cost information</li> <li>4. Calculations using Historical CH2M HILL project cost information (separate worksheet)</li> </ol>			

**Northern Target Area - Alternative 2(NTA)**  
**Land Use Controls**
**COST ESTIMATE SUMMARY**

**Site:** Waikane Valley  
**Location:** Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

**Description:** This alternative includes fencing, signage around the Northern Target Area to separate it from the Southern Area and the Non-Target Area. Educational programs would be implemented.

**CAPITAL COSTS**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>Land Use Controls</b>					
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000	
Fence, warning signs separate three areas	3600	LF	\$25	\$90,000	
<b>SUBTOTAL</b>				<b>\$100,000</b>	
<b>Other Costs</b>					
Site boundary survey	1	LS	\$30,000	\$30,000	
<b>SUBTOTAL</b>				<b>\$30,000</b>	
Contingency	25%		\$130,000	\$32,500	10% Scope + 15% Bid
<b>SUBTOTAL</b>				<b>\$32,500</b>	
Project management	8%		\$162,500	\$13,000	USEPA 2000, p. 5-13, \$200k - \$500k
Remedial design workplan	15%		\$162,500	\$24,375	USEPA 2000, p. 5-13, \$200k - \$500k
Construction Management	10%		\$162,500	\$16,250	USEPA 2000, p. 5-13, \$200k - \$500k
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate
<b>SUBTOTAL</b>				<b>\$63,625</b>	
Hawaii GET	4.72%		\$ 226,125	\$ 10,673	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
				<b>\$ 10,673</b>	
<b>TOTAL CAPITAL COST</b>				<b>\$ 236,798</b>	

**OPERATIONS AND MAINTENANCE COST**

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
<b>O&amp;M LUC</b>					
Labor	96	HR	\$80	\$7,680	CH2M Est.
Educational Program	80	HR	\$80	\$6,400	CH2M Est.
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance
Misc	1	LS	\$100	\$100	CH2M HILL Allowance
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.
<b>SUBTOTAL</b>				<b>\$23,820</b>	
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>					
Mobilization/Demobilization	5%			\$1,191	
Subcontractor General Conditions	25%			\$5,955	
<b>SUBTOTAL</b>				<b>\$30,966</b>	
Contingency	25%			\$7,742	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11
<b>SUBTOTAL</b>				<b>\$38,708</b>	
Escalation to Mid-Pt	4%			\$1,548	
Project Management	10%			\$3,871	USEPA 2000, p. 5-13, <\$100K
Remedial Design	20%			\$7,742	USEPA 2000, p. 5-13, <\$100K
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K
<b>SUBTOTAL</b>				<b>\$51,868</b>	
<b>Taxes</b>					
Hawaii GET	4.72%		\$ 51,868	\$ 2,448	
<b>SUBTOTAL</b>	0%		\$ -	\$ -	
				<b>\$ 2,448</b>	
<b>TOTAL O&amp;M</b>				<b>\$54,316</b>	

**Periodic Costs**

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5.  
This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

**PRESENT VALUE ANALYSIS**

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$236,798	\$236,798	1.00	\$236,798	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$54,316	21.50	\$1,167,772	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$1,466,169	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 2(NTA)</b>					<b>\$1,470,000</b>	

**SOURCE INFORMATION**

- United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- R.S. Means Company. 2007. 26th Edition.
- ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
- Historical CH2M HILL project cost information
- Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Northern Target Area - Alternative 3(NTA)** **COST ESTIMATE SUMMARY**  
**Land Use Controls with Construction Support**

**Site:** Waikane Valley **Description:** This alternative includes fencing, signage, and provides construction support if intrusive activities are planned. Land use restrictions would be documented in the Base Master Plan. Construction support would be needed for any excavation activities. Educational programs would also be implemented.  
**Location:** Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

CAPITAL COSTS						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>Land Use Controls</b>						
Deed Restriction Zoning	1	LS	\$10,000	\$10,000		
Fence, warning signs separate three areas	3600	LF	\$25	\$90,000		
<b>SUBTOTAL</b>				\$100,000		
<b>Other Costs</b>						
Deed Restrictions	1	LS	\$20,000	\$20,000		
Construction support	400	HR	\$130	\$52,000	Two months	
Site boundary survey	1	LS	\$30,000	\$30,000		
<b>SUBTOTAL</b>				\$102,000		
Contingency	25%		\$202,000	\$50,500	10% Scope + 15% Bid	
<b>SUBTOTAL</b>				\$50,500		
Project management	8%		\$252,500	\$20,200	USEPA 2000, p. 5-13, \$200k - \$500k	
Remedial design workplan	15%		\$252,500	\$37,875	USEPA 2000, p. 5-13, \$200k - \$500k	
Construction Management	10%		\$252,500	\$25,250	USEPA 2000, p. 5-13, \$200k - \$500k	
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate	
<b>SUBTOTAL</b>				\$93,325		
Hawaii GET	4.72%		\$ 345,825	\$ 16,323		
	0%		\$ -	\$ -		
<b>SUBTOTAL</b>				\$ 16,323		
<b>TOTAL CAPITAL COST</b>				<b>\$ 362,148</b>		

