DRAFT-FINAL

FEASIBILITY STUDY REPORT

PACIFIC JUNGLE COMBAT TRAINING CENTER
OAHU, HAWAII

FUDS Project Number H09HI027401
Contract: W912DY-10-D-0053
Task Order: 0002

Prepared for:

United States Army Corps of Engineers, Honolulu District

and

United States Army Engineering and Support Center, Huntsville

November 2015
Revision 2

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Acronyms and Abbreviations

AMR	Archaeological Monitoring Report
ARARs	applicable or relevant and appropriate requirements
BWS	Honolulu Board of Water Supply
CEPOH	Unites States Army Corps of Engineers, Honolulu District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	conceptual site model
DD	Decision Document
DEM	City and County of Honolulu Department of Emergency Management
DLNR	Department of Land and Natural Resources
DMM	discarded military munitions
DU	decision unit
EALs	environmental action levels
EPA	United States Environmental Protection Agency
ESQD	explosive safety quantity distance
FS	feasibility study
FUDS	Formerly Used Defense Sites
GIS	geographic information system
GRAs	general response actions
HAs	Hazard Assessments
HBMP	Hawaii Biodiversity and Mapping Program
HDOH	State of Hawaii Department of Health
HE	high explosive
IA	Institutional Analysis
INPR	Inventory Project Report
KVM	Kahana Valley Main
KVB	Kahana Valley Bunkers
LUCs	land use controls

MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MRS	munitions response site
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PD	point detonating
PJCTC	Pacific Jungle Combat Training Center
PP	Proposed Plan
RAC	risk assessment code
RAOs	remedial action objectives
RI	remedial investigation
SUXOS	senior UXO supervisor
Tech	technician
TNT	trinitrotoluene
TO	task order
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers
USAESCH	United States Army Engineering and Support Center, Huntsville
USC	United States Code
UU/UE	unlimited use and unrestricted exposure
UXO	unexploded ordnance
UXOQCS	UXO quality control specialist
UXOSO	UXO safety officer
VSP	Visual Sampling Plan
WERS	Worldwide Environmental Remediation Services
§	Section

1.0 Executive Summary

This Feasibility Study (FS) Report was prepared for the United States Army Corps of Engineers (USACE), Honolulu District (CEPOH) and United States Army Engineering and Support Center, Huntsville (USAESCH) under Contract No. W912DY-10-D-0053, Task Order (TO) 0002 to address contamination at Formerly Used Defense Sites (FUDS) Property Number H09HI027401, also known as the former Pacific Jungle Combat Training Center (PJCTC), Oahu, Hawaii, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (Title 42 United States Code [USC] Sections [§] 9601–9675). A FS is a mechanism for developing, screening, and evaluating remedial alternatives to address hazards and risk identified during a Remedial Investigation (RI) under CERCLA. Specifically, the purpose of this FS Report is to evaluate remedial alternatives to address potential explosive hazards posed to humans from munitions and explosives of concern (MEC) identified during the RI at the PJCTC and documented in the "Draft Remedial Investigation Report, Pacific Jungle Combat Training Center, Oahu, Hawaii" (USACE, 2015). This FS has been developed as a separate document from the RI.

1.1 Site History and Description

1.1.0.1 The Army initially leased 485.25 acres in Kahana Valley in November 1944, retroactive to May 1943. Between 1943 and 1947, the Army acquired an additional 1,781.52 acres in the neighboring Punaluu Valley from various valley landowners through leases, licenses, and informal permits. The properties were established as a unit jungle combat training center beginning in September 1943. The training center was used to teach basic and advanced jungle warfare, as well as instructor training (USACE, 2015).

1.1.0.2 Training was divided among Blue, Red, and Green Courses. Basic jungle warfare training was conducted at Blue and Red Courses, while advanced jungle warfare training and the Instructor Jungle Training School were conducted on the Green Course. Live ammunition was reportedly used during jungle warfare training scenarios. Advanced training on the Green Course was discontinued in May 1944 to focus on basic jungle warfare training (USACE, 2015).

1.1.0.3 In March 1945, the center became known as the Unit Combat Training Centers. One month later, it was redesignated as Pacific Combat Training Center to de-emphasize jungle warfare. Over 241,000 men received basic, advance, or instructor training at the center (USACE, 2015).

1.1.0.4 Postwar plans called for closing most of the center except for the Green Course in Punaluu Valley, which was to be retained to fulfill the Army's postwar training requirements. Parcels in Kahana Valley were returned to previous landowners in August 1946. The leases, licenses, and permits for parcels in Punaluu Valley, including the Green Course, terminated between April 1945 and November 1950 and were reverted back to previous owners (USACE, 2015).

1.1.0.5 The former PJCTC is located on the northeast end of the island of Oahu, Hawaii (Appendix A, Figure A1-1). It consists of several noncontiguous parcels within the adjacent Kahana and Punaluu Valleys that total approximately 2,545[1] acres based on the 2004 Inventory Project Report (INPR) Supplement (USACE, 2004). The parcels are collectively considered a munitions response site (MRS) (USACE, 2015).

1.1.0.6 The MRS is naturally divided by topographic features into two separate and distinct valleys, Punaluu Valley to the northwest and Kahana Valley to the southeast (Appendix A, Figure A1-1). Although both valleys were used for jungle warfare training, the types and quantities of MEC and munitions debris (MD) found vary significantly. For these reasons, and based on a comparison of RI findings and previous investigation data with respect to historical usage, topographical features, current/future land use scenarios, property ownership, and potential receptors of the MRS, the MRS was divided into two sections: Kahana Valley and Punaluu Valley. Kahana Valley was further divided into two subareas: Kahana Valley Main (KVM) and Kahana Valley Bunkers (KVB). The KVB area is a small area located in the southwest corner of the Kahana Valley. KVM was used solely as a maneuver area and includes all areas of Kahana Valley outside of KVB. KVB was used as both a maneuver area and a target area (Appendix A, Figure A1-1; USACE, 2015).

1.1.1 Kahana Valley

1.1.1.1 The Kahana Valley FUDS property is naturally bound by the Koolau mountain range to the south and ridgelines to the east and west. It consists of one large parcel and several smaller parcels closer to the mouth of the valley (Appendix A, Figure A1-1). Collectively, the parcels total approximately 484 acres. All parcels are owned by the State of Hawaii and managed by the Department of Land and Natural Resources (DLNR), Division of State Parks (USACE, 2015).

1.1.1.2 The Kahana Valley parcels are located in the Ahupua‘a ‘O Kahana State Park. The park was established as a “living park” with the primary purpose to nurture and foster native Hawaiian cultural traditions and the cultural landscape of rural windward Oahu. Thirty-one families live within the ahupua’a of Kahana. They assist with interpretive programs that share the Hawaiian values and lifestyle. Additionally, public hiking trails, campsites, and hunting areas within the park intersect with the site. Permits are required to access the campsites and hunting areas (USACE, 2015).

1.1.1.3 KVM encompasses approximately 480.09 acres and is wholly contained within the Kahana Valley FUDS property (Appendix A, Figure A1-1). KVM is primarily undeveloped forest with steep, rugged terrain. Public hiking trails, an agricultural field, and access to a public water utility are within the FUDS property boundaries. KVB encompasses approximately 10.14 acres

[1] *Site acreage calculated with Geographical Information System (GIS) is 2,387 acres. The acreages reported in this document and on maps are based on GIS-calculated acreages, unless otherwise noted.*

and is partially contained within the Kahana Valley FUDS property (Appendix A, Figure A1-1). Approximately 5.85 acres of KVB is located outside of the FUDS MRS boundary. KVB is primarily undeveloped forest with moderate to steep, rugged terrain located in the west, southwest portion of Kahana Valley. The boundaries of KVB were determined by topography and the footprint of the cluster of bunkers. A portion of a public hiking trail runs through the area (USACE, 2015).

1.1.1.4 Future anticipated land use is not expected to deviate from the current land use.

1.1.2 Punaluu Valley

1.1.2.1 The Punaluu Valley section encompasses approximately 1,903 acres (Appendix A, Figure A1-1). Kamehameha Schools primarily owns the Punaluu Valley parcels. Kamehameha Schools leases land for agricultural purposes. Private landowners own several of the smaller parcels (USACE, 2015).

1.1.2.2 Interior portions of the Punaluu Valley parcels are located in the Hauula Forest Reserve. Residential dwellings are located at the mouth of the valley, mainly outside of the MRS boundaries. Isolated residences are located within the MRS closer to the front of the valley, with the majority of the available flat or less steep portions being used for agricultural purposes. These agricultural areas have undergone significant vegetation removal and mass grading to allow for light farming operations. Hunting is allowed by permit only from Kamehameha Schools in the interior portions of the valley, although access is judiciously controlled and generally restricted to valley residents, guests, and landowner and lessees. Kamehameha Schools has developed the Punaluʻu Ahupuaʻa Plan that identifies 29 projects and programs to be developed in the future. Several have target dates within the next 3 to 5 years. Future projects and programs focus on economic and agricultural development, educational programs, cultural support, and environmental management (USACE, 2015).

1.2 Environmental Setting

1.2.1 The PJCTC is located along the northeastern slope of the Koolau Range and the coastal plain of Oahu. Kahana and Punaluu Valleys are undeveloped, rugged, and densely forested land with mixed residential, agricultural, and recreational uses confined to the lower portions at the front of the valley. The topography of each valley is relatively flat to gently sloping in the lower portions of the valleys, with shallow to deep gulches and moderate to steep slopes farther into the valleys. As shown on Figure A1-1, the majority of the PJCTC MRS occupies inland areas deep within the two valleys, more than half of a mile from the entrance to the valleys. The Punaluu Valley interior is uninhabited and densely vegetated with no access roads or trails beyond the valley's midway point with the exception of a few sparse unmarked hunting trails. The Ahupuaʻa ʻO Kahana State Park covers the interior of the Kahana Valley, which is also uninhabited, but is accessible by the Nakoa Trail that roughly encircles the perimeter of the largest MRS parcel in

Kahana Valley. Elevations range from near sea level to approximately 2,000 feet above sea level in the mountainous interior regions (Parsons, 2008).

1.2.2 The surface water hydrology is characterized by the occurrence of numerous streams that flow from the high-elevation mountain areas of the Koolau Range into the valleys, where they coalesce and eventually discharge into the ocean. No lakes or other large bodies of water are in the PJCTC, although wetlands are present in the lower parts of both valleys and a fishpond is in the lower Kahana Valley (Parsons, 2008).

1.2.3 The depths to groundwater in the PJCTC are uncertain, but likely vary considerably depending on the ground surface elevation. In the lower parts of the valleys near the coast, groundwater probably occurs at relatively shallow depths that approximate sea level elevation. In the inland portions of the PJCTC, where surface elevations are considerably higher, the depth to groundwater is probably much deeper relative to surface grade. Most of the PJCTC is located above the State of Hawaii Department of Health (HDOH) Underground Injection Control (UIC) Line, which means the underlying aquifer is considered a drinking water source (Parsons, 2008).

1.2.4 Most of the PJCTC is dominated by non-native or introduced plant species; however, four plants species, Maʻoliʻoli (*Schiedea kaalae*), pendant kihi fern (*Adenophorus periens*), haha (*Cyanea grimesiana*), and haha (*Cyanea humboldtian*a), were identified in the Hawaii Biodiversity & Mapping Program (HBMP) as being present within the PJCTC. These four plant species are federally listed as endangered species. A portion of Designated Critical Habitat for Oahu, Unit 20, designated for two Cyanea species (*C. crispa* and *C. truncate)*, has boundaries within the higher elevations of Punaluu Valley (Huikala, 2013).

1.2.5 The HBMP also identified five federally listed endangered animal species in the PJCTC. The animal species include Koloa (*Anas wyvilliana*), `Alae`ula (*Gallinula chloropus sandvicensis*), `Alae Ke`oke`o (*Fulica alai*), Oahu `Elepaio (*Chasiempis sandwichensis ibidis*), and honu, also known as the Green Sea Turtle (*Chelonia mydas*) (USACE, 2015).

1.2.6 No threatened or endangered plant species were observed during the RI. Additional information on the environmental setting of the site is presented in Section 2.3.4 of this FS Report.

1.3 Nature and Extent of Contamination

Cumulatively from all previous investigations and incident responses, 37 MEC items, 122 MD items, and 114 small arms ammunitions debris were found within the PJCTC (i.e., Kahana Valley and Punaluu Valley) during previous investigations (Section 2.3.7) (Appendix A, Figures A1-2 and A1-3). The MEC and MD finds were generally concentrated in four areas of Kahana Valley and six areas of Punaluu Valley. All of the MEC items were found on the surface or at a depth less than 1 foot below ground surface. In addition, analysis of the MEC and MD data using Visual Sample Plan (VSP) software identified 11 areas of either high anomaly density (i.e., >100 anomalies per acre) or elevated anomaly density (i.e., >50 anomalies per acre) within the PJCTC

(Appendix A, Figures A1-4 and A1-5). Four areas were determined to represent target or maneuver areas. The following sections summarize the nature and extent of contamination within Kahana Valley and Punaluu Valley.

1.3.1 Kahana Valley

1.3.1.1 Cumulatively from all previous investigations and incident responses, 2 MEC items, 68 MD items, 53 small arms ammunition debris have been found in Kahana Valley (Appendix A, Figure A1-2). Section 2.3.7.1 summarizes the type and number of MEC, MD, and small arms items found during previous investigations. Figure A1-2 shows the original locations of the items found in Kahana Valley.

1.3.1.2 In addition, two high anomaly density areas (one of which was identified as a target area) and two elevated anomaly density areas were identified during the RI (Appendix A, Figure A1-4). Of these four high- and elevated anomaly density areas, only one was identified as a target area, specifically the southwestern high anomaly density area (i.e., KVB) (Appendix A, Figure A1-4).

1.3.1.3 Soil samples for analysis of munitions constituents (MC), including metals (antimony, copper, lead, molybdenum, and zinc) and explosives (nitroaromatics, nitramines, and nitrate esters) were collected in accordance with the Uniform Federal Policy-Quality Assurance Project Plan included as an appendix to the approved Work Plan (Huikala, 2013).

1.3.2 Punaluu Valley

1.3.2.1 Cumulatively from all previous investigations and incident responses, 35 MEC items, 54 MD items, and 61 small arms ammunition debris have been found in Punaluu Valley (Appendix A, Figure A1-3). Section 2.3.7.1 summarizes the type and number of MEC, MD, and small arms items found during previous investigations. Figure A1-3 shows the original locations of the items.

1.3.2.2 In addition, five high anomaly density areas (two of which were identified as a target area) and two elevated anomaly density areas were identified using VSP software during the RI (Appendix A, Figure A1-5). An additional target area not delineated by VSP was identified during the RI based on field observations and a recovered MEC item.

1.3.2.3 Consistent with the sampling conducted in the Kahana Valley, soil samples in Punaluu were analyzed for MC (i.e., metals [antimony, copper, lead, molybdenum, and zinc] and explosives [nitroaromatics, nitramines, and nitrate esters]) in accordance with the Uniform Federal Policy-Quality Assurance Project Plan included as an appendix to the approved Work Plan (Huikala, 2013).

1.4 Hazard Assessment for MEC and Baseline Risk Evaluation for MC

1.4.1 Baseline MEC Hazard Assessments (HAs) were performed for KVM, KVB, and Punaluu Valley as part of the RI to assess the explosive hazards to humans from MEC, specifically the

acute hazard posed by the explosive components of MEC, assuming no response action was taken at each site. Separate MEC HAs were performed for each area rather than for the PJCTC as a whole to more accurately evaluate the potential risk posed by MEC to site receptors.

1.4.2 The MEC HAs evaluated current and future human receptors at the sites and consisted of, as applicable, residents, recreational users (i.e., visitors, hikers, hunters), agricultural workers, and occupational workers (i.e., trail, road, and utility maintenance workers). They evaluated the potential exposure pathways to MEC, which included direct contact with MEC present on the surface and subsurface in accessible areas. Potential MEC HA scores range from a minimum possible score of 125 and maximum possible score of 1,000, with corresponding hazard levels ranging 1 to 4 (1 being the highest hazard and 4 being the lowest hazard). Results of the MEC HAs are as follows:

- KVM – The MEC HA score for this subdivision is 755, with a MEC HA hazard level of 2 (high potential explosive hazard)
- KVB - The MEC HA score for this subdivision is 825, with a MEC HA hazard level of 2 (high potential explosive hazard)
- Punaluu – The MEC HA score for this section is 895 with a MEC HA hazard level of 1 (highest potential explosive hazard)

1.4.3 The MEC HA does not directly address the environmental or ecological risks that might be associated with the chemical components of MEC (i.e., MC). These risks, when present, are generally addressed in separate human health and ecological risk assessments. MC were not identified at concentrations exceeding the HDOH Tier 1 environmental action levels (EALs) in any of the samples collected during the RI. Because MCs did not exceed HDOH Tier 1 EALs, they do not pose a risk to human health or the environment. Therefore, human health and ecological risk assessments were not performed and no response action is required to address these contaminants.

1.5 Remedial Action Objectives

The remedial action objectives (RAOs) for the former PJCTC are based on the results of the previous investigations and the results of the MEC HAs. The following RAOs were identified for the PJCTC:

- Kahana Valley – reduce exposure of residents, recreational users (i.e., campers, hikers, hunters), and occupational workers (i.e., trail and utility maintenance personnel) to explosive hazards associated with munitions items varying in size from fuzes to 2.36-inch rocket mortars present in surface and subsurface soil and sediment to a depth of 1 foot below ground surface within the boundaries of the Kahana Valley section of the MRS to acceptable risk levels. Acceptable risk will be defined such that exposure to

MEC can be considered an "unlikely" or a "negligible" hazard to the public based on supporting data.