OPERATIONS AND MAINTENANCE COST						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>O&amp;M LUC</b>						
Labor	96	HR	\$80	\$7,680	CH2M Est.	
Educational Program	80	HR	\$80	\$6,400	CH2M Est.	
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance	
Misc	1	LS	\$100	\$100	CH2M HILL Allowance	
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.	
<b>SUBTOTAL</b>				\$23,820		
<b>Environmental Sampling</b>						
Pre-Post BIP Sampling	0	LS	\$0.00	\$0		
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical	
Lab Analysis	1	LS	\$1,200.00	\$1,200	CCI Historical	Monthly
Data Validation	8	HR	\$100.00	\$800	CCI Historical	
Reports	1	EA	\$2,500.00	\$2,500	CCI Historical	
Misc	1	LS	\$500.00	\$500	CCI Historical	
		EA	\$0.00	\$0		
<b>SUBTOTAL</b>				\$5,000		
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$28,820</b>		
Mobilization/Demobilization	5%			\$1,441		
Subcontractor General Conditions	25%			\$7,205		
<b>SUBTOTAL</b>				<b>\$37,466</b>		
Contingency	25%			\$9,367	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11	
<b>SUBTOTAL</b>				<b>\$46,833</b>		
Escalation to Mid-Pt	4%			\$1,873		
Project Management	10%			\$4,683	USEPA 2000, p. 5-13, <\$100K	
Remedial Design	20%			\$9,367	USEPA 2000, p. 5-13, <\$100K	
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K	
<b>SUBTOTAL</b>				<b>\$62,756</b>		
<b>Taxes</b>						
Hawaii GET	4.72%		\$ 62,756	\$ 2,962		
	0%		\$ -	\$ -		
<b>SUBTOTAL</b>				<b>\$ 2,962</b>		
<b>TOTAL O&amp;M</b>				<b>\$65,718</b>		

Periodic Costs						
DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	10	1	LS	\$0	\$0	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	20	1	LS	\$0	\$0	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

PRESENT VALUE ANALYSIS						
COST TYPE	YEAR	TOTAL COST	PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$362,148	\$362,148	1.00	\$362,148	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					\$1,836,643	
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 3(NTA)</b>					<b>\$1,840,000</b>	

**SOURCE INFORMATION**

- United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).
- R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)
- R.S. Means Company. 2007. 26th Edition.
- ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.
- Historical CH2M HILL project cost information
- Calculations using Historical CH2M HILL project cost information (separate worksheet)

**Northern Target Area - Alternative 4(NTA)** **COST ESTIMATE SUMMARY**  
**Surface Clearance with Land Use Controls**

**Site:** Waikane Valley **Description:** This alternative would consist of surface clearance from accessible areas of the Northern Target Area and implementation of deed restrictions and zoning. Construction support would be required for any planned excavations. Educational programs would also be implemented.

**Location:** Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

<b>CAPITAL COSTS</b>						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>Land Use Controls</b>						
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000		
Fence, warning signs separate three areas	3600	LF	\$25	\$90,000		
<b>SUBTOTAL</b>				<b>\$100,000</b>		
<b>Clearance Activities</b>						
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000		
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,000.00	\$4,000		
Explosive Safety Submission	1	LS	\$10,000.00	\$10,000		
Permits	1	LS	\$1,000.00	\$1,000		
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000		
SOPs and AHAs	1	LS	\$20,000.00	\$20,000		
Site Visit	1	LS	\$15,000.00	\$15,000		
Mobilization/Survey	1	LS	\$17,000.00	\$17,000		
Mob/Demob Analog Magnetometer Man Portable Team	1	LS	\$25,000.00	\$25,000	5 person team	
Surface Clearance, < 30 degree slope	14.6	AC	\$8,500.00	\$124,100		
Surface Clearance, > 30 degree slope	2.9	AC	\$13,000.00	\$37,960		
Guarding Recovered MEC, MPPEH	15	DY	\$1,500.00	\$22,500		
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200		
MD Recovery, Storage and Disposal	3,500	LBS	\$3.00	\$10,500		
MEC Escort - Survey, Brush Clearing, etc.	30	DY	\$2,000.00	\$60,000		
Anomaly Investigation	500	EA	\$15.00	\$7,500		
BIP	20	EA	\$6,500.00	\$130,000		
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000		
Final Report	1	LS	\$30,000.00	\$30,000		
Pre-Post BIP Sampling	20	EA	\$10,000.00	\$200,000		
Site boundary survey	1	LS	\$30,000	\$30,000		
<b>SUBTOTAL</b>				<b>\$796,760</b>		
Contingency	25%		\$896,760	\$224,190	10% Scope + 15% Bid	
<b>SUBTOTAL</b>				<b>\$224,190</b>		
Project management	6%		\$1,120,950	\$67,257	USEPA 2000, p. 5-13, \$500K - \$2M	
Remedial design workplan	12%		\$1,120,950	\$134,514	USEPA 2000, p. 5-13, \$500K - \$2M	
Construction Management	8%		\$1,120,950	\$89,676	USEPA 2000, p. 5-13, \$500K - \$2M	
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate	
<b>SUBTOTAL</b>				<b>\$301,447</b>		
Hawaii GET	4.72%		\$ 1,422,397	\$ 67,137		
0%			\$ -	\$ -		
<b>SUBTOTAL</b>				<b>\$ 67,137</b>		
<b>TOTAL CAPITAL COST</b>				<b>\$ 1,489,534</b>		

<b>OPERATIONS AND MAINTENANCE COST</b>						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>O&amp;M LUC</b>						
Labor	96	HR	\$80	\$7,680	CH2M Est.	
Educational Program	80	HR	\$80	\$6,400	CH2M Est.	
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance	
Misc	1	LS	\$100	\$100	CH2M HILL Allowance	
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.	
<b>SUBTOTAL</b>				<b>\$23,820</b>		
<b>Environmental Sampling</b>						
Pre-Post BIP Sampling	0	LS	\$0.00	\$0		
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical	
Lab Analysis	1	LS	\$1,200.00	\$1,200	CCI Historical	Monthly
Data Validation	8	HR	\$100.00	\$800	CCI Historical	
Reports	1	EA	\$2,500.00	\$2,500	CCI Historical	
Misc	1	LS	\$500.00	\$500	CCI Historical	
		EA	\$0.00	\$0		
<b>SUBTOTAL</b>				<b>\$5,000</b>		
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$28,820</b>		
Mobilization/Demobilization	5%			\$1,441		
Subcontractor General Conditions	25%			\$7,205		
<b>SUBTOTAL</b>				<b>\$37,466</b>		
Contingency	25%			\$9,367	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11	
<b>SUBTOTAL</b>				<b>\$46,833</b>		
Escalation to Mid-Pt	4%			\$1,873		
Project Management	10%			\$4,683	USEPA 2000, p. 5-13, <\$100K	
Remedial Design	20%			\$9,367	USEPA 2000, p. 5-13, <\$100K	
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K	
<b>SUBTOTAL</b>				<b>\$62,756</b>		
<b>Taxes</b>						
Hawaii GET	4.72%		\$ 62,756	\$ 2,962		
0%			\$ -	\$ -		
<b>SUBTOTAL</b>				<b>\$ 2,962</b>		
<b>TOTAL O&amp;M</b>				<b>\$65,718</b>		

<b>Periodic Costs</b>						
DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	10	1	LS	\$0	\$0	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	20	1	LS	\$0	\$0	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

<b>PRESENT VALUE ANALYSIS</b>						
COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$1,489,534	\$1,489,534	1.00	\$1,489,534	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	
					<b>\$2,964,029</b>	

Discount Rate = 2.3%

Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

Northern Target Area - Alternative 4(NTA) Surface Clearance with Land Use Controls		COST ESTIMATE SUMMARY	
<b>Site:</b>	Waikane Valley	<b>Description:</b>	This alternative would consist of surface clearance from accessible areas of the Northern Target Area and implementation of deed restrictions and zoning. Construction support would be required for any planned excavations. Educational programs would also be implemented.
<b>Location:</b>	Target Area		
<b>Phase:</b>	Feasibility Study		
<b>Base Year:</b>	2011		
<b>Date:</b>	9/15/2011		
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 4(NTA)</b>		<b>\$2,960,000</b>	
<p><b>SOURCE INFORMATION</b></p> <ol style="list-style-type: none"> <li>1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000).</li> <li>2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor)</li> <li>2b. R.S. Means Company. 2007. 26th Edition.</li> <li>2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition.</li> <li>3. Historical CH2M HILL project cost information</li> <li>4. Calculations using Historical CH2M HILL project cost information (separate worksheet)</li> </ol>			

**Northern Target Area - Alternative 5(NTA) COST ESTIMATE SUMMARY**  
**Surface/Subsurface Clearance (All Accessible Land) with Land Use Controls**

**Site:** Waikane Valley **Description:** This alternative involves surface and subsurface clearance of MEC from accessible areas within the Northern Target Area. Maximum depth of clearance would be 2 feet bgs. Land use would be accompanied by deed restrictions and zoning/planning controls. Construction support would be required for excavations beyond 2-feet in depth anywhere within the Target Area. Educational programs would also be implemented.