- Punaluu Valley – reduce exposure of residents, recreational users (i.e., hikers and hunters), agricultural workers, and occupational workers (i.e., road and utility workers) to explosive hazards associated with munitions items varying in size from fuzes to 81-millimeter (mm) mortars present in surface and subsurface soil and sediment to a depth of 1 foot below ground surface within the boundaries of the Punaluu Valley section of the MRS to acceptable risk levels. Acceptable risk will be defined such that exposure to MEC can be considered an "unlikely" or a "negligible" hazard to the public based on supporting data.

1.6 General Response Actions, Remedial Technologies, and Process Options

1.6.1 General response actions (GRAs) are responses or remedies that would meet the RAOs to protect human health from MEC in the PJCTC. The two primary GRAs applicable to these sites are land use controls (LUCs) and removal of MEC. Other GRAs, such as containment, are not feasible based on the terrain and vegetation, professional engineering judgment, and experience with response actions proven successful for MEC at other MRSs.

The following GRAs, including associated technologies and, processes, were identified:

- Land Use Controls – Includes land use and access restrictions implemented through administrative mechanisms, legal mechanisms, and engineering controls to reduce the potential for human interaction with MEC and associated unintentional detonation, which may result in injury or death to humans and/or to damage ecological and cultural resources. Processes for implementation of LUCs include legal and administrative mechanisms (e.g., permitting to restrict land use and/or specific site access restrictions) and engineering and educational controls (e.g., warning signs and, community outreach and visitor education)

- Removal of MEC – Includes surface and subsurface clearance of MEC using various technologies to assist with locating items. The technology used for surface and subsurface removal of MEC includes analog detection methods (i.e., metal detectors) to detect the presence of MEC and MD. Reduction of MEC volume includes demilitarization of MEC by detonation in place or, if deemed acceptable to move, in a consolidated point, and disposal of MD in 55-gallon drums to an authorized recycler.

1.6.2 The associated process options, including technologies, identified for each GRA were screened using the following three criteria: (1) effectiveness; (2) implementability; and (3) cost. Both GRAs and their process options were retained for further evaluation in the FS.

1.7 Development of Remedial Alternatives

The retained process options were combined into remedial alternatives to meet RAOs and to satisfy applicable or relevant and appropriate requirements (ARARs). The remedial alternatives were derived using experience and engineering judgment to formulate process options into the most plausible site-specific response actions. The following remedial alternatives for Kahana Valley and Punaluu Valley were selected for the detailed and comparative analysis.

Kahana Valley

- Alternative 1 – No Action
- Alternative 2 – LUCs. LUCs would be implemented to reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources.
- Alternative 3 – Complete Removal of MEC from Target Area (Appendix A, Figure A4-1). Removal of surface and subsurface MEC within the identified target area (i.e., KVB) would significantly reduce, if not eliminate, the probability of a human encounter with MEC and the potential for unintentional MEC detonation and would result in unlimited use and unrestricted exposure (UU/UE).

  This alternative includes clearance of up to 10.58 acres to remove surface and subsurface MEC from KVB, the only identified target area within Kahana Valley.

Punaluu Valley

- Alternative 1 – No Action
- Alternative 2 – LUCs. LUCs would be implemented to reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources.
- Alternative 3 – Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs (Appendix A, Figure A4-2). Complete removal of surface and subsurface MEC within three identified and accessible areas and implementation of LUCs would significantly reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation.

  This alternative includes clearance of up to 18.83 acres to remove surface and subsurface MEC from the two identified target areas, one of which includes active agricultural fields, and one high anomaly density area. MEC removal in these areas in

addition to signage and long-term management will significantly reduce the potential for human interaction with MEC and associated unintentional detonation.

- Alternative 4 – Complete Removal of MEC from Target Areas and High Anomaly Density Areas (Appendix A, Figure A4-3). Complete removal of surface and subsurface MEC within three identified target areas and two high anomaly density areas would predominantly eliminate the probability of a human encounter with MEC and the potential for unintentional MEC detonation. This alternative would result in UU/UE.

  This alternative includes clearance of up to 38.87 acres to remove surface and subsurface MEC from the three identified target areas (one of which includes active agricultural fields) and two high anomaly density areas. MEC removal in these areas will predominantly eliminate the potential for human interaction with MEC and associated unintentional detonation in the areas of Punaluu Valley with the greatest potential MEC presence.

1.8 MEC Hazard Assessment of Alternatives

1.8.1 As part of the FS, the MEC HAs for the PJCTC (i.e., KVM, KVB, and Punaluu Valley) were updated to evaluate hazards to humans under the remedial alternative scenarios identified in Section 1.7. The MEC HAs were performed in accordance with the U.S. Environmental Protection Agency's (EPA) "Munitions and Explosives of Concern Hazard Assessment Methodology" guidance (EPA, 2008). Under the MEC HA methodology, sites are scored based on a variety of input parameters and are ultimately ranked according to hazard levels. Hazard levels ranging from 1 to 4 with a hazard level of 1 corresponding to the highest potential explosive. Results of the MEC HAs are as follows:

<u>KVM</u>

- Scenario 1: No Action. Score = 755, Hazard Level 2
- Scenario 2: LUCs. Score = 715, Hazard Level 3

<u>KVB</u>

- Scenario 1: No Action. Score = 825, Hazard Level 2
- Scenario 2: LUCs. Score = 750, Hazard Level 2
- Scenario 3: Complete Removal of MEC from Target Area. Score = 435, Hazard Level 4

<u>Punaluu Valley</u>

- Scenario 1: No Action. Score = 895, Hazard Level 1

- Scenario 2: LUCs. Score = 895, Hazard Level 1
- Scenario 3: Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs. Score = 480, Hazard Level 4
- Scenario 4: Complete Removal of MEC from Target Areas and High Anomaly Density Areas. Score = 480, Hazard Level 4

1.8.2 Section 5.1 provides detailed information on the MEC HA input parameters. Appendix B includes the MEC HA worksheets.

1.9 Detailed Analysis of Alternatives

Each remedial alternative was evaluated in comparison to the two threshold and five balancing evaluation criteria established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The two modifying criteria, state and community acceptance, will be assessed after the Proposed Plan (PP) public comment period and documented in the Decision Document (DD) following comment on the FS Report and the PP. A comparative analysis was then conducted to evaluate the relative performance of the remedial alternatives. Section 5.2 summarizes the detailed analysis.

NATIONAL CONTINGENCY PLAN EVALUATION CRITERIA

Threshold Criteria
- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements

Balancing Criteria
- Long-term effectiveness and permanence
- Reduction of mobility, toxicity, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria
- State acceptance
- Community acceptance

1.10 Comparative Analysis of Alternatives

The remedial alternatives for each valley were compared to each other and the seven NCP criteria evaluated by valley. The following subsections detail the results of the comparison.

1.10.1 Kahana Valley

Alternative 3, Complete Removal of MEC from Target Area, received the highest rating with an overall rating of very good. This alternative, when compared against the other three alternatives, presents the best alternative for achieving overall protection of human health and the environment in compliance with ARARs. Alternative 3 permanently reduces the mobility, toxicity, and volume of MEC within the identified target area (i.e., KVB); thereby, significantly reducing the potential for a human encounter with MEC and associated unintentional detonation within Kahana Valley. Alternative 2, LUCs, would reduce the probability of a human encounter with MEC and the potential for an unintended MEC detonation through site access and use restrictions and public education. However, it would not reduce the mobility, toxicity, or volume of MEC at the site and long-term effectiveness is dependent on the LUCs being effectively administered. Therefore,

Alternative 2 received an overall rating of moderate. Alternative 1, No Action, would not reduce risks posed to the public by explosive hazards through removal of MEC or other means; therefore, it received an overall rating of poor.

1.10.2 Punaluu Valley

1.10.2.1 Alternative 3, Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs, received the highest rating with an overall rating of very good. This alternative, when compared against the other three alternatives, presents the best alternative for achieving overall protection of human health and the environment in compliance with ARARs. Alternative 3 would permanently reduce the mobility, toxicity, and volume of MEC, thereby significantly reducing the potential for human encounter with MEC and associated unintentional detonation within Punaluu Valley. Although munitions items could potentially remain in place in other areas of Punaluu Valley under this alternative, given the inaccessibility of the remaining areas (due to dense vegetation and ruggedness of terrain) and the lower anomaly densities in these areas, the probability of a human encounter with MEC in the remaining areas is considered extremely low. When compared against Alternative 4, this alternative results in less impact to the environment, is less costly to complete and requires less time to implement. In addition, LUCs implemented under Alternative 3 would provide additional reduction in risk from residual MEC in other areas of the site.

1.10.2.2 Alternative 4, Complete Removal of MEC from Target Areas and High Anomaly Density Areas, received an overall rating of good. Short-term effectiveness was rated moderate because remedial activities would not increase exposure of workers or the community during implementation and could be completed within 21 weeks. However, significant environmental impacts would occur, specifically vegetation clearance of 38.87 acres. Costs for implementation are high.

1.10.2.3 Alternative 2, LUCs, would reduce the probability of a human encounter with MEC and the potential for an unintended MEC detonation, through site access and use restrictions and public education. It would not reduce the mobility, toxicity, or volume of MEC at the site and long-term effectiveness is dependent on the LUCs being effectively administered. Therefore, Alternative 2 received an overall rating of moderate.

1.10.2.4 Alternative 1, No Action, would not reduce risks posed to the public by explosive hazards through removal of MEC or other means; therefore, it received an overall rating of poor.

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2.0 Introduction

This FS is performed for the former PJCTC, FUDS Project No. H09HI027401 and prepared on behalf of the CEPOH and USAESCH under Contract No. W912DY-10-D-0053, TO No. 0002.

2.1 Purpose and Scope

2.1.1 The purpose of this FS Report is to develop and evaluate remedial alternatives applicable at the FUDS property based on the findings of the "Remedial Investigation Report, Pacific Jungle Combat Training Center, Oahu, Hawaii" (USACE, 2015). Specifically, this FS Report evaluates remedial alternatives to address potential explosive hazards from potential MEC at the former PJCTC that pose a threat to humans and ecological (i.e., endangered animal and plant species) and cultural resources within the FUDS property boundaries. This FS has been developed as a separate document from the RI.

2.1.2 This FS Report was prepared in accordance with the following regulations and guidance:

- NCP (Title 40 Code of Federal Regulations [CFR] Part 300)
- "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988)
- Engineer Pamphlet 1110-1-18, "Ordnance and Explosives Response" (USACE, 2006)
- Worldwide Environmental Remediation Services (WERS) Data Item Description 010.02, "EE/CA, RI, and FS Reports" (USAESCH, 2012)

2.1.3 The NCP states that remediation should be accomplished through the use of cost-effective remedial alternatives that effectively lessen threats to and provide adequate protection of public health, welfare, and the environment (55 Federal Register 8850, March 8, 1990). This FS Report evaluates remedial alternatives that are protective of human health and the environment.

2.1.4 During the FS process, GRAs and technologies are evaluated and grouped into remedial alternatives, which are further evaluated. The process consists of the following general steps:

- Establish RAOs specifying the chemicals and media of concern, exposure pathways, receptors and potential receptors, and preliminary remediation goals that permit a range of alternatives to be developed. The RAOs are developed based on specific ARARs and the risk evaluation results included in the RI Report.
- Develop GRAs for each medium defining containment, removal, treatment, or other actions (such as LUCs,), singly or in combination, that may be taken to satisfy the RAOs for the site. Identify volumes or areas to which GRAs would apply.

- Identify and screen remedial technologies for each GRA to determine which technologies could be implemented technically and cost effectively at the site.
- Identify and screen process options for each remedial technology that are most appropriate for use at the site.
- Develop remedial alternatives by combining retained process options.
- Evaluate the alternatives against the evaluation criteria established by the NCP and against each other.

2.2 Report Organization

2.2.1 This FS Report is organized as follows:

- Section 1.0 – Executive Summary, summarizes the RI and provides an overview of the results of the development and analysis of remedial alternatives presented in this FS Report.
- Section 2.0 – Introduction, summarizes the purpose of the FS; provides key site information for the former PJCTC, including (1) site description, (2) site history, (3) environmental setting, (4) previous investigations, (5) nature and extent of contamination, (6) conceptual site model (CSM), and (7) risk assessment results.
- Section 3.0 – Identification and Initial Screening of Technologies, presents RAOs and ARARs for the former PJCTC based on previous investigation results. GRAs are then identified that address the RAOs and ARARs. Process options associated with each GRA are screened for technical effectiveness, implementability, and cost.
- Section 4.0 – Development and Description of Remedial Alternatives, presents a detailed description of the remedial alternatives that were developed based on the retained process options in Section 3.0 that will satisfy the RAOs. Process options recommended for consideration are assembled, singularly or in combination, to create the remedial alternatives.
- Section 5.0 – Detailed and Comparative Analysis of Remedial Alternatives, presents the MEC HA for each remedial alternative and the evaluation of each remedial alternative developed in Section 4.0 against the NCP's evaluation criteria and against each other to evaluate their relative advantages and disadvantages with respect to the nine evaluation criteria.
- Section 6.0 – References, presents a list of documents and supporting material used to prepare this report.

2.2.2 In addition, evaluations and supplemental information for this FS Report are presented in the following appendices:

- Appendix A – Figures
- Appendix B – MEC HA Worksheets, presents the detailed HAs for Kahana Valley and Punaluu Valley that were used to evaluate the relative hazard reductions associated with each alternative.
- Appendix C – Remedial Alternatives Cost Estimates, presents detailed costs and associated assumptions for each alternative that were used to support the evaluation of the cost criterion in Section 5.0.
- Appendix D – Institutional Analysis Report, presents the results of the institutional analysis, conducted to collect basic data to support the development of a land use control program.

2.3 Site Background

This section summarizes background information for the former PJCTC that was previously presented in the RI Report (USACE, 2015). Background information includes the site description and a summary of the site history, environmental setting, previous investigations, nature and extent of contamination, CSM, and risk assessments.

2.3.1 Site Description

2.3.1.1 The former PJCTC is located on the northeast end of the island of Oahu, Hawaii (Appendix A, Figure A1-1). It consists of several noncontiguous parcels within the adjacent Kahana and Punaluu Valleys that total approximately 2,545[2] acres based on the 2004 INPR Supplement (USACE, 2004). The parcels are collectively considered a MRS. Portions of the MRS are located within the boundaries of the Ahupua‘a ‘O Kahana State Park and Hauula Forest Reserve (USACE, 2015).

2.3.1.2 In February 2013, CEPOH corrected the MRS boundaries in both Kahana and Punaluu Valleys to align them with the property boundaries in the historical real estate records used to establish the property’s FUDS eligibility. Appendix A, Figure A1-1 depicts both the former and corrected MRS boundaries (USACE, 2015).

[2] *Site acreage calculated with GIS is 2,387 acres. The acreages reported in this document and on maps are based on GIS-calculated acreages, unless otherwise noted.*

2.3.1.3 The MRS is naturally divided by topographic features into two separate and distinct valleys, Punaluu Valley to the northwest and Kahana Valley to the southeast (Appendix A, Figure A1-1). Although both valleys were used for jungle warfare training, the types and quantities of MEC and MD found vary significantly. For these reasons, and based on a comparison of RI findings and previous investigation data with respect to historical usage, topographical features, current/future land use scenarios, property ownership, and potential receptors of the MRS, the MRS was divided into two sections: Kahana Valley and Punaluu Valley. Kahana Valley was further divided into two subareas to facilitate evaluation of remedial alternatives in this FS: KVM and KVB. KVM was used solely as a maneuver area and includes all areas of Kahana Valley outside of KVB. KVB was used as both a maneuver area and a target area (Appendix A, Figure A1-2; USACE, 2015).

2.3.2 Kahana Valley

2.3.2.1 The Kahana Valley section is naturally bound by the Koolau mountain range to the south and ridgelines to the east and west. It consists of one large parcel and several smaller parcels closer to the mouth of the valley (Appendix A, Figure A1-1). Collectively, the parcels total approximately 484 acres. All parcels are owned by the State of Hawaii and managed by the DLNR, Division of State Parks (USACE, 2015).

2.3.2.2 The Kahana Valley parcels are located in the Ahupua‘a ‘O Kahana State Park. The park was established as a “living park,” with the primary purpose to nurture and foster native Hawaiian cultural traditions and the cultural landscape of rural windward Oahu. Thirty-one families live within the ahupua’a of Kahana. They assist with interpretive programs that share the Hawaiian values and lifestyle. Additionally, public hiking trails, campsites, and hunting areas within the park intersect with the site. Permits are required to access the campsites and hunting areas. There are no known plans for future development that deviate from the current usage (USACE, 2015).

2.3.2.3 Kahana Valley Road is the primary access road to the Kahana Valley parcels. Locked gates or chained barriers are located at the end of the public vehicular thoroughfare. Gates are maintained by the State of Hawaii DLNR Division of State Parks or the Honolulu Board of Water Supply (BWS). Vehicular access beyond the gates requires permission of State Parks or BWS, as appropriate. Several of the smaller parcels located at the mouth of Kahana Valley can be accessed via Trout Farm Road (USACE, 2015).

2.3.2.4 Pedestrian access to the largest parcel within the valley is available via the Nakoa Trail, which is a 2.5-mile loop public hiking trail. This trail roughly encircles the perimeter of the major parcel of the Kahana Valley and crosses the Kahana Stream at three points.