**Location:** Target Area  
**Phase:** Feasibility Study  
**Base Year:** 2011  
**Date:** 9/15/2011

<b>CAPITAL COSTS</b>						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>Land Use Controls</b>						
Include Land Use Controls in Base General Plan	1	LS	\$10,000	\$10,000		
Fence, warning signs separate three areas	7500	LF	\$25	\$187,500		
<b>SUBTOTAL</b>				<b>\$197,500</b>		
<b>Clearance Activities</b>						
Project Management Plan/Workplan	1	LS	\$45,000.00	\$45,000		
Abbreviated Site Specific Health & Safety Plan	1	LS	\$4,500.00	\$4,500		
Explosive Safety Submission	1	LS	\$12,000.00	\$12,000		
Permits	1	LS	\$1,000.00	\$1,000		
Pre-Mobilization Co-ordination	1	LS	\$2,000.00	\$2,000		
SOPs and AHAs	1	LS	\$20,000.00	\$20,000		
Site Visit	1	LS	\$15,000.00	\$15,000		
Mobilization/Survey	1	LS	\$17,000.00	\$17,000		
Mob/Demob Analog Magnetometer Man Portable Team	1	LS	\$25,000.00	\$25,000	5 person team	
Surface Clearance, < 30 degree slope	14.6	AC	\$8,500.00	\$124,100		
Surface Clearance, > 30 degree slope	2.9	AC	\$13,000.00	\$37,960		
Analog Magnetometer mag & dig	18.7	AC	\$65,000.00	\$1,216,800		
Guarding Recovered MEC, MPPEH	10	DY	\$1,500.00	\$15,000		
MEC, MPPEH Explosive Disposal	1	EA	\$200.00	\$200		
MD Recovery, Storage and Disposal	4,200	LBS	\$3.00	\$12,600		
MEC Escort - Survey, Brush Clearing, etc.	30	DY	\$2,000.00	\$60,000		
Anomaly Investigation	500	EA	\$15.00	\$7,500		
BIP	20	EA	\$6,500.00	\$130,000		
Site Clean-up, Demob	1	LS	\$5,000.00	\$5,000		
Final Report	1	LS	\$30,000.00	\$30,000		
Pre-Post BIP Sampling	20	EA	\$10,000.00	\$200,000		
Site boundary survey	1	LS	\$30,000	\$30,000		
<b>SUBTOTAL</b>				<b>\$2,010,660</b>		
Contingency	25%		\$2,208,160	\$552,040	10% Scope + 15% Bid	
<b>SUBTOTAL</b>				<b>\$552,040</b>		
Project management	6%		\$2,760,200	\$165,612	USEPA 2000, p. 5-13, \$500K - \$2M	
Remedial design workplan	12%		\$2,760,200	\$331,224	USEPA 2000, p. 5-13, \$500K - \$2M	
Construction Management	8%		\$2,760,200	\$220,816	USEPA 2000, p. 5-13, \$500K - \$2M	
Documentation of Closure Activities	1	LS	\$10,000	\$10,000	ROM estimate	
<b>SUBTOTAL</b>				<b>\$727,652</b>		
Hawaii GET	4.72%		\$ 3,487,852	\$ 164,627		
<b>SUBTOTAL</b>	0%		\$ -	\$ -		
<b>TOTAL CAPITAL COST</b>				<b>\$ 3,652,479</b>		

<b>OPERATIONS AND MAINTENANCE COST</b>						
DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES	
<b>O&amp;M LUC</b>						
Labor	96	HR	\$80	\$7,680	CH2M Est.	
Educational Program	80	HR	\$80	\$6,400	CH2M Est.	
Replacement Parts/Supplies	1	LS	\$1,000	\$1,000	CH2M HILL Allowance	
Misc	1	LS	\$100	\$100	CH2M HILL Allowance	
UXO Escort, Includes vehicle	96	HR	\$90	\$8,640	CH2M Est.	
<b>SUBTOTAL</b>				<b>\$23,820</b>		
<b>Environmental Sampling</b>						
Pre-Post BIP Sampling	0	LS	\$0.00	\$0		
Groundwater/Surface Water Monitoring	0	LS	\$3,000.00	\$0	CCI Historical	
Lab Analysis	1	LS	\$1,200.00	\$1,200	CCI Historical Monthly	
Data Validation	8	HR	\$100.00	\$800	CCI Historical	
Reports	1	EA	\$2,500.00	\$2,500	CCI Historical	
Misc	1	LS	\$500.00	\$500	CCI Historical	
		EA	\$0.00	\$0		
<b>SUBTOTAL</b>				<b>\$5,000</b>		
<b>SUBTOTAL - ALL TASKS - O &amp; M</b>				<b>\$28,820</b>		
Mobilization/Demobilization	5%			\$1,441		
Subcontractor General Conditions	25%			\$7,205		
<b>SUBTOTAL</b>				<b>\$37,466</b>		
Contingency	25%			\$9,367	10% Scope + 15% Bid, USEPA 2000, p.5-10 & 5-11	
<b>SUBTOTAL</b>				<b>\$46,833</b>		
Escalation to Mid-Pt	4%			\$1,873		
Project Management	10%			\$4,683	USEPA 2000, p. 5-13, <\$100K	
Remedial Design	20%			\$9,367	USEPA 2000, p. 5-13, <\$100K	
Construction Management	0%			\$0	USEPA 2000, p. 5-13, <\$100K	
<b>SUBTOTAL</b>				<b>\$62,756</b>		
<b>Taxes</b>						
Hawaii GET	4.72%		\$ 62,756	\$ 2,962		
<b>SUBTOTAL</b>	0%		\$ -	\$ -		
<b>TOTAL O&amp;M</b>				<b>\$65,718</b>		

<b>Periodic Costs</b>						
DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
5 year Review	5	1	LS	\$15,000	\$15,000	
5 year Review	10	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	10	1	LS	\$0	\$0	
5 year Review	15	1	LS	\$15,000	\$15,000	
5 year Review	20	1	LS	\$15,000	\$15,000	
Reapplication for POTW Permit	20	1	LS	\$0	\$0	
5 year Review	25	1	LS	\$15,000	\$15,000	
5 year Review	30	1	LS	\$15,000	\$15,000	
				Total	\$90,000	
<b>TOTAL ANNUAL PERIODIC COST</b>					<b>\$90,000</b>	

Discount Rate = 2.3% Source: USEPA 2000, page 4-5. This rate represents a "real" discount rate approximating interest rates adjusted for inflation. Annual & periodic costs should be constant in this analysis.

<b>PRESENT VALUE ANALYSIS</b>						
COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (2.3%)	PRESENT VALUE	NOTES
CAPITAL COST	0	\$3,652,479	\$3,652,479	1.00	\$3,652,479	
ANNUAL O&M COST - Cap	1 to 30	\$0	\$65,718	21.50	\$1,412,896	
PERIODIC COST	5	\$15,000	\$15,000	0.89	\$13,388	
PERIODIC COST	10	\$15,000	\$15,000	0.80	\$11,949	
PERIODIC COST	15	\$15,000	\$15,000	0.71	\$10,665	
PERIODIC COST	20	\$15,000	\$15,000	0.63	\$9,519	
PERIODIC COST	25	\$15,000	\$15,000	0.57	\$8,496	
PERIODIC COST	30	\$15,000	\$15,000	0.51	\$7,583	

Northern Target Area - Alternative 5(NTA) Surface/Subsurface Clearance (All Accessible Land) with Land Use Controls		COST ESTIMATE SUMMARY	
<b>Site:</b>	Waikane Valley	<b>Description:</b>	This alternative involves surface and subsurface clearance of MEC from accessible areas within the Northern Target Area. Maximum depth of clearance would be 2 feet bgs. Land use would be accompanied by deed restrictions and zoning/planning controls. Construction support would be required for excavations beyond 2-feet in depth anywhere within the Target Area. Educational programs would also be implemented.
<b>Location:</b>	Target Area		
<b>Phase:</b>	Feasibility Study		
<b>Base Year:</b>	2011		
<b>Date:</b>	9/15/2011		
			\$5,126,974
<b>TOTAL PRESENT VALUE FOR ALTERNATIVE 6(NTA)</b>			<b>\$5,130,000</b>
<b>SOURCE INFORMATION</b>			
1. United States Environmental Protection Agency. July 2000. A Guide to Preparing and Documenting Cost Estimates During the Feasibility Study. EPA 540-R-00-002. (USEPA, 2000). 2a. R.S. Means Company. 2004. Environmental Remediation Cost Data - Unit Price, 10th Edition. R.S. Means Company and Talisman Partners, Ltd. Kingston, MA. (Includes materials, equipment, and labor) 2b. R.S. Means Company. 2007. 26th Edition. 2c. ECHOS (Environmental Cost Handling Options and Solutions). 2006. 12th Edition. 3. Historical CH2M HILL project cost information 4. Calculations using Historical CH2M HILL project cost information (separate worksheet)			



## **APPENDIX C**

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### **Comments and Responses**

State of Hawaii Department of Health  
Hazard Evaluation and Emergency Response Office  
File # 11-593-SPM  
Reviewer: Steven P. Mow