2.3.2.5 KVM is a subdivision of the Kahana Valley section. KVM encompasses approximately 480.09 acres located primarily on one larger parcel toward the rear of the valley more than a half mile from the entrance to the valley on Kamehameha Highway and is wholly contained within the

Kahana Valley FUDS property (Appendix A, Figure A1-2). KVM is primarily undeveloped forest with steep, rugged terrain. A public hiking trail (Nakoa Trail), an agricultural field, and access to a public water utility are within the FUDS property boundaries (USACE, 2015).

2.3.2.6 KVB is an isolated area of the Kahana Valley section, comprising of a former bunker area at the farthest interior point of the Kahana Valley MRS. KVB encompasses approximately 10.14 acres and is partially contained within the Kahana Valley FUDS property (Appendix A, Figure A1-2). Approximately 5.85 acres are located outside of the FUDS MRS boundary. KVB is primarily undeveloped forest with moderate to steep, rugged terrain located in the west, southwest portion of Kahana Valley. The boundaries of KVB were determined by topography and the footprint of the cluster of bunkers. The KVB is only accessible on foot via a the Nakoa Trail that runs through the area (USACE, 2015).

2.3.3 Punaluu Valley

2.3.3.1 The Punaluu Valley section encompasses approximately 1,903 acres (Appendix A, Figure A1-1). The Kamehameha Schools primarily owns the Punaluu Valley parcels. Kamehameha Schools leases land for agricultural purposes. Private landowners own several of the smaller parcels (USACE, 2015).

2.3.3.2 Interior portions of the Punaluu Valley parcels are located in the Hauula Forest Reserve. Residential dwellings are located at the mouth of the valley mainly outside of the MRS boundaries. Isolated residences are located within the MRS closer to the front of the valley, with the majority of the available flat or less steep portions being used for agricultural purposes. These agricultural areas have undergone significant vegetation removal and mass grading to allow for light farming operations. Hunting is allowed by permit only from Kamehameha Schools in the interior portions of the valley, although access is judiciously controlled and generally restricted to valley residents, guests, and landowner and lessees. Kamehameha Schools has developed the Punaluʻu Ahupuaʻa Plan that identifies 29 projects and programs to be developed in the future and largely relegated to the accessible areas at the front of the valley. Several have target dates within the next 3 to 5 years. Future projects and programs focus on economic and agricultural development, educational programs, cultural support, and environmental management (USACE, 2015).

2.3.3.3 The entrance to Punaluu Valley can be accessed via Punaluu Valley Road (sometimes referred to as Green Valley Road), a paved public thoroughfare. Punaluu Valley Road becomes unpaved at approximately a quarter mile into the valley and is blocked by a vehicle gate, controlled by private landowners. A privately owned and controlled irrigation access road off of Kamehameha Highway also provides access to the site entrance (USACE, 2015). The unpaved road is the only road available to access the interior portions of Punaluu Valley. It is only traversable with a four-wheel drive vehicle because it is steep and narrow in some areas and crosses a fast-moving stream

in several locations. The unpaved road terminates approximately half way into the valley at a gauging station, beyond which there is no vehicular access and extremely dense vegetation.

2.3.4 Site History

2.3.4.1 The Army initially leased 485.25 acres in Kahana Valley in November 1944, retroactive to May 1943. Between 1943 and 1947, the Army acquired an additional 1,781.52 acres in the neighboring Punaluu Valley. The properties were established as a unit jungle combat training center beginning in September 1943. The training center was used to teach basic and advanced jungle warfare, as well as instructor training (USACE, 2015).

2.3.4.2 Training was divided among Blue, Red, and Green Courses. Basic jungle warfare training was conducted at Blue and Red Courses, while advanced jungle warfare training and the Instructor Jungle Training School were conducted on the Green Course. Live ammunition was reportedly used during jungle warfare training scenarios. The Army reportedly constructed Japanese villages and pillboxes for training purposes. Temporary barracks, a mess hall, a bakery, and shower facilities were also erected, although they no longer exist. Advanced training on the Green Course was discontinued in May 1944 to focus on basic jungle warfare training (USACE, 2015).

2.3.4.3 In March 1945, the center became known as the Unit Combat Training Centers. One month later, it was redesignated as Pacific Combat Training Center to de-emphasize jungle warfare. More than 241,000 men received basic, advance, or instructor training at the center (USACE, 2015).

2.3.4.4 Postwar plans called for closing most of the center except for the Green Course in Punaluu Valley, which was to be retained to fulfill the Army's postwar training requirements. The Army reopened Punaluu Valley on 01 April 1946 to provide emergency shelter for area residents displaced by a tsunami. Tents were erected for sleeping quarters, to render medical treatment, and to feed approximately 1,700 individuals. De-dudding efforts were conducted in Punaluu Valley in 1949 as a result of live ammunition used during training (USACE, 2015).

2.3.4.5 Parcels in Kahana Valley were returned to previous landowners in August 1946. The leases, licenses, and permits for parcels in Punaluu Valley terminated between April 1945 and November 1950 and were reverted back to previous owners (USACE, 2015).

2.3.5 Formerly Used Defense Site Eligibility

The Hui of Kahana et al. issued a license dated 1 November 1944, retroactive to 20 May 1943, to the Army for use of approximately 485.25 acres of land in Kahana Valley. The Army acquired approximately 1781.52 acres in neighboring Punaluu Valley through leases, licenses, and informal permits issued by various valley landowners between 15 October 1943 and 1 March 1947. Several instruments were executed retroactively to 1, 15, and 18 October 1943. Kahana and Punaluu Valleys were used as a unit jungle combat training center beginning on 6 September 1943, in response to a

9 August 1943 directive from the Commanding General, Hawaiian Department to establish a school on Oahu to supplement Department Ranger and Combat School training. Licenses for use of Kahana Valley were terminated on 31 August 1946. Leases, licenses, and informal permits for the Punaluu Valley parcels were terminated beginning on 23 April 1945, and the final license terminated on 30 November 1950. In the Findings and Determination of Eligibility included in the INPR, based on the historical use of Kahana and Punaluu Valleys as a unit combat training center, the PJCTC was deemed to be eligible for the Defense Environmental Restoration Program – FUDS, as presented in the Findings and Determination of Eligibility and signed by Brigadier General Ralph V. Locurcio (USACE, 1993).

2.3.6 Environmental Setting

The following sections summarizes the environmental setting of the PJCTC, including topography, climate, geology, hydrogeology, ecology, and cultural and ecological resources.

2.3.6.1 Topography

The PJCTC is located along the northeastern slope of the Koolau Range and the coastal plain of Oahu. Kahana and Punaluu Valleys are mostly undeveloped, rugged, and densely forested land with mixed residential, agricultural, and recreational uses towards the front of the valley. As shown on Figure A1-1, the majority of the PJCTC MRS occupies inland areas deep within the two valleys, more than half of a mile from the entrance to the valleys. The Punaluu Valley interior is uninhabited and densely vegetated with no access roads or trails beyond the valley's midway point with the exception of a few sparse unmarked hunting trails. The Ahupua'a 'O Kahana State Park covers the interior of the Kahana Valley, which is also uninhabited, but is accessible by the Nakoa Trail that roughly encircles the perimeter of the largest MRS parcel in Kahana Valley. The topography of each valley is relatively flat to gently sloping in the lower portions of the valleys, with shallow to deep gulches and moderate to steep slopes farther into the valleys. Elevations range from near sea level to approximately 2,000 feet above sea level in the mountainous interior regions (USACE, 2015).

2.3.6.2 Climate

Due to the location of the Hawaiian Islands in the northern tropics, Oahu's climate is mild and pleasant, primarily due to the presence of cooling trade winds. Average temperatures range from 65 to 88 ºF with moderate humidity of 53 percent during the day, with decreasing temperatures in higher elevations. Temperatures are coolest in January/February and warmest in August/September. Mean relative humidity on Oahu ranges from 61 to 80 percent per month (National Oceanic and Atmospheric Administration, 2013). The main mechanism for rainfall is warm, moist ocean air rising and cooling as it passes over the mountains causing precipitation. This results in higher rainfall in the windward and mountain areas and little rainfall in the leeward and coastal zones. The average annual rainfall ranges from 69 inches per year to 235 inches per year in the vicinity of the PJCTC (Giambelluca et al., 2012).

2.3.6.3 Geology

2.3.6.3.1 Oahu consists of the eroded remains of two coalesced shield volcanoes, the Waianae Volcano and the Koolau Volcano. Shield-building lavas emanated mainly from rift zones of the volcanoes. Subaerial eruptions of the Waianae Volcano occurred between 3.9 and 2.5 million years ago. Eruptions of the Koolau Volcano occurred between 2.6 and 1.8 million years ago. The volcanoes have subsided more than 6,000 feet, and erosion has destroyed all but the western rim of the Koolau Volcano and the eastern part of the Waianae Volcano, represented by the Koolau and Waianae Ranges, respectively (Hunt, 1996).

2.3.6.3.2 The geology in the interior parts of the PJCTC along the slope of the Koolau Range is mapped as the Koolau Basalt, which consists of tholeiitic basalt lava flows and feeder dikes (Hunt, 1996). The lower elevation areas that lie in the Kahana and Punaluu Valleys are underlain by alluvium at shallow depths. Marine sediment may underlie the alluvium in the lower parts of the valleys near the coast. Both valleys were cut back into the ancient cliffs of the Koolau Range by erosion during a higher stand in sea level and are considered to be "drowned valleys," as the floor of each valley extends offshore (Parsons, 2008).

2.3.6.3.3 Chemical weathering readily decomposes basaltic rocks to produce thick zones of clay rich saprolite that is easily eroded. The soil covering most of the PJCTC is the Waikane Series dark brown silty clay on steep terraces and alluvial fans. The Hanalei series dark gray silty clay is found in the less well-drained floodplains of the lower valleys (Parsons, 2008).

2.3.6.4 Site Hydrogeology

2.3.6.4.1 The surface water hydrology is characterized by the occurrence of numerous streams that flow from the high elevation mountain areas of the Koolau Range into the valleys, where they coalesce and eventually discharge into the ocean. Two primary streams, referred to as "pristine," are located in the PJCTC: the Punaluu Stream, which drains the Punaluu Valley, and the Kahana Stream, which drains Kahana Valley. No lakes or other large bodies of water are present in the PJCTC, although wetlands are present in the lower parts of both valleys and a fishpond is present in the lower Kahana Valley (Parsons, 2008).

2.3.6.4.2 The PJCTC is located in the eastern Oahu groundwater flow system. In this flow system, which lies east of the Koolau Range topographic divide, fresh groundwater flows east–northeast from the high elevation mountainous areas of the Koolau Range toward the low elevation coastal plain. A narrow band of caprock (sedimentary deposits) along the northeast Oahu coast confines fresh groundwater in the area. Springs present along the slope of the Koolau Range in the western part of the PJCTC result from the release of confined basal and/or dike impounded groundwater. The depths to groundwater in the PJCTC are uncertain, but likely vary considerably depending on the ground surface elevation. Appendix A, Figure A1-1 show the topography and ground surface elevations. In the lower parts of the valleys near the coast, groundwater probably occurs at relatively shallow depths that approximate sea level elevation. In the inland portions of

the PJCTC, where surface elevations are considerably higher, the depth to groundwater is probably much deeper relative to surface grade. Most of the PJCTC is located above the HDOH UIC Line, which means the underlying aquifer is considered a drinking water source (Parsons, 2008).

2.3.6.4.3 According to the Banks Environmental Data Water Well Report, 76 registered wells are within a 4-mile radius of PJCTC, of which 41 are listed as active wells. No active wells are present in any of the PJCTC parcels. Eleven public water supply (municipal) wells are located less than 0.5 mile of the PJCTC parcel boundaries. These municipal wells are owned by the Honolulu BWS (Banks Environmental Data, 2008).

2.3.6.5 Biological and Ecological Resources

2.3.6.5.1 Most of the PJCTC is dominated by non-native or introduced plant species; however, four plants species, Ma‘oli‘oli (*Schiedea kaalae*), pendant kihi fern (*Adenophorus periens*), haha (*Cyanea grimesiana*), and haha (*Cyanea humboldtian*a), were identified in the HBMP as being present within the PJCTC. These four plant species are federally listed as endangered species. A portion of Designated Critical Habitat for Oahu, Unit 20, designated for two Cyanea species (*C. crispa* and *C. truncate),* has boundaries within the higher elevations of Punaluu Valley (Huikala, 2013).

2.3.6.5.2 HBMP also identified five federally listed as endangered animal species in the PJCTC. The animal species include Koloa (*Anas wyvilliana*), `Alae`ula (*Gallinula chloropus sandvicensis*), `Alae Ke`oke`o (*Fulica alai*), Oahu `Elepaio (*Chasiempis sandwichensis ibidis*), and honu, also known as the Green Sea Turtle (*Chelonia mydas*) (Huikala, 2013).

2.3.6.5.3 No threatened or endangered plant species were observed during the RI. The few native plant species observed were located primarily on Punaluu ridges, out of the stream and valleys. Native plant species observed included ohia lehua (*Metrosideros polymorpha),* lama (*Diospyros sandwicensis*), koa (*Acacia koa),* hala (*Pandanus tectorius*), akia (*Wikstroemia oahuensis*), palaa (*Odontosoria chinensis*), ieie (F*reycinetia arborea*), maile (*Alyxia oliviformis*), and keee or sea bean (*Mucuna gigantea*) (USACE, 2015).

2.3.6.5.4 No threatened or endangered animal species were observed during the RI. Two migratory shorebirds, the Pacific Golden-Plover or Kolea (*Pluvialis fulva*) and the Black-crowned Night–Heron or `Auku`u (*Nycticorax nycticorax hoactli*), were observed in the PJCTC. While neither are threatened nor endangered species, they are protected by federal law under the Migratory Bird Treaty Act and by state law under Hawaii Administrative Rules Title 13 Chapter 124 (USACE, 2015).

2.3.6.5.5 Additional information on plant and animal species identified in the PJCTC is provided in the Biological Monitoring Report prepared as part of the RI Report (USACE, 2015).

2.3.6.6 Cultural Resources

2.3.6.6.1 An Archaeological Monitoring Report (AMR) (Cultural Surveys Hawaii, 2014) prepared for the PJCTC identified multiple archaeological features and areas of cultural significance within the PJCTC. During the RI, the project archaeologist identified an additional 132 features that were not previously recorded.

2.3.6.6.2 Additional information on cultural resources identified in the PJCTC is provided in the AMR (Cultural Surveys Hawaii, 2014) prepared as part of the RI Report (USACE, 2014).

2.3.7 Previous Investigations

2.3.7.1 The previous investigations summarized below have been conducted for the former PJCTC.

- 1993 Inventory Project Report (Wil Chee Planning, 1993)
  - Established the former PJCTC as an eligible property under the FUDS program.
  - Established the acreage, preliminary site boundaries.
  - Summarized the historical military usage and investigations at the former training area.
  - Identified munitions historically detected at the site, including:
    - Kahana Valley (Appendix A, Figure A2-1): 2.36-inch rocket (MD) and 105mm armor piercing projectile (MD)
    - Punaluu Valley (Appendix A, Figure A2-1): .30 caliber bullets, (M1 and M2 cartridges (MD), 75mm armor piercing or high explosive (HE) projectile (MEC), MK28 sea marker (MD), and an 81mm mortar (MEC)
  - Evaluated hazard severity and hazard probability for the PJCTC and assigned a Risk Assessment Code (RAC) of 1 (i.e., “imminent hazard”).
- 2004 INPR Supplement (USACE, 2004):
  - Increased MRS acreage; however, boundaries did not change and revised acreage was not officially approved.
  - Reevaluated hazard severity and probability and RAC downgraded to 2, “recommend and approve further action as appropriate.”
- 2008 Site Inspection Report (Parsons, 2008):
  - Conducted qualitative reconnaissance of 11.91 miles in the MRS (Appendix A, Figure A2-1).
  - One unexpended smoke grenade (MEC) was found in Punaluu Valley and .30 caliber casings (MD) were found in Kahana Valley during the qualitative reconnaissance. In

addition, four gun emplacements found in upper Kahana Valley and one gun emplacement found in Punaluu Valley (Appendix A, Figure A2-1).

- Incremental surface soil samples were collected from three decision units (DUs) within areas impacted by munitions and from two ambient locations in areas not expected to be affected by munitions activities (Appendix A, Figure A2-2). Surface water and sediment samples were collected from Kahana Stream and Punaluu Stream within the PJCTC boundary. Samples were analyzed for explosives (i.e., 2,4-dinitrotoluene) and metals (i.e., antimony, copper, lead, and zinc).
- 2,4-Dinitrotoluene was detected in one replicate sample from one ambient soil location, but not in the remaining samples. Metals were detected in all soil samples. Metals concentrations in the DU soil samples exceeded the metals concentrations in ambient soil samples.
- No explosives or metals were detected in the surface water samples.
- No explosives were detected, but copper, lead, and zinc were detected in both sediment samples.
- Human health and ecological risk assessments were performed for soil and sediment.
- No unacceptable risks were posed to humans or ecological receptors from exposure to the MC in surface soil or sediment.