Document: Draft Feasibility Report		Date: 13-Oct-11		
Item	Page	Section	Comment	Response
1	ES-5	Comparative Analysis of Alternatives	The No Action alternative is meant to be a baseline for the other alternatives considered. As a risk has been identified in the RI and the alternative does not meet the Remedial Action Objectives, this alternative does not pass the threshold criteria (Overall protectiveness and Compliance with ARARs) and should not be scored at all. Furthermore, every table (e.g., Table ES-1) that indicates that the No Action Alternative meets the Threshold Criteria should be changed from "Yes" to "No".	Agree. The current condition of the site provides protection to the public by restricting access, thereby meeting the threshold criteria. That's why we scored the No Action alternative against the balancing criteria. We will add the cost of maintenance to continue with this No Action alternative. However, we realize that the current condition does not meet the RAOs, and that's why we eliminated the No Action alternative as a viable option. The Recommendations section and Executive Summary will clarify this distinction.
2	Tables ES-1, ES-2, & ES-3	Summary of Comparative Analysis	Revise the "Yes" responses under the No Action alternative as explained in Comment #1.	Agree. See above.
3	Tables ES-2, & ES-3	Summary of Comparative Analysis	For short-term effectiveness, why would LUCs with Construction Support in the Northern Target Area (scored a 3) be rated lower than in the Northern Non-Target Area (scored a 4)?	Since the Northern Target Area has the highest concentration of MEC and has a higher accessible acreage, it is expected to require more construction support, with greater short-term impact on the community. Therefore it is less favorable.
4	Tables ES-2, & ES-3	Summary of Comparative Analysis	For comparative cost, the cost difference between LUCs with Construction Support versus LUCs alone is less in the Northern Non-Target Area (\$120K) than in the Northern Target Area (\$370K) yet LUCs with Construction Support scores worse in the Northern Non-Target Area than in the Northern Target Area (3 vs. 4). Please explain why that is.	The main reason the Northern Non-Target Area scores lower than the Northern Target Area is because the accessible acreage is so much lower. However, we agree that for Northern Target Area the LUC and LUCs w/Construction Support should not have the same score and have been revised. The scores are now in agreement with Northern Non-Target Area.
5	Tables ES-2, & ES-3	Summary of Comparative Analysis	For implementability, if the Northern Non-Target Area is harder to access than the Northern Target Area, how can it score better in implementation (2 vs. 1)? Please explain.	Northern Non-Target Area was scored independently from Northern Target Area. The NNTA scored better in implementation because there was such a small accessible acreage when compared to the Northern Target Area. However, when you look at both areas together, we agree that they should score equally for implementation. Table has been revised accordingly.
6	General		Given that the three areas are connected, it seems odd to look at them as three separate remedies instead of collectively as one. Another table that shows the different combinations of the alternatives in the different areas (e.g., Alt #3 in the Southern Area, Alt #4 in the Northern Area, and Alt #2 in the Northern Non-Target Area) would be helpful and more useful in selecting an appropriate overall remedy for the area.	A table is provided showing the three sites combined to allow an easier comparison. We can substitute this table for the three tables currently used in the Executive Summary.
7	General		Given the limited site access to and clearance coverage of the Northern Non-Target Area, is surface clearance of this area the best alternative? Greater clean-up in the areas that are accessible (the Southern Area) or are more contaminated (the Northern Target Area) would seem like a better use of resources.	Agree. Based on DOH and community comments, surface clearance of the Northern Non-Target Area is not necessary. FS Report is being revised to shift resources to the Southern Area and cultural sites per public comment.
8	General		Revise the Comparative Analysis Tables per the comments above and re-submit the tables for review as soon as possible.	See response to Comments 1-6 above.
				Note: Based on stakeholder and public comments, we are now proposing the following alternatives for addressing the property: 1) Surface clearance of accessible areas in Southern Area and Northern Target Area; 2) Removal of the fence from the Southern Area; Installation of fencing between the Southern and Northern Areas; 3) Subsurface clearance of a 10-foot wide buffer strip along the south side of the fence; 4) Subsurface clearance in the Southern Area in a 50-foot radius of any MEC found during the surface clearance; and 5) Subsurface clearance of corridors to and around the Kamaka Shrine and Waikane Spring, and the installation of fencing along and around these cleared areas, to allow free access to these sites from the Southern Area. Subsurface clearance is 2 foot depth, since evidence shows that the ordinance used at WVIA does not penetrate deeper than 2 feet. Land use controls will be recommended for the Northern Areas.

Restoration Advisory Board  
 Letter To Whom It May Concern  
 Reviewer: David Henkin, Co-Chair

Document: Draft Feasibility Report			
Date: 20-Oct-11			
Item	Page	Section	Comment
			<p>The selection of alternatives to analyze in the Waikane Valley Impact Area (WVIA) Feasibility Study (FS) does not arise in a vacuum. It arises in the context of a promise that the U.S. military made to the Kamaka family that, once military training in Waikane was completed, the land would be cleared of unexploded ordnance (UXO) and returned. The purpose of referencing this history is not to lay blame for decisions that were made in the past, but rather to point the way forward toward a solution to a longstanding issue of major concern to the community.</p> <p>The Marines have received a comment letter from the Kamaka family, dated October 12, 2011, in which the family identifies priorities for UXO clearance to permit a return to traditional farming and cultural practices on its ancestral land. The family's priorities include clearing the Southern Area to a depth of five feet to permit unrestricted residential and agricultural use, such as the reestablishment of taro lo'i. [The draft Feasibility Study evaluates subsurface clearance to only two feet in depth, which would permit only grazing (which raises the potential for significant environmental degradation in the Southern Area's riparian zone), rather than traditional agriculture.] It also emphasizes the need to ensure unrestricted access to the sacred sites (including the Waikane Spring and Kamaka family shrine) that are located in the Northern Target Area.</p>
1	General		<p>The Marines should revise their FS to evaluate the Kamaka family's priorities. In the Southern Area, this means considering an alternative that would ensure subsurface UXO clearance to a minimum of five feet in depth, rather than only two feet, as evaluated in the draft FS. As discussed at the September 21, 2011 RAB meeting, a phased approach might accomplish this outcome, with subsurface clearance required only if an initial surface sweep reveals the presence of munitions and explosives of concern (MEC). [At the RAB meeting, Bob Nore of USA Environmental stated that the rockets that were used at the WVIA were thin-skinned and could not penetrate deep into the ground. Accordingly, he said that, if MEC were not encountered in the first two feet of depth, one could safely assume there is no MEC in the Southern Area, and unrestricted use of the land should be possible. The FS should be revised to reflect this important information.]</p>
2	General		<p>For the Northern Target Area, the FS should evaluate subsurface clearance of designated paths to the cultural sites, as well as thorough clearance of the sites themselves, to permit unrestricted cultural access to the sites without the future need for escort by UXO technicians.</p>
			<p>From the beginning of the RAB process, the community members have consistently advocated for maximum clean-up of the WVIA to permit the return of the land to culturally appropriate, civilian use. The results of the Remedial Investigation indicate that achieving this goal is possible, at least in those portions of the WVIA that are most suited for residential, agricultural, and cultural use. We encourage the Marines to ensure the FS examines the clean-up options that respond to the community's core needs and aspirations. [Please note that, prior to submittal, these comments were shared with the community RAB members, and no objections or suggestions for revision were received.]</p>
			<p>Thank you for your interest and input to the feasibility study for WVIA. We believe that with the continued guidance of the RAB we will arrive at the solution that best addresses the long-term interests of the community.</p>
			<p>Based on your comments, those of the Kamaka family, and those of others who reviewed the draft Feasibility Study Report and attended the last RAB meeting, we are now proposing the following alternatives for addressing the property:</p> <ol style="list-style-type: none"> <li>1) Surface clearance of accessible areas in Southern Area and Northern Target Area;</li> <li>2) Removal of the fence from the Southern Area; Installation of fencing between the Southern and Northern Areas;</li> <li>3) Subsurface clearance of a 10-foot wide buffer strip along the south side of the fence;</li> <li>4) Subsurface clearance in the Southern Area in a 50-foot radius of any MEC found during the surface clearance; and</li> <li>5) Subsurface clearance of corridors to and around the Kamaka Shrine and Waikane Spring, and the installation of fencing along and around these cleared areas, to allow free access to these sites from the Southern Area. Subsurface clearance is to 2 foot depth, since evidence shows that the ordnance used at WVIA does not penetrate deeper than 2 feet. Land use controls will be recommended for the Northern Areas.</li> </ol>
			<p>In the Southern Area, if MEC is found on the surface, we propose to conduct subsurface clearance of the entire accessible area within 50 feet of the MEC item. If MEC continues to be found inside the radius, the step-out process continues until no more MEC is being discovered. This approach should convince the Department of Defense Explosives Safety Board that the land can be released for unrestricted use. If they cannot be convinced, The USMC will activate the Construction Support option for future development plans.</p>
			<p>The proposed fence between Southern and Northern Areas currently follows close to the 200-foot elevation, and we are proposing subsurface clearance of corridors to and around Kamaka Shrine and Waikane Spring, and the installation of fencing along and around those cleared areas. This approach allows free access to the two sites.</p>
			<p>The comments provided by the community and other stakeholders have been most helpful in guiding us to what we believe is the most appropriate response to the MEC issues at WVIA. We thank you and the RAB for your comments.</p>