- 2012 Bomb Incident Log (Honolulu Police Department, 2012):
  - Hunters identified military ordnance near a gauging station in Punaluu Valley.
  - A 2.36-in HE anti-tank rocket, M6A1 and a 0.25-pound block of trinitrotoluene (TNT) with a copper blasting cap were found (Appendix A, Figure A2-1).
  - U.S. Army Explosive Ordnance Disposal team disposed of MEC in place.
- 2014 Remedial Investigation (USACE, 2015):
  - A total of 33.02 miles (13.13 acres) of parallel and meandering transects and 11.51 acres of grids on land and 0.56 miles (0.22 acres) of underwater parallel transects were investigated (Appendix A, Figure A2-3 and A2-4).
  - Two MEC items, 31 MD items, and 32 small arms ammunitions debris were found in KVM as follows (Appendix A, Figure A2-5):

Table 2-1: MEC and MD in Kahana Valley – Main

Item Description	Quantity
MEC, Slap Flare, M127A1	1
MEC, Fuze point detonating (PD), M48 (Kahana Stream investigation)	1
MD, 2.36-inch Rocket Motor, Expended	1
MD, Fragmentation Unknown	10
MD, Fuze Component	1
MD, Slap Flare, M127A1	19
Small Arms Ammunitions Debris	32

- Thirty-five MD items and 22 small arms ammunitions debris were found in KVB as follows (Appendix A, Figure A2-5):

Table 2-2: MEC and MD in Kahana Valley – Bunkers

Item Description	Quantity
MD, 2.36-inch Rocket Motor, Expended	24
MD, Fragmentation Unknown	6
MD, M1 Firing Device*	1
MD, Slap Flare, M127A1*	2
MD, Trip Flare, M48, Expended*	2
Small Arms Ammunitions Debris	22

- Thirty MEC items, 53 MD items, and 61 small arms ammunitions debris were found in Punaluu Valley, all on land, as follows (Appendix A, Figure A2-6):

Table 2-3: MEC and MD in Punaluu Valley

Item Description	Quantity
MEC, 1/2-pound TNT Demolition Block	1
MEC, 60-mm Mortar, M49A2*	6
MEC, 81-mm Mortar, M56	6
MEC, Fuze, Type 88*	1
MEC, Hand Grenade, MK II*	1
MEC, 2.36-inch Rocket, M6A1	9
MEC, 2.36-inch Rocket, M6A1 (DMM)	1
MEC, Rifle Grenade, M9A1*	4

Table 2-3: MEC and MD in Punaluu Valley (continued)

Item Description	Quantity
MEC, Slap Flare, M127A1*	1
MD, 2.36-inch Rocket Motor, Expended	5
MD, 2.36-inch Rocket, M6A1	1
MD, 60-mm Mortar Tail Boom*	10
MD, 81-mm Mortar Tail Boom	5
MD, Fragmentation Unknown	24
MD, Fuze Component*	3
MD, Hand Grenade, Practice, MK1*	2
MD, Projectile, Lifting Lug*	1
MD, Slap Flare, M127A1*	2
Small Arms Ammunitions Debris	61

- Two high anomaly density areas and two elevated anomaly density areas were identified in Kahana Valley (Appendix A, Figure A1-4) using VSP[3]. The high anomaly density area at grid K08 was associated with a single slap flare that appears to have been discarded in place when it failed to perform as designed (Appendix A, Figure A2-5). No other MEC items were found in the vicinity of K08. The second high anomaly density area, located in the southwestern back corner of the valley, contained nine bunkers and, based on the concentration of expended 2.36-inch rocket motors (MD) around the bunkers, appears to have been used as a target area (Appendix A, Figure A2-5). The two areas of elevated anomaly density (i.e., located near transects K003/T80 and K023) were associated with a high quantity of small arms debris finds and one slap flare MD (Appendix A, Figure A2-5), which do not pose a risk to the public. Of the four high and elevated anomaly density areas identified, only the high anomaly density area around the bunkers (i.e., KVB) is considered to have been a target area.

- Two large high anomaly density areas, three smaller high anomaly density areas, and two elevated anomaly density areas were identified in Punaluu Valley (Appendix A, Figure A2-6) using VSP[4]. Both of the large high anomaly density areas were identified as likely target areas.

[3] *VSP software was used to analyze transect and grid data (i.e., number of MEC, MD, and small arms items recovered along transects cleared during mag-and-dig operations) to estimate anomaly densities within accessible areas of the MRS.*
[4] *Ibid*

The high anomaly density area near the back of the valley (labeled Target Area 3) is contaminated with 60-mm and 81-mm mortars and was very likely a target area (Appendix A, Figure A2-6). The high anomaly density area on the northwest side of the valley (i.e., labeled Target Area 1) was determined to be a likely target area based on the MEC items found (i.e., 2.36-inch rockets, 60-mm mortar, and rifle grenades) (Appendix A, Figure A2-6).

The high anomaly density area in the center of the valley (labeled High Anomaly Density Area 1) was likely a general training or maneuver area. This determination was made based on the types of MEC and MD items recovered during the RI (i.e., fuze [Type 88], MK II hand grenade, and slap flare) (Appendix A, Figure A2-6).

High Anomaly Density Area 2 is not a target but is considered MEC-contaminated because a single 2.36-inch rocket was found (Appendix A, Figure A2-6); however, this item was classified as DMM. Several MD items, but no other MEC items were found in this area.

High Anomaly Density Area 3 and the elevated anomaly density area labeled Elevated Anomaly Density Area 1 are associated with a high concentration of small arms debris finds and are not considered target areas nor present a hazard to the public.

- One additional target area (labeled Target Area 2) was identified during the field investigation of grid P19, near the mouth of the valley at the north end. Five vertical wooden posts were identified upslope from the grid, and a 2.36-inch rocket was found on transect P044. Based on these findings, it was determined that the posts were likely used as targets for the 2.36-inch rockets (Appendix A, Figure A2-6). This area is considered a target area based on the types of MEC and MD items recovered during the RI (i.e., 2.36-inch rockets, 60-mm mortars, and rifle grenades).

- Seventeen residential-use grids (approximately 6.88 acres) and 20 low-use grids and transects (approximately 2.51 acres of grids and 12.82 acres of transects) outside of MEC-contamination and high anomaly density MEC areas were investigated (Appendix A, Figure A2-7).

- Residential-use areas were below the threshold of 0.1 unexploded ordnance (UXO) per acre, and low-use areas were below the threshold of 0.5 UXO per acre (Appendix A, Figure A2-7).

- The MRS was subdivided into two sections based on topography, land use, and cumulative findings: Kahana Valley and Punaluu Valley. The Kahana Valley subsection was further divided into two subareas based on historical munitions activities: KVM and KVB (Appendix A, Figure A1-1).

- Forty incremental surface soil samples were collected at 22 sampling units throughout the PJCTC, including 11 locations where MEC and/or MD were removed during the RI, 3 demolition locations, and 8 background locations not impacted by MEC (Appendix A, Figures A2-8 and A2-9). Samples were analyzed for metals (i.e., antimony, copper, lead, molybdenum, and zinc) and explosives (i.e., nitroaromatics, nitramines, and nitrate esters).

- Metals were detected in all soil samples and explosives were detected in nine soil samples at concentrations less than the HDOH Tier 1 EALs (i.e., Potentially impacted groundwater is a current or potential drinking water resource; Surface water body is located within 150 meters).

2.3.8 Nature and Extent of Contamination

This section summarizes the nature and extent of MEC, MD, and MC at the PJCTC based on the results of the previous investigations discussed in Section 2.3.7. Cumulatively, from all previous investigations and incident responses, 37 MEC items, 122 MD items, and 114 small arms ammunitions debris were found within the PJCTC during previous investigations. Eleven areas of high anomaly density (i.e., >100 anomalies per acre) or elevated anomaly density (i.e., >50 anomalies per acre) were identified within the PJCTC using VSP[5]. All of the items recovered during these investigations were found on the surface or at a depth less than 1 foot below ground surface. The following sections summarize the nature and extent of contamination within Kahana Valley and Punaluu Valley.

2.3.8.1 Kahana Valley

2.3.8.1.1 MEC

In total, two MEC items have been found in Kahana Valley. Section 2.3.7.1 summarizes the type and number of MEC items found during previous investigations. Appendix A, Figure A2-5 shows the original locations of the MEC items found in Kahana Valley.

2.3.8.1.2 MD

In total, 120 MD items have been found in Kahana Valley. The presence of MD is an indicator of potential MEC contamination; where high concentrations of MD exist, MEC may be more likely found in this area. Section 2.3.5.1 summarizes the type and number of MD items found during previous investigations. Appendix A, Figure A2-5 shows the original locations of the MD items found in Kahana Valley.

[5] *Ibid*

2.3.8.1.3 MC

MCs were not identified at concentrations exceeding the HDOH Tier 1 EALs. Copper, lead, and zinc were detected in all samples at concentrations one to two orders of magnitude less than their respective HDOH Tier 1 EALs. Molybdenum was detected in all but two samples, also well below the HDOH Tier 1 EALs. Antimony was detected in three characterization samples and one background sample at approximately half the HDOH Tier 1 EALs. Overall, metal concentration results were generally less than the maximum detected background concentration. As far as explosives are concerned, only 2,6-dintrotoluene was measured above detection limits in one sampling unit at a concentration two orders of magnitude less than the respective HDOH Tier 1 EALs.

2.3.8.1.4 Anomaly Density

Two high anomaly density areas (one of which was identified as a target area [i.e., KVB]) and two elevated anomaly density areas were identified during the RI (Appendix A, Figure A1-4). The two areas of elevated anomaly density were associated with a high quantity of small arms ammunitions debris finds and one slap flare MD.

2.3.8.2 Punaluu Valley

2.3.8.2.1 MEC

In total, 30 MEC items have been found in Punaluu Valley. Section 2.3.7.1 summarizes the type and number of MEC items found during previous investigations. Appendix A, Figure A2-6 shows the original locations of the MEC items found in Punaluu Valley.

2.3.8.2.2 MD

In total, 114 MD items have been found in Punaluu Valley. The presence of MD is an indicator of potential MEC contamination; where high concentrations of MD exist, MEC may be more likely found in this area. Section 2.3.7.1 summarizes the type and number of MD items found during previous investigations. Appendix A, Figure A2-6 shows the original locations of the MD items found in Punaluu Valley.

2.3.8.2.3 MC

MC were not identified at concentrations exceeding the HDOH Tier 1 EALs. Copper, lead, molybdenum, and zinc were detected in all samples at concentrations one to two orders of magnitude less than their respective HDOH Tier 1 EALs. Antimony was not detected. Overall, metal concentration results were generally less than the maximum detected background concentration. Three explosive compounds (2,4-dinitrotoluene, 2,6-dintrotoluene, and HMX) were measured sporadically above detection limits. 2,4-dinitrotoluene and HMX were detected in only one sample unit each; 2,6-dinitrotoluene was detected in two sample units. The explosive compound concentrations were one to two orders of magnitude less than the respective HDOH Tier 1 EALs.

2.3.8.2.4 Anomaly Density

Five high anomaly density areas (two of which were identified as target areas) and two elevated anomaly density area were identified during the RI (Appendix A, Figure A1-5). One high and one elevated anomaly density areas are associated with a high concentration of small arms ammunitions debris finds. One of the high anomaly density areas was identified as a general training or maneuver area, and one was identified with a single 2.36-inch rocket classified as DMM.

2.3.9 Conceptual Site Model

2.3.9.0.1 This section summarizes the CSMs developed for MEC at the PJCTC based on the results of the previous investigations discussed in Section 2.3.7. MD and MC do not pose an explosive hazard to humans or the environment, thus they have been eliminated from further consideration and are not addressed in these CSMs. Separate CSMs were developed for Kahana Valley and Punaluu Valley.

2.3.9.0.2 The purpose of the CSMs is to identify the potential sources of contamination, potentially affected media, migration and exposure pathways, and possible receptors based on available site information. The CSMs are not intended to provide details or quantification of the potential sources and pathways. However, they are intended to provide the framework for characterizing site contamination and assessing risks.

2.3.9.1 Kahana Valley

2.3.9.1.1 Potential Sources of Contamination

The potential sources of MEC contamination in Kahana Valley are locations where MEC items were previously found and removed as described in Section 2.3.7.

2.3.9.1.2 Potentially Affected Media

Based on physical characteristics and historical uses and the previous investigations in the Kahana Valley section, potentially affected media include surface and subsurface soil and sediment.

2.3.9.1.3 Migration Pathways

The migration pathways identified for MEC include movement of MEC by naturally occurring events and human activity. It is possible that MEC within the Kahana Valley section will migrate from its original site of deposition (e.g., target areas) due to naturally occurring events (storm water runoff, landslides) and the steep terrain. It is also possible that MEC could be disturbed by human activity. Residents, recreational users, and occupational workers using paths and trails could possibly disturb MEC or collect MEC as a souvenir. All of the munition items found are relatively lightweight and could be hand-carried without much difficulty. The heaviest munition item identified, the 2.36-inch rocket motor, weighs approximately 1 to 1.5 pounds.

2.3.9.1.4 Potential Receptors and Exposure Pathways

Current and future human receptors in the Kahana Valley section consist of residents, recreational users (i.e., campers, hikers, hunters), and occupational workers (i.e., trail and utility maintenance). The primary potential exposure pathway to MEC is through direct contact with MEC present on the surface. Contact with subsurface MEC is also possible for agricultural workers while excavating plots and for occupational workers performing subsurface infrastructure maintenance. Human and ecological receptors may be exposed to MC in soil but risk is considered negligible.

2.3.9.2 Punaluu Valley

2.3.9.2.1 Potential Sources of Contamination

The potential sources of MEC contamination in Punaluu Valley are locations where MEC items were previously found and removed as described in Section 2.3.7.

2.3.9.2.2 Potentially Affected Media

Based on physical characteristics and historical uses and the previous investigations in the Punaluu Valley section, potentially affected media include surface and subsurface soil and sediment.

2.3.9.2.3 Migration Pathways

The migration pathways identified for MEC include movement of MEC by naturally occurring events and human activity. It is possible that MEC within the Punaluu Valley section will migrate from its original site of deposition (e.g., target areas) due to naturally occurring events (storm water runoff, landslides) and the steep terrain. It is also possible that MEC could be disturbed by human activity. Residents, recreational users, agricultural workers, and occupational workers could possibly disturb MEC or collect MEC as a souvenir. All of the munition items found are relatively lightweight and could be hand-carried without much difficulty. The heaviest munition item identified, the 81-mm mortar (i.e., M56), weighs approximately 10 pounds.

2.3.9.2.4 Potential Receptors and Exposure Pathways

Current and future human receptors at the Punaluu Valley section consist of residents, recreational users (i.e., hikers and hunters), agricultural workers, and occupational workers (i.e., road and utility workers). The primary potential exposure pathway to MEC is through direct contact with MEC present on the surface. Contact with subsurface MEC is also possible for agricultural workers while excavating plots and for occupational workers performing subsurface infrastructure maintenance. Human and ecological receptors may be exposed to MC in soil but risk is considered negligible.

2.3.10 Hazard and Risk Assessment Summary

2.3.10.1 Baseline MEC HAs were performed for KVM, KVB, and Punaluu Valley as part of the RI to evaluate risks to human health from MEC assuming no response action was taken at each

site. Separate MEC HAs were performed for each area rather than for the PJCTC as a whole to more accurately evaluate the risk posed by potential MEC to site receptors at each location.

2.3.10.2 The MEC HAs evaluated current and future human receptors at the sites, including recreational users (i.e., campers, hikers, hunters), agricultural workers, and occupational workers (i.e., trail, road, and utility maintenance), as appropriate. They evaluated the potential exposure pathways to MEC, which included direct contact with MEC potentially present on the surface and subsurface in accessible areas. Potential MEC HA scores range from a minimum possible score of 125 and maximum possible score of 1,000, with corresponding hazard levels ranging from 1 to 4 (1 being the highest hazard and 4 being the lowest hazard). Results of the MEC HAs are as follows:

- KVM – The MEC HA score for this subdivision is 755, with a MEC HA hazard level of 2 (high potential explosive hazard)
- KVB - The MEC HA score for this subdivision is 825, with a MEC HA hazard level of 2 (high potential explosive hazard)
- Punaluu Valley – The MEC HA score for this section is 895, with a MEC HA hazard level of 1 (highest potential explosive hazard)

2.3.10.3 Section 5.1 provides detailed information on the MEC HA input parameters and scoring.

2.3.10.4 As summarized in Section 2.3.8, all of the MC analytes were either not detected or well below the HDOH Tier 1 EALs. Per the HDOH, concentrations of chemicals less than the HDOH Tier 1 EALs do not pose a risk to human health or the environment. Therefore, baseline human health and ecological risk assessments were not performed and no response action is required to address these contaminants.

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3.0 Identification and Initial Screening of Technologies

This section (1) presents the site-specific RAOs, (2) identifies ARARs, and (3) presents a range of GRAs and process options that will satisfy the RAOs. The GRAs and process options retained through the screening process are used in later sections of this FS Report as the basis for developing remedial alternatives.

3.1 Remedial Action Objectives

3.1.1 RAOs are goals specific to a type of media for protecting human health and the environment. The RAO evaluation for this FS Report is based on the results of the previous investigations identified in Section 2.3.5 and the results of the MEC HA (Section 5.1).

3.1.2 An important component of developing RAOs is the determination of future land use. According to EPA's land use directive (EPA, 1995), RAOs "should reflect the reasonably anticipated future land use or uses...," thereby allowing for the development of "alternatives that would achieve cleanup levels associated with the reasonably anticipated future land use..." of the site. The EPA land use directive states that "in cases where future land use is relatively certain, the remedial action objective generally should reflect this land use..." and "...need not include alternative land use scenarios..." (EPA, 1995). RAOs developed for the PJCTC are based on the future land use remaining unchanged from the current land use.

3.1.3 The following RAOs were identified for the PJCTC:

- Kahana Valley – reduce exposure of residents, recreational users (i.e., campers, hikers, hunters), and occupational workers (i.e., trail and utility maintenance) to explosive hazards associated with munitions items varying in size from fuzes to 2.36-inch rocket mortars present in surface and subsurface soil and sediment to a depth of 1 foot below ground surface within the boundaries of the Kahana Valley section of the MRS to acceptable hazard levels. Acceptable hazard levels will be defined such that exposure to MEC can be considered an "unlikely" or a "negligible" hazard to the public based on supporting data.

- Punaluu Valley – reduce exposure of residents, recreational users (i.e., hikers and hunters), agricultural workers, and occupational workers (i.e., road and utility workers) to explosive hazards associated with munitions items varying in size from fuzes to 81-mm mortars present in surface and subsurface soil and sediment to a depth of 1 foot below ground surface within the boundaries of the Punaluu Valley section of the MRS to acceptable hazard levels. Acceptable hazard levels will be defined such that exposure to MEC can be considered an "unlikely" or a "negligible" hazard to the public based on supporting data.

3.2 Applicable or Relevant and Appropriate Requirements

3.2.0.1 CERCLA § 121(d)(l) states that remedial actions on CERCLA sites must attain (or the DD must justify the waiver of) any ARARs, which include standards, criteria, or limitations promulgated under federal or more stringent state laws or environmental regulations. An ARAR may be either applicable or relevant and appropriate.

3.2.0.2 Per the NCP (40 CFR § 300.5), applicable requirements are 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.

3.2.0.3 Likewise, per the NCP (40 CFR § 300.5), relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. A requirement must be determined to be both relevant and appropriate (using the criteria identified in the NCP, specifically 40 CFR § 300.400[g][2]) in order to be considered an ARAR.

3.2.0.4 To qualify as a state ARAR under CERCLA and the NCP, a state requirement must be (1) a standard, requirement, criterion, or limitation under a state environmental or facility siting law; (2) promulgated (of general applicability and legally enforceable); (3) substantive (not procedural or administrative); (4) more stringent than the federal requirement; (5) identified by the state in a timely manner; and (6) consistently applied.

3.2.0.5 CERCLA § 121(e) exempts on-site response actions from having to obtain a federal, state, or local permit when the action is carried out in compliance with § 121. In general, onsite actions need only comply with ARARs, which include only the substantive part of the requirements, not with the corresponding administrative procedures, such as administrative reviews and recording and recordkeeping requirements. Offsite actions must comply with all legally applicable requirements, both substantive and administrative.

3.2.0.6 ARAR identification considers a number of site-specific factors, including potential remedial actions, compounds at the site, site physical characteristics, and the site location. ARARs are usually divided into three categories: chemical-specific, location-specific, and action-specific.

3.2.0.7 The following sections summarize state and federal ARARs for MEC at the PJCTC (i.e., Kahana Valley and Punaluu Valley). Table 3-1 presents the complete ARARs evaluation.

3.2.1 Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based numerical values that, when applied to site-specific conditions, result in the establishment of numerical cleanup values. These values are protective of human health and the environment and establish the acceptable amount or concentration of a chemical that may be found in or discharged to the ambient environment. Because MC were not detected at concentrations exceeding the pertinent promulgated standards (i.e., the HDOH Tier 1 EALs for surface soil), the potential for adverse risks to human health or ecological receptors from exposure to MCs is negligible. Therefore, no chemical-specific ARARs were identified for the PJCTC.

3.2.2 Location-Specific ARARs

Location-specific requirements are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations. For example, location-specific ARARs might focus on wetland or floodplain protection areas or on archaeologically significant areas. Potential location-specific ARARs were identified for the PJCTC relating to ecological and archaeological resources (Sections 2.3.6.5 and 2.3.6.6). Table 3-1 provides detailed information on each of the location-specific ARARs.

3.2.3 Action-Specific ARARs

Action-specific ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of response activities. For example, action-specific ARARs may include restrictions that define acceptable procedures for detonation or open burning of explosives. One action-specific ARAR was identified for the PJCTC relating to detonation of MEC recovered during a removal action or implementation of LUCs. Table 3-1 provides detailed information on the action-specific ARARs.

3.3 General Response Actions

GRAs are categories of actions that are made up of technologies. Multiple process options may be available for each technology. GRAs are responses or remedies that would meet the RAOs to protect human health and the environment from MEC at the PJCTC. GRAs were developed based on professional engineering judgment and experience with response actions proven successful for MEC at other MRSs. The two GRAs considered applicable to the site were LUCs and removal of MEC. Each of these GRAs are discussed in the following subsections.

3.3.1 Land Use Controls

3.3.1.1 LUCs are mechanisms that protect property owners and the public from hazards contained on a site by limiting the access to or use of a property or by warning of the hazard. LUCs may take the form of legal mechanisms, administrative mechanisms, and engineering controls. Legal mechanisms include proprietary controls such as restrictive covenants, negative easements,

equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems (including educational programs) that are intended to ensure compliance with land use or activity restrictions. Engineering controls either limit the public's access to a site or limit the public's exposure to the residual contamination (in this case MEC) to an acceptable level. Examples of engineering controls include physical barriers and warning signs.

3.3.1.2 The following LUCs were considered for the PJCTC:

1. Administrative mechanisms involving the application of permitting and leasing conditions to restrict land use and/or specific site activities (i.e., define areas unavailable for use and/or requiring UXO support for all intrusive activities, and appending informational material on the presence of MD, safety precautions, and necessary safety procedures during intrusive activities).

2. Administrative mechanisms involving the implementation of educational programs. The education programs could include community outreach and visitor education to increase awareness of MEC hazards at the site and appropriate response actions if a MEC item is identified, as well as providing MEC-related educational materials in conjunction with issuing special use permits.

3. Engineering controls, including limiting public access to designated trails and installation of warning signs notifying the public of the potential presence of MEC.

3.3.1.3 The overall purpose of the LUCs is to prevent potential human exposure to MEC and associated unintentional detonation that may result in injury or death to humans thus meeting the RAOs. The DLNR (i.e., sole landowner of parcels within the Kahana Valley), Kamehameha Schools (i.e., largest private landowner within the Punaluu Valley), and the City and County of Honolulu Department of Emergency Management (DEM) have indicated they are willing to participate in the LUC planning process and maintain LUCs. Currently, DLNR and Kamehameha Schools have permits and leasing agreements that restrict the use of the property to authorized activities. Appending educational material to these permits/lease agreements would be included in LUCs for the site.

3.3.1.4 The indicated LUCs are easily implemented, and the materials and trained personnel required to implement LUCs are readily available. This GRA would include initial capital costs for engineering and administrative controls, as well as recurring long-term management costs. Overall costs for this GRA are considered moderate. This GRA was retained for further evaluation as a remedial alternative.

Table 3-1. ARARs for Remedial Actions within the PJCTC

Requirement	Citation	Description	Governmental Authority	ARAR Type	Applicability to Site
MEC Activities					
Detonation	40 CFR § 264.601 (RCRA, Subpart X)	Requires miscellaneous units for the management of hazardous waste, such as open burning/open detonation units, to be located, designed, constructed, operated, maintained, and closed in a manner that will ensure protection of human health and the environment.	Federal	Action-Specific	MEC recovered during a remedial action and/or accidentally discovered during implementation of LUCs may need to be detonated or burned before offsite disposal. Permits are not required for onsite response actions conducted under CERCLA. Only the substantive requirements of Subpart X are considered ARARs.
Conservation and Protection of Ecological and Cultural Resources					
Endangered Species Act	16 USC § 1538(a)(1)(B) and 1536(a)(2)	Prohibits the "taking" of any federally listed threatened or endangered species of fish or wildlife. In addition, federal agencies must ensure that their actions will not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the designated critical habitat of a listed species.	Federal	Location-Specific	Multiple endangered species are located within Kahana and Punaluu Valleys, although none were observed during the RI. Federally listed endangered plant and animal species identified in the valleys include: 1. Plant species: Maʻoliʻoli (*Schiedea kaalae*), pendant kihi fern (*Adenophorus periens*), haha (*Cyanea grimesiana*), and haha (*Cyanea humboldtiana*) 2. Animal species: Koloa (*Anas wyvilliana*), `Alae`ula (*Gallinula chloropus sandvicensis*), `Alae Ke`oke`o (*Fulica alai*), Oahu `Elepaio (*Chasiempis sandwichensis ibidis*), and honu (*Chelonia mydas*). Formal consultation is not an ARAR because it is an administrative requirement.

Table 3-1. ARARs for Remedial Actions within the PJCTC (continued)

Requirement	Citation	Description	Governmental Authority	ARAR Type	Applicability to Site
Migratory Bird Treaty Act	16 USC § 703(a)	Prohibits the take of migratory birds native to the United States or its territories.	Federal	Location-Specific	Two migratory shorebirds, the Pacific Golden-Plover or Kolea (*Pluvialis fulva*) and the Black-crowned Night–Heron or `Auku`u (*Nycticorax nycticorax hoactli*) were observed in the MRS during the RI. Only substantive requirements are considered ARARs.
Indigenous Wildlife, Endangered and Threatened Wildlife, and Introduced Wild Birds	Hawaii Revised Statutes Title 12, Chapter 195D-4(e)(2) Hawaii Administrative Rules Title 13, Chapter 124-3(b)(1)	Prohibits the take of any threatened or endangered species of aquatic life, wildlife, or land plant within the State of Hawaii. In addition to species listed under the federal Endangered Species Act, the prohibition on take under the state endangered species law applies to certain other indigenous species identified under state law as endangered or threatened.	State	Location-Specific	Multiple threatened and endangered species are located within the site (see Endangered Species Act). Only substantive requirements are considered ARARs.

3.3.2 Removal of MEC

A general response action involving removal of MEC would include identification and removal of surface and subsurface MEC (and incidental MD, if found) and could be performed over the entire site, if feasible or warranted, or within designated areas. Table 3-2 lists the typical technologies used in detecting munitions. The proposed technology to assist with the remedial action is analog detection (i.e., metal detectors) to detect the presence of MEC and MD. Table 3-3 provides a summary of detection technologies available. Treatment includes removal and demilitarization of MEC by detonation in place or, if deemed acceptable to move, in a consolidation point; and disposal of MD in 55-gallon drums to an authorized recycler. The overall purpose of this GRA is to remove MEC from PJCTC, thereby significantly reducing, if not eliminating, the probability of a human encounter with and possible unintentional detonation of MEC, which may result in injury or death to humans and/or damage to ecological or cultural resources. Implementing this GRA is considered moderately difficult to difficult depending on the acreage and location of areas to be cleared. Costs for this GRA would include labor, equipment, and materials and are considered moderate to high depending on the scope of the MEC removal (i.e., the total acreage and location of areas to be cleared). However, regardless of scope and location, the equipment and trained personnel would be readily available. This GRA was retained for further evaluation as a remedial alternative.

3.3.3 Identification and Initial Screening of Technologies and Process Options

3.3.3.1 Technologies and process options identified for each of the GRAs selected for this FS Report underwent an initial screening. The goal of screening process options is to provide a "toolbox" of available technologies that can be applied as needed in the selected remedial alternative presented in the DD to best achieve the RAOs. During the initial screening, a range of technology types and process options was evaluated in terms of technical implementability, effectiveness, and cost. Table 3-2 summarizes the results of the initial screening. The process options considered for each valley are described in the subsections below.

3.3.3.2 The following process options were identified for Kahana Valley:

- LUCs – Includes land use and access restrictions implemented through administrative mechanisms (e.g., educational programs and permits) and engineering controls (e.g., fencing and signs) to reduce the potential for human interaction with MEC and associated unintentional detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources

- Removal of MEC from Target Area – Includes clearance of areas with high anomaly densities to remove surface and subsurface MEC. MEC removal from these areas will significantly reduce the potential for human interaction with MEC and associated unintentional detonation, which may result in injury or death to humans and/or damage ecological and cultural resources in Kahana Valley.

3.3.3.3 The following process options were identified for Punaluu Valley:

- LUCs – Includes land use and access restrictions implemented through administrative mechanisms (e.g., educational programs),and engineering controls (e.g., fencing and signs) to reduce the potential for human interaction with MEC and associated unintentional detonation, which may result in injury or death to humans and/or to damage ecological and cultural resources.

- Removal of MEC from Accessible Target Areas and High Anomaly Density Areas – Includes clearance of high anomaly density areas to remove surface and subsurface MEC from accessible areas near the front of Punaluu Valley. MEC removal in these areas will significantly reduce the potential for human interaction with MEC and associated unintentional detonations.

- Complete Removal of MEC from Target Areas and High Anomaly Density Areas – Includes clearance of high anomaly density areas to remove surface and subsurface MEC from target and elevated anomaly density. MEC removal in these areas will eliminate the potential for human interaction with MEC and associated unintentional detonations in the areas of Punaluu Valley with the greatest potential MEC presence.

Table 3-2 Initial Screening of Technologies and Process Options for the PJCTC (Kahana Valley and Punaluu Valley)

GRA	Remedial Technology Type	Process Option	Process Option Description	Retained/Eliminated for Further Evaluation	Comments
Land Use Controls	Legal Mechanisms	Restrictive Covenants	Reduces potential exposure to MEC and unintentional detonation by restricting use of parcel through environmental restrictive covenants that will run with the land.	Eliminated	Difficult to implement due to number of landowners, effective, moderate cost
	Administrative Mechanisms	Permitting and Lease Conditions	Reduces potential exposure to MEC and unintentional detonation by restricting use of parcel through permitting requirements and lease conditions.	Retained	Easily implemented, effective, low cost
		Educational Programs Including Community Outreach and Visitor Education (may include educational signs)	Reduces potential exposure to MEC and unintentional detonation by educating the public and visitors on the presence and identification of MEC and appropriate response actions if MEC is identified.	Retained	Easily implemented, effective, moderate cost
	Engineering Controls	Warning Signs	Reduces potential exposure to MEC and unintentional detonation by warning public of the potential presence of an explosive hazard. Signs would be installed in publically accessible areas such as along hiking trails, in camp grounds, and in hunting areas.	Retained	Easily implemented, effective, moderate cost
Removal of MEC	Identification, Demolition (as required), and Offsite Disposal of MEC and MD	Limited Clearance of MEC	Permanently removes explosive hazard in target areas, thereby significantly reducing potential exposure to, and unintentional detonation of MEC, by performing a surface and subsurface clearance and removal of MEC (and MD, if identified) in target areas.	Retained	Low to moderately difficult to implement, effective, moderate cost
		Complete Clearance of MEC	Permanently removes explosive hazard from areas with the greatest potential volume of MEC (i.e., target areas and high anomaly density areas), thereby predominantly eliminating potential exposure to, and unintentional detonation of MEC, by performing a surface and subsurface clearance and removal of MEC (and MD, if identified) in target areas.	Retained	Difficult, effective, high cost

Notes:
GRA = general response action
MD = munitions debris
MEC = munitions and explosives of concern
PJCTC = Pacific Jungle Combat Training Center

Table 3-3 Detection Technologies

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
Visual Searching	Land	**Low:** Effective for surface clearance in open areas with little ground cover. However, no surface MEC/MD was identified during the RI. Not appropriate for subsurface clearance.	**Easy:** Easily implemented by qualified UXO Technicians and sweep personnel. Minimal to no impacts to cultural or natural resources.	**Low**	NA	Typically supported with magnetometer or metal detectors	**Low/Not Retained:** Visual detection of MEC/MD as a standalone technology would not be effective since the risk for exposure is subsurface.
Flux-Gate Magnetometers: Fluxgate magnetometers measure the vertical component of the geomagnetic field along the axis of the sensor and not the total intensity of the geomagnetic field.	Land	**Moderate - High:** Flux-gate magnetometers have been used as the primary detector in traditional mag & dig operations. There is a high industry familiarization Detects ferrous objects only.	**Easy:** Light and compact. Can be used in any traversable terrain. Costs, transportation, and logistics requirements are equal to or less than other systems. Widely available from a variety of sources. Minimal to no impacts to cultural or natural resources.	**Low:** A number of flux-gate magnetometers have a low cost for purchase and operation compared to other detection systems.	Schonstedt GA-52Cx Schonstedt GA-72Cd Foerster FEREX 4.032	Analog output not usually coregistered with navigational data.	**Low /Not Retained:** This technology is not effective due to the volcanic nature of the soil/rocks at PJCTC**.**
Proton Precession Magnetometers: Proton precession magnetometers measure the total intensity of the geomagnetic field. Multiple sensors are sometimes arranged in proximity to measure horizontal and vertical gradients of the geomagnetic field.	Land	**Low:** Proton precession systems have similar sensitivities as flux-gate systems, but with a relatively slow sampling rate. There is a high industry familiarization. Detects ferrous objects only.	**Moderate:** Generally is heavier and requires more battery power than flux-gate sensors. Sampling rate is low. Can be used in any traversable terrain. Is widely available from a variety of sources. Minor impacts to cultural or natural resources based on clearing of areas for data collection.	**Moderate:** Costs are higher than flux-gate systems because proton precession systems often acquire digital data.	Geometrics G-856AX GEM Systems GSM-19T		**Low/Not Retained:** Proton precession systems are not viable options as a standalone detection system at the MRSs because of low effectiveness.