Document: Draft Feasibility Report		Date: 21-Oct-11	
Item	Page	Section	Response
			<p>We appreciate your interest in the Waikane Valley feasibility study, and the time and effort you have provided as a RAB member and in offering your comments. While the Navy and Marine Corps environmental cleanup team is not in a position to address the issue of future land ownership, we are making every effort to work with the community and regulators to identify remedial alternatives that are both technologically possible and safe for workers and nearby residents and will result in the least amount of restrictions on future land use options. Changes have been made in the feasibility study to focus our remedial efforts on the Southern Area and cultural sites within the Northern Target Area as these were identified by the community as most significant. Our goal is to return as much land as possible in these areas to conditions which will allow for agricultural and cultural activities similar to what was conducted on the site prior to Marine Corps training activities.</p>
1	General	<p>Thank you for the opportunity to comment on the Draft Feasibility Study. I submit these comments in my personal capacity as a RAB member. However, I'd like to note that my organization, Hawaii Peace and Justice (formerly the American Friends Service Committee Hawaii Area Program) has long advocated for the cleanup and return of Waikane lands to the Kamaka family. We have held that the lands were unjustly taken from the family, with devastating consequences for the lives of family members, cultural sites and practices and agricultural activities that had been conducted there. The promise made by the U.S. military to return the Waikane lands in its original condition after military training ended still needs to be fulfilled.</p> <p>As I stated in our last RAB meeting, the Marine Corps should incorporate additional evaluation criteria that take into account the history, cultural significance and desires of the people with ancestral connections to the land. This prioritization criterion might be called "Environmental Justice" — on a scale of 1 to 5, how well is justice being served by the particular alternative.</p>	<p>During the feasibility study process, we evaluated 7 of the required 9 evaluation criteria. The two remaining criteria that are now being evaluated are Stakeholder Acceptance and Community Acceptance. These criteria are meant to consider cultural significance and the desires of the people who are concerned with the land. As a result of your comments and those of others who reviewed the draft Feasibility Study Report and attended the last RAB meeting, we are now proposing the following alternatives for addressing the property: 1) Surface clearance of accessible areas in Southern Area and Northern Target Area; 2) Removal of the fence from the Southern Area; 3) Subsurface Installation of fencing between the Southern and Northern Areas; 4) Subsurface clearance of a 10-foot wide buffer strip along the south side of the fence; 5) Subsurface clearance in the Southern Area in a 50-foot radius of any MEC found during the surface clearance; and 6) Subsurface clearance of corridors to and around the Kamaka Shrine and Waikane Spring, and the installation of fencing along and around these cleared areas, to allow free access to these sites from the Southern Area. Subsurface clearance is to 2 foot depth, since evidence shows that the ordinance used at WVI/A does not penetrate deeper than 2 feet. Land use controls will be recommended for the Northern Areas.</p>
2	General	<p>The criterion of "comparative cost" is problematic because it only looks at the monetary cost to the Marine Corps, but externalizes the social and environmental costs. A more accurate way to determine the cost would be to take into consideration the social and environmental cost to the community. For example the alternative that is least costly to the Marine Corps might have a very high cost to the community in terms of lost productivity, restricted land use, danger to future generations, and disintegration of traditional cultural knowledge, practices and resources. If these costs were to be factored in, it would change the overall rating of the alternatives.</p> <p>I concur with the Kamaka family that the Southern Zone should be restored to a condition suitable for unrestricted use and that the land should be cleared to a depth of five feet to allow for safe farming and construction. The FS should be amended so that in the event that UXO is discovered in the surface sweeps, it would trigger a more intensive and thorough subsurface investigation in that vicinity rather than land use controls.</p>	<p>The comparative cost followed EPA guidance, and is limited in what it can consider. However, we trust that our revisions to the recommended alternatives will be the approach that is most acceptable to the community.</p>
3	General	<p>The Northern Target Area contains a number of sacred sites that must be cleaned up and opened to unrestricted cultural access. We propose that the Marine Corps concentrate its effort on the accessible terrain up to a two-hundred foot elevation and the cultural sites (including the Kamaka family shrine and Waikane Spring). These areas must be cleared to allow for unrestricted access. Mahalo for your commitment to restoring this important area.</p>	<p>Your comment has been incorporated into our recommendation for the Southern Area</p>
4	General		<p>Your comment to provide access to the Kamaka family shrine and Waikane Spring has been addressed in our recommendation for the Northern Target Area. The boundary between northern and southern areas roughly follows the 200-foot elevation. Mahalo for your comments.</p>