Table 3-3 Detection Technologies (continued)

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
Optically Pumped Magnetometers: This technology is based on the theory of optical pumping and operates at the atomic level as opposed to the nuclear level (as in proton precession magnetometers).	Land	**High:** This is the industry standard technology to detect MEC using magnetic data analysis. There is a high industry familiarization. Detects ferrous objects only.	**Moderate to Difficult:** Equipment is digital, rugged, and weather resistant. Common systems weigh more than most flux-gate systems and are affected by heading error. Can be used in most traversable terrain. Widely available from a variety of sources. Processing and interpretation requires trained specialists. Detection capabilities are negatively influenced by iron-bearing soils, which are present in the MRS based on RI findings and known geology. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**Moderate – High:** Has high purchase cost compared to other technologies. More dependent on terrain than flux-gate magnetometers. Lower costs can be realized when using arrays of multiple detector sensors.	Geometrics G-858 GEM Systems GSMP-40 Scientrex Smart Mag	Digital signal should be coregistered with navigational data for best results.	**Moderate/Not Retained:** While optically pumped magnetometers can be highly effective, they are more difficult to use and have a higher cost than flux-gate magnetometers.
Time-Domain Electromagnetic Induction (TDEMI) Metal Detectors: TDEMI is a technology used to induce a pulsed magnetic field beneath the Earth's surface with a transmitter coil, which in turn causes a secondary magnetic	Land	**High:** TDEMI technology is the industry standard for MEC detection using electromagnetic data analysis. There is a high industry familiarization. Detects both ferrous and non-ferrous metallic objects. Can be limited by terrain.	**Easy - Moderate:** Sensors are typically larger than digital magnetometers. Can be used in most traversable terrain. Most commonly used instrument and is widely available. Processing and interpretation are relatively straightforward.	**Moderate – High:** Has higher purchase cost compared to other technologies. Dependent on terrain. Lower costs can be realized when using arrays of	Geonics EM61-MK2, -MK2A, -HH, EM63 G-tek/GAP TM5-EMU Schiebel AN PSS-12	Digital signal should be coregistered with navigational data for best results.	**Moderate/ Not Retained:** This technology is effective in accessible areas with minimal obstacles and relatively flat terrain. The majority of the site has undulating to steep topography covered with thick

Table 3-3 Detection Technologies (continued)

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
field to emanate from nearby objects that have conductive properties.			Anomaly classification possibilities exist for multi-channel systems. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	multiple detector sensors.			vegetation, which would hamper the effectiveness of this technology
Advanced Electromagnetic Induction (EMI) Sensors and Anomaly Classification: Advanced sensors have the ability to precisely capture measurements from enough locations to sample all principal axis responses of an anomaly/item of interest. This provides the necessary information for analysis and classification of hazardous and nonhazardous items.	Land	**Moderate – High:** Some sensors may be used in production mode, but most require target locations from previous DGM survey to navigate to for static measurements. Greatest ability of all sensors for the classification of anomalies as either MEC or non-hazardous items. Detects both ferrous and non-ferrous metallic objects	**Moderate:** Most require the use of a vehicle to tow the sensor to the location of an anomaly, although some smaller, man-portable systems are in development. One-meter-wide coil width (or greater) limits accessibility in forested or steeply sloped areas. Advanced analysis is required to effectively use the data acquired by the sensors and accurately classify detected anomalies as MEC or non-hazardous material that will not be removed.	**High:** Use of the advanced systems often represents additional surveying and processing costs, which may be offset by the decrease in the intrusive investigation costs.	ALLTEM Berkeley UXO Discriminator (BUD) BUD Handheld Geometrics MetalMapper (MM) TEMTADS 2x2 Man Portable Vector (MPV)	Sensors have limited industry availability. Requires advanced training for operation, data processing, and analysis. Government standards for use not yet developed/finalized.	**Low /Not Retained:** This technology has been demonstrated and validated by the DoD's Environmental Security Technology Certification Program (ESTCP). The technology would be generally difficult to implement in areas with vegetation. Only the Metal Mapper is currently commercially available. All other systems are under development or in testing.

Table 3-3 Detection Technologies (continued)

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
Frequency-Domain Electromagnetic Induction (FDEMI) Metal Detectors: FDEMI sensors generate one or more defined frequencies in a continuous mode of operation.	Land	**Moderate - High:** Some digital units have been used as the primary detector in highly ranked systems. Demonstrates capability for detecting small items using handheld units. Is not optimum for detecting deeply buried objects. Detects both ferrous and non-ferrous metallic objects.	**Easy:** Hand-held detectors are generally light and compact. Can be used in any traversable terrain. Most are handheld systems. Widely available from a variety of sources. Minimal to no impacts to cultural or natural resources.	**Low:** Instruments are slow and can detect very small items. Common handheld detectors are much lower cost than digital systems.	White's All Metals Detector Fisher 1266X Foerster Minex 2FD Minelabs Explorer II Minelab E-TRAC Minelab F3 Vallon VMH3		**Moderate – High/Retained:** FDEMI detects all metals, instead of only ferrous items. The White's All-Metals Detector was proven effective during the RI at the MRS.
Sub Audio Magnetics (SAM): SAM is a patented methodology by which a total field magnetic sensor is used to simultaneously acquire both magnetic and electromagnetic response of subsurface conductive items.	Land	**Low:** Detects both ferrous and non-ferrous metallic objects. Capable tool for detection of deep MEC. Low industry familiarization. System has seen limited application.	**Difficult:** High data processing requirements. Available from a few sources. High power requirements. Has longer than average setup times. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**High:** Has higher than average operating costs and low availability.	G-tek/GAP SAM	Not commercially available. No established track record.	**Low/Not Retained:** Difficult to implement, high cost, not commercially available.
Magnetometer-Electromagnetic Detection Dual Sensor Systems: These dual sensor systems are expected to be effective in detecting MEC as magnetometers respond to large, deep ferrous targets and TDEMI sensors respond to nonferrous metallic targets.	Land	**High:** Collects co-located magnetic and electromagnetic data to differentiate between ferrous and nonferrous metallic objects. Has medium industry familiarization.	**Moderate - Difficult:** Increased data processing requirements. Similar terrain constraints to time-domain electromagnetic systems. Available from few sources. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**High:** Costs are lower when using a towed array platform. Limited availability.	MSEMS (man-portable EM61-hh & G-822) VSEMS (vehicular EM61-hh & G-822)	Only available from a few sources.	**Low/Not Retained:** Difficult to implement, high cost, only available from a few sources.

Table 3-3 Detection Technologies (continued)

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
Airborne Synthetic Aperture Radar (SAR): This airborne method uses strength and travel time of microwave signals that are emitted by a radar antenna and reflected off a distant surface object.	Land	**Low:** Detects both metallic and non-metallic objects. Only detects largest MEC on or near ground surface. Low industry familiarization. Effectiveness increases when used for wide area assessment in conjunction with other airborne technologies.	**Difficult:** Requires aircraft and an experienced pilot. Substantial data processing and management requirements. Available from few sources. Minimal to no impacts to cultural or natural resources.	**High:** Aircraft and maintenance costs must be included. Processing costs are higher than other methods.	Intermap Technologies Corp., (STAR systems)	Typically not applied to detect MEC.	**Low/Not Retained:** Low effectiveness in clearance activities, difficult to implement, high cost.
Differential Global Positioning System (DGPS): Global Positioning System (GPS) is a worldwide positioning and navigation system that uses a constellation of 29 satellites orbiting the Earth. GPS uses these satellites as reference points to calculate positions on the Earth's surface. Advanced forms of GPS, like DGPS, can provide locations to centimeter accuracy	Land	**High:** Very effective in open areas for both digital mapping and reacquiring anomalies. Very accurate when differentially corrected. Not effective in wooded areas or around large buildings. Commonly achieves accuracy to a few centimeters, but degrades when minimum satellites are available.	**Easy - Moderate:** Easy to operate and set up. Requires trained operators. Available from a number of vendors. Better systems are typically rugged and very durable. However, significant work time can be lost when insufficient satellites are available because of topography and tree canopy. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**High:** Requires rover and base station units. Survey control points required for high accuracy results.	Leica GPS 1200 Trimble R8 Thales Ashtech Series 6500	Recommended in open areas.	**High/Retained:** This technology is not effective in wooded areas with tree canopy, but can be used in the open portions of the MRS.

Table 3-3 Detection Technologies (continued)

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
Robotic Total Station (RTS): RTS is a laser-based survey station that derives its position from survey methodology and includes a servooperated mechanism that tracks a prism mounted on the geophysical sensor.	Land	**Moderate - High:** Effective in open areas for both digital mapping and reacquiring anomalies. Effective around buildings and sparse trees. Is being used in heavily wooded areas with moderate success. Commonly achieves accuracy to a few centimeters.	**Easy - Moderate:** Relatively easy to operate with trained personnel. Requires existing control. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**High:** Operates as a stand-alone unit. Typically requires survey control points but can be used in a relative coordinate system.	Leica RTS 1100 Trimble Model 5600	Recommended in open areas and in moderately wooded areas. Typically used with TDEMI metal detectors (like Geonics EM61-MK2) and digital magnetometers (like Geometrics G-858).	**Moderate/Retained:** This technology could be effective in open areas but was not used during the RI
Fiducial Method: The fiducial method consists of digitally marking a data string with an indicator of a known position. Typically, markers are placed on the ground at known positions (e.g., 25 feet).	Land	**Moderate:** Moderate to high effectiveness when performed by experienced personnel. Low effectiveness when used by inexperienced personnel. Commonly achieved accuracy is 15 to 30 centimeters.	**Moderate:** Application requires a constant pace and detailed field notes. Can be used anywhere, with varying degrees of complexity in the operational setup. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**Moderate:** Minimal direct costs associated with this method; however, poor results may negatively impact costs associated with target resolution.	NA	Requires very capable operators. Useful method if digital positioning systems are unavailable.	**Moderate/Retained:** Because of the vegetation at the MRS, only a small accessible area remains where the fiducial method could be used.
Odometer Method: This method utilizes an odometer that physically measures the distance traveled.	Land	**Moderate:** Moderate to high effectiveness when performed b experienced personnel. Low effectiveness when used by inexperienced personnel.	**Moderate - Difficult:** Setup and operation affected by terrain/environment. Requires detailed field notes and setup times can be lengthy. Can be used anywhere, with varying	**Low:** Minimal direct costs associated with this method; however, poor results may negatively impact costs associated	NA	Requires very capable operators. Useful method if digital positioning systems are unavailable.	**Low/Not Retained:** This method is impractical for use given the anticipated need for accurate anomaly resolution during a future response action.

Table 3-3 Detection Technologies (continued)

Technology	MRS	Effectiveness	Implementability	Cost	Representative Systems	Notes	Viability at MRS/Status of Retention
		Commonly achieved accuracy is 15 to 30 centimeters in line and 20 to 80 centimeters on laterals.	degrees of complexity in the operational setup. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	with target resolution.			
Acoustic Method: This navigation system utilizes ultrasonic techniques to determine the location of a geophysical instrument each second. It consists of three basic elements: a data pack, up to 15 stationary receivers, and a master control center.	Land	**Low-Moderate:** Not very efficient in open areas because of substantial calibration and setup time. Effective in wooded areas although less accurate than other methods. Commonly achieves accuracy of 20 to 50 centimeters.	**Difficult:** Difficult to set up and setup requirements are complex. (However, more easily set up and used by trained personnel.) Very little available support. Negatively affected by certain aspects of the environment. Transponders have very limited range, on the order of 75 to 150 feet. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**High:** Lengthy setup time can be reduced by using trained personnel. Requires more than one operator. Is expensive to purchase or rent.	USRADS	Requires trained operators. Has been used extensively in wooded areas with success.	**Low/Not Retained:** This technology is difficult to implement and has high costs limit.

4.0 Development and Description of Remedial Alternatives

This section presents remedial alternatives developed for MEC at the PJCTC (i.e., Kahana Valley and Punaluu Valley) based on the technologies and process options retained in Section 3.0. The NCP states that development and analysis of remedial alternatives will reflect the scope and complexity of the response actions under consideration based on the environmental issues defined at the site. The number and types of alternatives to be analyzed were identified by considering the scope and characteristics of the environmental issues of Kahana Valley and Punaluu Valley as identified in Section 2.3.6.

4.1 Development of Remedial Alternatives

GRAs and process options were developed and screened as described in Section 3.0. The retained process options were combined into remedial alternatives to meet RAOs and to satisfy ARARs. The remedial alternatives were derived using experience and engineering judgment to formulate process options into the most plausible site-specific response actions. Except for the no further action alternative, all of the alternatives are designed to address explosive hazards associated with MEC. The following sections describe the alternatives developed for further analysis for Kahana Valley and Punaluu Valley.

4.2 Description of Remedial Alternatives

4.2.0.1 The following remedial alternatives were developed for Kahana Valley and Punaluu Valley based on a combination of the process options retained in Section 3.0:

Kahana Valley

- Alternative 1 – No Action
- Alternative 2 – LUCs
- Alternative 3 – Complete Removal of MEC from Target Area

Punaluu Valley

- Alternative 1 – No Action
- Alternative 2 – LUCs
- Alternative 3 – Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs
- Alternative 4 – Complete Removal of MEC from Target Areas and High Anomaly Density Areas

4.2.0.2 The following sections describe the remedial alternatives for Kahana Valley and Punaluu Valley.

4.2.1 Description of Remedial Alternatives for Kahana Valley

4.2.1.1 Alternative 1 – No Action

4.2.1.1.1 Under Alternative 1, no response action would be taken at Kahana Valley. Potential MEC would be left in place as-is, without implementing any LUCs or remedial actions. The no-action alternative is not considered an effective response action that meets the requirements of CERCLA because it does not address the explosive hazard posed to humans or the environment by potential MEC at the site. However, the no-action alternative is retained throughout the evaluation process, as required by the NCP, to provide a baseline for comparison with other alternatives.

4.2.1.2 Alternative 2 – Land Use Controls

4.2.1.2.1 Under Alternative 2, LUCs would be implemented to meet the RAOs by restricting site access or use and thereby reducing the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources. LUCs would include a combination of administrative mechanisms and engineering controls, as described below. The Institutional Analysis (IA) Report (Appendix D) identified government stakeholders that are willing and able to participate in implementation and management of LUCs (i.e., DLNR, and DEM). The LUCs alternative includes ongoing management of administrative mechanisms and engineering controls.

4.2.1.2.2 Because this alternative does not achieve UU/UE, five-year reviews will be required in accordance with 40 CFR § 300.430(f)(4)(ii). Though not part of the remedy, the cost of the five-year review will be considered in the review of the alternative.

4.2.1.2.3 The Kahana Valley section is located within state-owned land, controlled and managed by the DLNR, Division of State Parks. There are no plans to change the site use from recreational and agricultural use. While it is possible to add deed restrictions related to the potential hazards attributed to the munitions at the site, this course of action is deemed unnecessary because it is highly unlikely that the property will change from its current use as public lands maintained under the DLNR. Therefore, no legal mechanisms are proposed.

4.2.1.2.4 Right-of-entry permits are granted to recreational users (i.e., campers and hunters), as well as to entities performing infrastructure maintenance or construction activities. Special conditions can be appended to the right-of-entry permits. These conditions could include informational material on the presence of MD, safety precautions, and necessary procedures, as well as define areas unavailable for use and direct users away from potentially MEC-contaminated sites.

4.2.1.2.5 In addition, special conditions and educational material can be appended to the lease agreements with park residents, prior to issuance or renewal, to inform the lessees of the potential hazards related to munitions items on the site and necessary safety precautions.

4.2.1.2.6 Educational programs, including community outreach, visitor education, and safety and awareness training of State Parks staff, would be implemented under this alternative. The IA Report indicates the DLNR State Parks is willing to assist with the occasional maintenance of LUCs, such as maintaining a centrally located community information board with postings regarding recommended safety precautions for MD, participating in community and visitor outreach, and training. In addition, as mentioned previously, educational material could be appended to each lease agreement or right-of-entry permit to inform users of the potential presence of munitions at the site, provide safety precautions, and explain appropriate procedures if a suspected munitions item is discovered.

4.2.1.2.7 Visitor education would include installation of educational signs at key locations such as publically accessible trailheads, and hunting areas within the Kahana Valley section. A large educational sign, similar to those found in national parks, could be installed at a community information board designated by the State Parks. The signs would summarize key safety and access limitation information. Additional warning signs on the trails would be included to remind park visitors about hazards associated with munitions and staying on marked trails. Educational signs would be constructed by USACE and maintained by DLNR.

4.2.1.2.8 Community outreach activities would include community meetings and possibly outreach events at schools and community functions such as farmer's markets and fairs. Outreach activities would focus on educating the public access restrictions, as well as the potential presence and dangers of MEC. Discussion topics would include, but not necessarily be limited to:

- Site history
- Presence and identification of MEC at the PJCTC
- Safety considerations and the importance of staying on managed trails that are open for public access
- Response actions if MEC are identified (i.e., Recognize, Retreat, and Report [3Rs])

4.2.1.2.9 In addition, MEC hazard awareness training would be provided to DLNR staff. Training could be provided through videos or other computer-based training mechanisms. The training would be a more detailed version of the community outreach presentations and would include additional information on recognizing the type of MEC items that may be present in the PJCTC and response actions if a MEC item is found. Copies of the training video/presentation would be provided to various agencies for as-needed training of new staff or refresher training for

existing staff. In addition, quick reference books would be prepared for agencies that include pictures and descriptions of the MEC items anticipated to potentially be present at the site.

4.2.1.2.10 A cost estimate for Alternative 2 was developed based on the following assumptions:

- The most commonly accessed hiking trails, campgrounds, and hunting areas would be identified. DLNR, CEPOH, and USAESCH would select the final areas for placement of signage in highly accessible areas within KVM and KVB.
- Up to 50 aluminum warning signs, containing text similar to "Danger Explosive Hazard – Stay on Marked Trail," would be installed along designated trails and in designated hunting areas. Signs would be replaced as needed based on absences or sign legibility, up to a maximum of 300 signs over a 30-year period.
- A total of two community outreach events would be held during the first year of LUC implementation with the target of reaching up to 400 residents. No subsequent outreach activities would be conducted. Outreach events would be publicized via appropriate media, including newspaper notices.
- Educational signs would be placed at each of five locations along trails and in camp grounds and hunting areas and replaced as needed based on absence or legibility, up to a maximum of 30 signs over a 30-year period.
- Two in-person training events would be held for various agencies over a 30-year period. Staff training during the intervening years would be performed using the training videos filmed during the two in-person training events. Five copies of the training video would be provided annually to agencies.
- DLNR staff would be responsible for inspection, repair, and replacement of signs.

4.2.1.3 Alternative 3 – Complete Removal of MEC from Target Area

4.2.1.3.1 Under Alternative 3, complete removal of surface and subsurface MEC and MD by UXO-trained personnel would be performed within KVB (i.e., approximately 10.58 acres), an identified target area (Appendix A, Figure A4-1). A remedial action within the second high anomaly density area and the two elevated anomaly density areas was determined to be unnecessary because the second high anomaly density area is associated with a single DMM item (i.e., slap flare) and the two elevated anomaly density areas are associated with a high quantity of small arms and a single slap flare MD, neither of which presents an explosive hazard. Therefore, these areas are considered to present a low explosive risk to the public.

4.2.1.3.2 Visual and analog methods would be used to identify MEC and MD. Alternative 3 would permanently remove explosive hazards from MEC within the identified target area. In addition, to further reduce the risk of an unintentional detonation of MEC within Kahana Valley

in the interim period prior to completion of the removal action, Alternative 3 would include the establishment of prominent signage in KVM warning the public of the potential presence of explosive hazards and educating the public on potential hazards associated with munitions and the appropriate response to incidental discovery of munition items. This alternative would result in UU/UE.

4.2.1.3.3 The Alternative 3 cost estimate was developed based on the following assumptions:

- The clearance of surface and subsurface MEC would be performed by a team consisting of 17 qualified UXO personnel, including a project manager, 1 senior UXO supervisor (SUXOS), 1 UXO quality control specialist (UXOQCS), 1 UXO safety officer (UXOSO), 2 UXO Technician (Tech) IIIs, 6 UXO Tech IIs, and 6 UXO Tech Is. The estimated time to complete the surface and subsurface clearance is 20 days assuming a clearance rate of 0.5 acres per day.

- Vegetation clearance will be performed over a maximum of 10.58 acres.

- MEC identified during the removal would be demilitarized by blowing in place or by consolidated shots if multiple MEC items are found and are determined to be acceptable-to-move. No demolition explosives would be stored on site. Demolition explosives would be transported to the site on an as-needed basis. Identified MEC would be guarded 24 hours per day after discovery until demolition could be performed.

- MD identified during the surface removal would be containerized and shipped off-island for disposal by an authorized recycler. The estimate assumes a maximum of five 55-gallon drums of MD will be recovered.

- Prior to completion of the remedial action, up to 50 aluminum warning signs, containing text similar to "Danger Explosive Hazard – Stay on Marked Trail," would be installed along designated trails and in designated campgrounds and hunting areas.

- Prominent educational signage would be placed at up to five locations in areas of high traffic (e.g., trailheads and campgrounds) to educate the public of potential hazards associated with munitions and the appropriate response to incidental discovery of munition items in the interim period prior to completion of the remedial action. The signs would be constructed of long-lasting, fade-resistant durable material that is easily maintained and mounted to draw attention to the sign.

4.2.2 Description of Remedial Alternatives for Punaluu Valley

4.2.2.1 Alternative 1 – No Action

4.2.2.1.1 Under Alternative 1, no response action would be taken at Punaluu Valley. Potential MEC would be left in place as-is, without implementing any LUCs or remedial actions. The no-

action alternative is not considered an effective response action that meets the requirements of CERCLA because it does not address the explosive hazard posed to humans or the environment by potential MEC at the site. However, the no-action alternative is retained throughout the evaluation process, as required by the NCP, to provide a baseline for comparison with other alternatives.

4.2.2.2 Alternative 2 – Land Use Controls

4.2.2.2.1 Under Alternative 2, LUCs would be implemented to meet the RAOs similar to those described for Alternative 2 for Kahana Valley by restricting site access or use and thereby reducing the probability of a human encounter with MEC and the potential for unintentional MEC detonation. LUCs would include a combination of administrative mechanisms and engineering controls as described below. The IA Report (Appendix D) identified Kamehameha Schools as the primary landowner stakeholder. They have indicated that they are willing and able to participate in the implementation and management of LUCs The LUCs alternative includes ongoing management of administrative mechanisms and engineering controls.

4.2.2.2.2 Five-year reviews are a requirement for alternatives not allowing for UU/UE in accordance with 40 CFR § 300.430(f)(4)(ii). Because this alternative does not achieve UU/UE, five-year reviews costs will be considered in the evaluation; however these costs are not part of the alternative.

4.2.2.2.3 Educational programs, including community outreach and safety and awareness training of Kamehameha Schools' staff, are implemented under this alternative. The IA Report indicates that Kamehameha Schools is willing to assist with the occasional maintenance of LUCs. As mentioned previously, educational material will be appended to each lease agreement or right-of-entry permit to inform users of the potential presence of munitions at the site, provide safety precautions, and explain appropriate procedures if a suspected munitions item is discovered.

4.2.2.2.4 Community outreach activities would include community meetings and possibly outreach events at schools and community functions such as farmer's markets and fairs. Outreach activities would focus on educating the public access restrictions, as well as the presence and dangers of MEC. Discussion topics would include, but not be limited to:

- Site history
- Presence and identification of MEC at PJCTC
- Safety considerations and the importance of staying on managed trails that are open for public access
- Response actions if MEC are identified (i.e., Recognize, Retreat, and Report [3Rs])

4.2.2.2.5 In addition, MEC hazard awareness training would be provided to Kamehameha Schools' staff. Training will be provided through videos or other computer-based training mechanisms. The training is a more detailed version of the community outreach presentations and would include additional information on recognizing the type of MEC items that may be present in the PJCTC and response actions if a MEC item is found. Copies of the training video/presentation would be provided to various agencies for as-needed training of new staff or refresher training for existing staff. In addition, quick reference books will be prepared for agencies that include pictures and descriptions of the MEC items anticipated to potentially be present at the site.

4.2.2.2.6 Engineering controls that will be implemented under this alternative consist of installing warning signs in publicly accessible areas (i.e., hiking trails and hunting areas) and along the aboveground utility corridor notifying the maintenance personnel and public of the potential presence of an explosive hazard. Kamehameha Schools shall enforce this restriction on their property to the extent that ownership of the land allows and in accordance with Kamehameha Schools' policies and procedures.

4.2.2.2.7 A cost estimate for Alternative 2 was developed based on the following assumptions:

- The most commonly accessed hiking trails and hunting areas will be identified. Kamehameha Schools, CEPOH, and USAESCH would select the final areas for placement of signage.
- Up to 50 aluminum warning signs, containing text similar to "Danger Explosive Hazard – Stay on Marked Trail," will be installed along designated trails. Signs would be replaced as needed based on absences or sign legibility, up to a maximum of 300 signs over a 30-year period. Kamehameha Schools' staff will inspect, repair, and replace signs on their property.
- A total of two community outreach events would be held during the first year of LUC implementation with the target of reaching up to 400 residents. No subsequent outreach activities would be conducted. Outreach events would be publicized via appropriate media, including newspaper notices.
- Two in-person training events would be held for various agencies (including Kamehameha Schools) over a 30-year period. Staff training during the intervening years would be performed using the training videos filmed during the two in-person training events. Five copies of the training video would be provided annually to agencies.

4.2.2.3 Alternative 3 – Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs

4.2.2.3.1 Under Alternative 3, a limited removal of surface and subsurface MEC and MD by UXO-trained personnel would be performed over approximately 18.83 acres in relatively accessible areas closer to the front of the valley. Visual and analog methods would be used to identify MEC and MD. The limited removal would be performed in two of the three identified target areas (Target Areas 1 and 2, which includes the target areas within the active agricultural fields) and one of the high anomaly density areas near the front of the valley (Appendix A, Figure A4-2). High Anomaly Density Area 3 and Elevated Anomaly Density Area 1 are associated with high concentrations of small arms finds and present a low explosive risk to the public; therefore, a remedial action in these areas was determined to be unnecessary. The remaining target area (Target Area 3) and elevated anomaly density area (High Anomaly Density Area 2) toward the rear of the valley are inaccessible and are not included in this alternative.

4.2.2.3.2 The removals would be limited to areas with less than 18 degree slope for safety reasons. Alternative 3 would permanently remove explosive hazards from MEC in Target Areas 1 and 2 and High Anomaly Density Area 1, which are all currently accessible by the public. In addition, Alternative 3 would include LUCs to further reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources. Alternative 3 would include the same LUCs specified for Alternative 2. Because this alternative does not achieve UU/UE, five-year reviews will be considered in the alternative evaluation, although these costs are not part of the alternative.

4.2.2.3.3 The Alternative 3 cost estimate was developed based on the following assumptions:

- All of Alternative 2 assumptions apply
- The clearance of surface and subsurface MEC would be performed by a team consisting of 17 qualified UXO personnel, including a project manager, 1 SUXOS, 1 UXOQCS, 1 UXOSO, 2 UXO Tech IIIs, 6 UXO Tech IIs, and 6 UXO Tech Is. The estimated time to complete the surface and subsurface clearance is 54 days, assuming a clearance rate of 0.5 acre per day.
- Vegetation clearance would be performed over a maximum of 18.83 acres.
- MEC identified during removal activities would be demilitarized by blowing in place or by consolidated shots if multiple MEC items are found and are determined to be acceptable-to-move. No demolition explosives would be stored on site. Demolition explosives would be transported to the site on an as-needed basis. Identified MEC would be guarded 24 hours per day after discovery until demolition could be performed.

- MD identified during the surface removal would be containerized and shipped off-island for disposal by an authorized recycler. The estimate assumes a maximum of five 55-gallon drums of MD would be recovered.

4.2.2.4 Alternative 4 – Complete Removal of MEC from Target Areas and High Anomaly Density Areas

4.2.2.4.1 Under Alternative 4, a complete removal of surface and subsurface MEC and MD by UXO-trained personnel would be performed over approximately 38.87 acres. Visual and analog methods would be used to identify MEC and MD. The remedial action would be performed in the three identified target areas (includes Target Areas 1, 2, and 3) and the two identified high anomaly density areas (High Anomaly Density Areas 1 and 2) shown on Appendix A, Figure A4-3. The removal action would be conducted in areas with less than an 18 degree slope for safety reasons. Alternative 4 would permanently remove explosive hazards from MEC in the areas of Punaluu Valley with the highest density of anomalies as defined by VSP and with the greatest potential volume of MEC that pose a risk to the public. Although other high or elevated anomaly density areas exist (High Anomaly Density Areas 3 and Elevated Anomaly Density 1), they do not pose a safety or explosive hazard to the public because they are only associated with a high concentration of small arms finds and are not considered target areas. This alternative would result in UU/UE.

4.2.2.4.2 The Alternative 4 cost estimate was developed based on the following assumptions:

- The clearance of surface and subsurface MEC would be performed by a team consisting of 17 qualified UXO personnel, including 1 project manager, 1 SUXOS, 1 UXOQCS, 1 UXOSO, 2 UXO Tech IIIs, 6 UXO Tech IIs, and 6 UXO Tech Is. The estimated time to complete the surface clearance is 82 days, assuming a clearance rate of 0.5 acre per day. Areas previously cleared during the RI may be cleared again.

- Vegetation clearance would be performed over a maximum of 38.87 acres.

- MEC identified during removal activities would be demilitarized by blowing in place or by consolidated shots if multiple MEC items are found and are determined to be acceptable-to-move. No demolition explosives would be stored on site. Demolition explosives would be transported to the site on an as-needed basis. Identified MEC would be guarded 24 hours per day after discovery until demolition could be performed.

- MD identified during the surface removal would be containerized and shipped off-island for disposal by an authorized recycler. The estimate assumes a maximum of 10 55-gallon drums of MD would be recovered.

- Prior to completion of the remedial action, up to 50 aluminum warning signs, containing text similar to “Danger Explosive Hazard – Stay on Marked Trail,” would be installed along designated trails and in designated campgrounds and hunting areas.

- Erecting signage prior to conducting the remedial action at up to five locations in areas of high traffic (e.g., trailheads and campgrounds) to educate the public of potential hazards associated with munitions and the appropriate response to incidental discovery of munition items.

5.0 Detailed and Comparative Analysis of Remedial Alternatives

5.0.1 This section provides the MEC HA and a detailed and comparative analysis of each remedial alternative developed in Section 4.0. This information will be used to help select a final remedy for the Kahana Valley and Punaluu Valley sections at the former PJCTC. The alternatives developed in Section 4.0 are evaluated using criteria based on statutory requirements of CERCLA, as amended by the Superfund Amendments and Reauthorization Act, § 121; the NCP; and "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988).

5.0.2 The NCP specifies nine criteria to be used in the detailed analysis. The first two criteria are threshold criteria that must be satisfied for a remedy to be eligible for selection. The next five criteria are balancing criteria used to evaluate the comparative advantages and disadvantages of the remedial alternatives. The final two criteria are modifying criteria generally considered after comments are received from the regulatory agencies and the public on the PP. The nine criteria are listed below.

Threshold Criteria

1. Overall Protection of Human Health and the Environment: This criterion describes how each alternative, as a whole, protects human health and the environment and indicates how each hazardous substance source is to be removed, reduced, or controlled.

2. Compliance with ARARs: This criterion evaluates each alternative's compliance with ARARs, or, if an ARAR waiver is required, how the waiver is justified. ARARs consider chemical-specific, location-specific, and action-specific concerns.

Balancing Criteria

1. Long-Term Effectiveness and Permanence: This criterion evaluates the effectiveness of each alternative in protecting human health and the environment after the response action is complete. Factors considered include magnitude of residual hazards and adequacy and reliability of release controls.

2. Reduction of Toxicity, Mobility, or Volume: This criterion evaluates the anticipated capability of each alternative's specific technology to reduce the toxicity, mobility, or volume of hazardous substances.

3. Short-Term Effectiveness: This criterion addresses the effectiveness of each alternative in protecting human health and the environment during the implementation and/or construction phase. Factors considered include:

- Exposure of the community during implementation
- Exposure of the workers during construction
- Effects to the environment
- Time required to meet the RAOs

4. Implementability: This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of the required services and materials during its implementation. Factors considered include:

   - Ability to perform the response action
   - Reliability of the response action
   - Monitoring considerations
   - Availability of equipment and specialists

5. Cost: This criterion evaluates the costs for each alternative. Cost estimates are order-of-magnitude-level estimates and have an expected accuracy of minus 30 to plus 50 percent (EPA, 2000). A comparative analysis of the costs for each alternative is used to support remedy selection. Disproportionately expensive alternatives are screened out from further consideration.

Modifying Criteria

1. Community Acceptance: This criterion evaluates issues and concerns the public may have regarding each alternative. This criterion will be assessed following receipt of public comments on the FS Report and the PP.

2. State Acceptance: This criterion evaluates technical and administrative issues and concerns the state regulatory agencies may have about each alternative. This criterion will be assessed following receipt of regulatory agency comments on the FS Report and the PP.

5.0.3 In the following sections, each remedial alternative is compared with the two threshold and five balancing NCP criteria, and subsequently compared with the other alternatives to assess their relative performance with respect to the NCP criteria. Comparison with the two modifying criteria of community and state acceptance will be based on comments provided during the PP public review period; further discussion of these criteria is not included in this FS Report. Section 5.2 provides a detailed analysis of each remedial alternative. Section 5.3 provides a comparative analysis of the remedial alternatives.

5.1 MEC Hazard Assessment of Alternatives

5.1.0.1 As part of the FS, the MEC HAs for the PJCTC (i.e., KVM, KVB, and Punaluu Valley) were updated to evaluate hazards to humans under the remedial alternative scenarios identified in Section 4.0.

5.1.0.2 The MEC HA addresses human health and safety concerns associated with potential exposure to MEC. Specifically, it assesses the acute hazard posed by the explosive components of MEC. The MEC HA does not directly address the environmental or ecological risks that might be associated with the chemical components of MEC; however, remedial actions to mitigate potential explosive hazards must comply with ARARs that protect sensitive natural and cultural resources. These risks, when present, are generally addressed in separate human health and ecological risk assessments. Because MC were found to be below the HDOH Tier 1 EALs in the PJCTC, human health and ecological risk assessments were not performed (USACE, 2015).

5.1.0.3 The MEC HAs for PJCTC were prepared in accordance with EPA's "Munitions and Explosives of Concern Hazard Assessment Methodology (Interim)" (EPA, 2008). The MEC HA was designed to be used as the CERCLA hazard assessment methodology for a MRS where an explosive hazard from the known or suspected presence of MEC exists (EPA, 2008). An explosive hazard exists at a site if a potentially complete exposure pathway to MEC exists. A potentially complete exposure pathway to MEC is present any time a receptor can come near or into contact with MEC and interact with the item in a manner that might result in its detonation. A potentially complete exposure pathway to MEC has the following three components: (1) a source of MEC, (2) a receptor, and (3) the potential for interaction between the MEC source and the receptor. All three of these elements must be present for a potentially complete MEC exposure pathway to exist.

5.1.0.4 The MEC HA is structured around three components of a potential explosive hazard incident, as discussed below.

- Severity, which is the potential consequences (e.g., death, severe injury, property damage, etc.) of a MEC item detonating.
- Accessibility, which is the likelihood that a receptor will be able to come in contact with a MEC item.
- Sensitivity, which is the likelihood that a receptor will be able to interact with a MEC item such that it will detonate.