Document: Draft Feasibility Report		Date: 12-Oct-11	
Item	Page	Section	Response
			<p>We appreciate your comments and your understanding of the difficulties involved in a total cleanup of the property. Based on your comments and those of others who reviewed the draft Feasibility Study Report and attended the last RAB meeting, we are now proposing the following alternatives for addressing the property:</p> <ol style="list-style-type: none"> <li>1) Surface clearance of accessible areas in Southern Area and Northern Target Area;</li> <li>2) Removal of the fence from the Southern Area; Installation of fencing between the Southern and Northern Areas;</li> <li>3) Subsurface clearance of a 10-foot wide buffer strip along the south side of the fence;</li> <li>4) Subsurface clearance in the Southern Area in a 50-foot radius of any MEC found during the surface clearance; and</li> <li>5) Subsurface clearance of corridors to and around the Kamaka Shrine and Waikane Spring, and the installation of fencing along and around these cleared areas, to allow free access to these sites from the Southern Area.</li> </ol> <p>Subsurface clearance is to 2 foot depth, since evidence shows that the ordinance used at WVVA does not penetrate deeper than 2 feet. Land use controls will be recommended for the Northern Areas.</p>
1	General	<p>On behalf of the Kamaka family, we respectfully submit the following comments and proposed modifications to the feasibility study. As we are the traditional konohiki of this land and have farmed the lands of Waikane Valley for generations, we want to continue our traditional farming and cultural practices. We understand that in said study, there were a number of requirements involved in pursuing a clean-up of unexploded ordnance (UXO). Our ultimate goal is to have our land be returned in its original condition prior to military use and to eliminate hazards to the health and safety of the people and the environment. Since previous fieldwork in Waikane has proven unsuccessful in reaching the regions with steep grades, we propose the following prioritization list:</p>	<p>In the Southern Area, if MEC is found on the surface, we propose to conduct subsurface clearance of the entire accessible area within 50 feet of the MEC item. If MEC continues to be found inside the radius, the step-out process continues until no more MEC is being discovered.</p>
2	General	<p>The Northern Target Area is the most contaminated with UXO but also contains a number of sacred sites that must be cleaned up and opened to unrestricted cultural access. We propose that the Marine Corps concentrate its effort on the accessible terrain up to a two-hundred foot elevation and the cultural sites (including the Kamaka family shrine and Waikane Spring). These areas must be cleared to allow for unrestricted access.</p>	<p>The proposed fence between Southern and Northern Areas currently follows close to the 200-foot elevation, and we are proposing subsurface clearance of corridors to and around Kamaka Shrine and Waikane Spring, and the installation of fencing along and around those cleared areas. This approach allows free access to the two sites.</p>
3	General	<p>We concur with the proposed Feasibility Study on the treatment of the Northern Non-Target Area. The steep slopes in most of the Northern non-target area are not safe to access and cannot be utilized for residential, agricultural, cultural or recreational activities.</p> <p>The bottom line is that to be pono (just, fair) the military should restore the land to its previous condition to the greatest extent possible. The areas that are most useful and sacred must be a priority for the highest level of clean up. We know that the Mairnes wish to do the right thing by the community and our family. Mahalo for your commitment to restoring this important area.</p>	<p>We appreciate your understanding of the safety hazards involved in working along these steep slopes, and are proposing only Land Use Controls for the Northern Non-Target Area.</p> <p>Mahalo for your comments. Changes were made to the FS Report recommended actions so that resources and efforts will be focused on the Southern Area and cultural sites in the Northern Area as requested by the community and RAB members.</p>