5.1.0.5 The MEC HA assesses each of these components by input factors. The sum of the input factor scores falls within one of four defined ranges, called "hazard levels." Each of the four hazard levels reflects site attributes that describe groups of sites and site conditions ranging from highest to lowest hazards. The MEC HA hazard levels are summarized below.

- Hazard Level 1 (Score 840–1,000): Sites with the highest potential explosive hazard. There may be instances where an imminent threat to human health from MEC exists.

- Hazard Level 2 (Score 725–835): A site with surface MEC or intrusive activities that would encounter MEC in the subsurface and the site has moderate or greater accessibility by the public.

- Hazard Level 3 (Score 530–720): A site that would be considered safe for the current land use without further munitions responses, although not necessarily suitable for reasonable anticipated future use. Level 3 sites generally have restricted access and a low number of contact hours and MEC is typically only in the subsurface.

- Hazard Level 4 (Score 125–525): A site compatible with current and determined or reasonably anticipated future use. A MEC cleanup has typically been performed at Level 4 sites.

5.1.0.6 A qualitative evaluation of the potential MEC hazards within the PJCTC was conducted for the following remedial alternative scenarios, which are described in detail in Section 5.2.

Kahana Valley

- Alternative 1 – No Action.

- Alternative 2 – LUCs. LUCs would be implemented to reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources.

- Alternative 3 – Complete Removal of MEC from Target Area. Complete removal of surface and subsurface MEC within the identified target area (i.e., KVB) would significantly reduce, if not eliminate, the probability of a human encounter with MEC and the potential for unintentional MEC detonation and would result in UU/UE.

Punaluu Valley

- Alternative 1 – No Action

- Alternative 2 – LUCs. LUCs would be implemented to reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans and/or damage to ecological and cultural resources.

- Alternative 3 –Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs. Complete removal of surface and subsurface MEC within two identified target areas and one high anomaly density area located in accessible areas near the front of

the valley coupled with implementation of LUCs would significantly reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation.

- Alternative 4 – Complete Removal of MEC from Target Areas and High Anomaly Density Areas. Complete removal of surface and subsurface MEC within all three identified target areas and two high anomaly density areas coupled with installation of education and warning signs would eliminate the probability of a human encounter with MEC and the potential for unintentional MEC detonation and would result in UU/UE.

5.1.0.7 The following sections summarize the details for the seven MEC HA input factors and the results of the MEC HA for each alternative.

5.1.1 Energetic Material Type

5.1.1.1 KVM – The MEC items known to be present within KVM include rockets (i.e., M6A1), pyrotechnics (M127A1 slap flare, M48 trip flare), and fuzes (PD, M46). Based on these findings, the energetic material type selected for KVM is determined to be "high explosive and low explosive filler in fragmenting rounds," which is the most potentially hazardous of the available selections. This factor applies to all alternatives evaluated.

5.1.1.2 KVB – The MEC items known to be present within KVB include rockets (i.e., M6A1), pyrotechnics (i.e., M12A1 slap flare), and an M1 firing device. Based on these findings, the energetic material type selected for KVB is determined to be "high explosive and low explosive filler in fragmenting rounds," which is the most potentially hazardous of the available selections. This factor applies to all alternatives evaluated.

5.1.1.3 Punaluu Valley – The MEC items known or suspected to be present within Punaluu Valley include mortars (i.e., M49A2, M56), pyrotechnics (i.e., M127A1 slap flare), fuzes (i.e., Type 88), grenades (i.e., MK II hand grenade), rockets (i.e., M6A1), and artillery (i.e., M9A1 rifle grenade). Based on these findings, the energetic material type selected for the site is determined to be "high explosives and low explosive filler in fragmenting rounds," which is the most potentially hazardous of the available selections. This factor applies to all alternatives evaluated.

5.1.2 Location of Additional Human Receptors

5.1.2.1 Within the PJCTC (i.e., Kahana Valley and Punaluu Valley), public hiking trails, campsites, hunting grounds, agricultural fields, and residences are within the 2,111-foot explosive safety quantity distance (ESQD) arc. Even if LUCs are implemented, recreational users, agricultural/occupational workers, and residents will continue to access the PJCTC. As a result, the location of additional human receptors is assessed to be "inside MRS or inside the ESQD arc." This factor applies to all alternatives evaluated.

5.1.3 Site Accessibility

5.1.3.1 The PJCTC (i.e., Kahana Valley and Punaluu Valley) contains public hiking trails, campsites, hunting grounds, agricultural fields, and residences that are readily accessible. However, the remaining portions of the valleys contain dense vegetation and steep terrain that render much of the PJCTC difficult to access. Therefore, site accessibility for all alternatives was rated as "Moderate Accessibility."

5.1.4 Potential Contact Hours

5.1.4.1 The Potential Contact Hours factor is evaluated by estimating both the number of users per year and the number of hours that each user engages in activities that may result in encounters with MEC. For KVM, KVB, and Punaluu, potential contact hours are not expected to change regardless of the alternative selected.

5.1.4.2 KVM – Activities currently occurring within KVM include agriculture, maintenance of trails and infrastructure, recreation (i.e., hiking and hunting), and education. The Potential Contact Hours input factor was assessed as "Few Hours (10,000 to 99,999 receptor-hours per year)" for all alternatives.

5.1.4.3 KVB – Activities currently occurring within KVB include maintenance of trails and infrastructure and recreation (i.e., hiking and hunting). The Potential Contact Hours input factor was assessed as "Few Hours (10,000 to 99,999 receptor-hours per year)" for all alternatives.

5.1.4.4 Punaluu – Activities currently occurring within Punaluu Valley include residential living, agriculture, maintenance of trails and infrastructure, recreation (i.e., hiking and hunting), and education. The Potential Contact Hours input factor was assessed as "Few Hours (10,000 to 99,999 receptor-hours per year)" for all alternatives.

5.1.5 Amount of MEC

5.1.5.1 KVM – Based on the RI and previous investigation findings, KVM is believed to have been used solely as a maneuver area; therefore, the Amount of MEC Input Factor Category selected for all alternatives was "Maneuver Areas."

5.1.5.2 KVB – Based on the RI and previous investigation findings, KVB was identified as a target area; therefore, the Amount of MEC Input Factor Category selected for all alternatives was "Target Area."

5.1.5.3 Punaluu Valley – Based on the RI and previous investigation findings, Punaluu Valley was identified as containing both maneuver and target areas; therefore, the Amount of MEC Input Factor Category selected for all alternatives was "Target Area."

5.1.6 Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth

Within the PJCTC (i.e., Kahana Valley and Punaluu Valley), MEC and MD were found on the ground surface and in the subsurface. The maximum receptor intrusive depth at the PJCTC is anticipated to be 2 feet for all receptors. Based on this information, the minimum MEC depth relative to the maximum receptor intrusive depth is assessed to be "Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC." This factor is applied to all alternatives.

5.1.7 Migration Potential

Migration potential for the PJCTC (i.e., Kahana Valley and Punaluu Valley) was rated as "Possible" for all alternatives because migration can occur via natural forces such as erosion caused by overland water flow or landslides along steep slopes.

5.1.8 MEC Classification

5.1.8.1 KVM was used as a maneuver area where MEC and MD, including rockets, pyrotechnics, and fuzes, have been found. Based on the MEC and MD identified within KVM, the MEC Classification factor is assessed as "DMM" for all alternatives.

5.1.8.2 KVB was used as a target area where MD, including rockets and pyrotechnics, have been found. The MEC HA guidance suggests that assessment teams should assume UXO is present in former target areas (EPA, 2008). Based on the MEC and MD identified within KVB, the MEC Classification factor is assessed as "UXO" for all alternatives.

5.1.8.3 Punaluu Valley – Punaluu Valley was used as both a maneuver and target area. MEC and MD, including rockets, pyrotechnics, fuzes, mortars, and grenades, have been found. In addition, a 0.25-pound block of TNT was found within Punaluu Valley. Based on the MEC and MD identified within Punaluu Valley, the MEC Classification is "UXO Special Case" for all alternatives.

5.1.9 MEC Size

The items known or suspected to be present within the PJCTC (i.e., Kahana Valley and Punaluu Valley) vary in size from fuzes (<1 pound) up to 81-mm mortars (approximately 10 pounds). A potential receptor is more likely to pick up a small item (i.e., less than 90 pounds) and initiate detonation than a larger item (i.e., >90 pounds). The possible exposure to an explosive hazard is greater for smaller items as a result. Therefore, the MEC Size classification for this site is assessed as "Small" for all alternatives.

5.1.10 MEC HA Results

MEC HA results by remedial alternative scenario are as follows:

KVM

- Scenario 1: No Action. Score = 755, Hazard Level 2
- Scenario 2: LUCs. Score = 715, Hazard Level 3

KVB

- Scenario 1: No Action. Score = 825, Hazard Level 2
- Scenario 2: LUCs. Score = 750, Hazard Level 2
- Scenario 3: Complete Removal of MEC from Target Area. Score = 435, Hazard Level 4

Punaluu Valley

- Scenario 1: No Action. Score = 895, Hazard Level 1
- Scenario 2: LUCs. Score = 895, Hazard Level 1
- Scenario 3: Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs. Score = 480, Hazard Level 4
- Scenario 4: Complete Removal of MEC from Target Areas and High Anomaly Density Areas. Score = 480, Hazard Level 4

5.2 Detailed Analysis of Alternatives

This section compares each alternative with the two threshold and five balancing NCP evaluation criteria. Tables 5-1 (Kahana Valley) and 5-2 (Punaluu Valley) summarize the comparison of each alternative to the seven NCP criteria evaluated. The ranking categories used in Tables 5-1 and 5-2 and in the discussion of the alternatives are (1) protective or not protective and meets ARARs or does not meet ARARs for the two threshold criteria; and (2) excellent, very good, good, moderate, and poor for the five balancing criteria. Table 5-3 summarizes the costs for each alternative for both sites. Appendix C provides the cost analysis, including the detailed cost information.

5.2.1 Kahana Valley

5.2.1.1 Kahana Valley, Alternative 1 – No Action

Under Alternative 1, no remedial action would be taken. Potential MEC within Kahana Valley would remain in place as-is, without implementing any LUCs or remedial actions.

5.2.1.1.1 Alternative 1: Overall Protection of Human Health and the Environment

MEC items pose a potential hazard to human health and the environment. Alternative 1 would not address these hazards; therefore, the rating for Alternative 1 for the overall protection of human health and the environment is not protective.

5.2.1.1.2 Alternative 1: Compliance with ARARs

There is no need to identify ARARs for the no-action alternative because ARARs apply to "any removal or remedial action conducted entirely on-site" and "no action" is not a removal or remedial action. CERCLA § 121 (42 USC § 9621) cleanup standards for selection of a remedy, including the requirement to meet ARARs, are not triggered by the no-action alternative (EPA, 1988). Therefore, a discussion of compliance with ARARs is not applicable for this alternative.

5.2.1.1.3 Alternative 1: Long-Term Effectiveness and Permanence

Under the no-action alternative, potential MEC would remain in place. No LUCs would be implemented to further restrict public access or reduce the probability of a human encounter with MEC and the potential for unintentional MEC detonation, which may result in injury or death to humans. Based on this evaluation and the accessibility of the site to the public, the overall rating for Alternative 1 for long-term effectiveness and permanence is poor.

5.2.1.1.4 Alternative 1: Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 1 does not provide a reduction in volume of MEC. Therefore, the overall rating for reduction in the mobility, toxicity, or volume through treatment of MEC is poor.

5.2.1.1.5 Alternative 1: Short-Term Effectiveness

Under Alternative 1, no remedial action would occur. As a result, the public and environment would not be exposed to additional hazards during a remedial action but would remain exposed to MEC currently on site. However, the no action alternative would never achieve the RAOs. Therefore, the overall rating for Alternative 1 for short-term effectiveness is poor.

5.2.1.1.6 Alternative 1: Implementability

Implementability includes technical and administrative feasibility and availability of required resources. No action would be required to implement this alternative; therefore, Alternative 1 would be very easy to implement and the overall rating for implementability is excellent.

5.2.1.1.7 Alternative 1: Cost

No costs are associated with Alternative 1; therefore, the overall rating for Alternative 1 for cost is excellent.

5.2.1.1.8 Alternative 1: Summary

The overall rating for Alternative 1 is poor because it fails to meet one or more of the threshold criteria and would not meet the RAOs.

5.2.1.2 Kahana Valley, Alternative 2 – Land Use Controls

Alternative 2 includes implementation of LUCs to reduce the probability of a human encounter with MEC and the potential for an unintentional MEC detonation in Kahana Valley. LUCs include administrative mechanisms (right-of-entry permit and lease conditions and educational programs [i.e., community outreach, visitor education, and safety and awareness training for DLNR and DEM]) and engineering controls (i.e., warning signs). Because this alternative will not reach UU/UE, statutory five-year reviews are required, though not part of the remedy. The cost of 5-year reviews are included in the cost analysis of this remedy.

5.2.1.2.1 Alternative 2: Overall Protection of Human Health and the Environment

Potential MEC items remaining in Kahana Valley pose an explosive hazard to humans. The implementation of LUCs would reduce the probability of a human encounter with MEC and the potential for an unintended MEC detonation, which could result in injury or death to humans. Alternative 2 would reduce site hazards by restricting site access and activities and educating the public on MEC awareness, safety, and response. Therefore, the rating for Alternative 2 for the overall protection human health and the environment is protective.

5.2.1.2.2 Alternative 2: Compliance with ARARs

Action- and location-specific ARARs apply to this alternative and could readily be met during and after implementation. No chemical-specific ARARs were identified for the site. This alternative complies with ARARs.

5.2.1.2.3 Alternative 2: Long-Term Effectiveness and Permanence

The factors evaluated under long-term effectiveness and permanence are the magnitude of residual hazards and adequacy and reliability of controls. Under Alternative 2, hazards related to potential onsite MEC would be reduced by educating residents, recreational users (i.e., hikers, hunters), and occupational workers (i.e., trail and utility maintenance) on the presence and hazards of MEC and the appropriate response actions if MEC items are identified. The LUCs would reduce both the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC. However, under Alternative 2, potential MEC would remain in-place in Kahana Valley in accessible areas and could still be encountered by workers and recreational users. The adequacy and reliability of the LUCs depend on monitoring and maintenance of the administrative mechanisms and engineering controls. The overall rating for Alternative 2 for long-term effectiveness and permanence is moderate.

5.2.1.2.4 Alternative 2: Reduction of Mobility, Toxicity, or Volume through Treatment

5.2.1.2.4.1 Alternative 2 does not provide a reduction in volume of MEC. Therefore, the overall rating for reduction in the mobility, toxicity, or volume through treatment of MEC is poor.

5.2.1.2.5 Alternative 2: Short-Term Effectiveness

5.2.1.2.5.1 Alternative 2 presents minimal hazards to the public or site workers during implementation and would have minimal impact on the environment. Initial implementation of the LUCs (i.e., instituting right-of-entry and lease agreement permit conditions, community outreach events, installation of signs, and training of DLNR and DEM staff would likely be completed within 6 months. However, because the RAO is never fully achieved with MEC potentially remaining in accessible areas under this alternative, the effectiveness of this remedy in the short-term is inadequate. The overall rating for Alternative 2 for short-term effectiveness of LUCs is moderate.

5.2.1.2.6 Alternative 2: Implementability

Implementability includes technical and administrative feasibility and availability of required resources. Alternative 2 would be technically feasible and implementable because the proposed mechanisms such as providing informational material with right-of-entry permits and lease agreements can be readily implemented by DLNR or the City and County of Honolulu Department of Planning and Permitting. The administrative mechanisms (i.e., preparation of informational materials, and public education and outreach) and engineering controls (i.e., warning signs) are conventional and commonplace activities that would be easily implemented. The overall rating for Alternative 2 for implementability is excellent.

5.2.1.2.7 Alternative 2: Cost

The total cost over 30 years for Alternative 2 is $541,075. The overall rating for Alternative 2 for cost is very good.

5.2.1.2.8 Alternative 2: Summary

Under Alternative 2, potential MEC would remain in-place in Kahana Valley and could still be encountered by workers and visitors on approved trails. However, both the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC, would be reduced through site use restrictions and public education. Therefore, the overall rating for Alternative 2 is moderate.

5.2.1.3 Kahana Valley, Alternative 3 – Complete Removal of MEC from Target Area

Alternative 3 is a complete removal of surface and subsurface MEC and MD from within KVB (approximately 10.58 acres) at an identified target area (Appendix A, Figure A4-1). Alternative 3 would permanently remove explosive hazards from MEC within the identified target area (i.e., KVB). In addition, to reduce the potential for an unintentional MEC detonation prior to

completing the remedial action, Alternative 3 would include the establishment of signage within KVM warning the public of the potential presence of explosive hazards and educating the public on potential hazards associated with munitions and the appropriate response to incidental discovery of munition items.

5.2.1.3.1 Alternative 3: Overall Protection of Human Health and the Environment

Potential MEC items remaining at Kahana Valley pose an explosive hazard to humans. Implementation of the removal action in the KVB target area would significantly reduce the probability of a human encounter with MEC in the area with the greatest potential volume of MEC. Therefore, the rating for Alternative 3 for overall protection of human health and the environment is protective.

5.2.1.3.2 Alternative 3: Compliance with ARARs

Action- and location-specific ARARs apply to this alternative and could readily be met during and after alternative implementation. No chemical-specific ARARs were identified for the site. This alternative complies with ARARs.

5.2.1.3.3 Alternative 3: Long-Term Effectiveness and Permanence

Under Alternative 3, hazards related to potential onsite MEC would be reduced by removing MEC from the area with the greatest potential volume of MEC (i.e., the target area). This alternative significantly reduces both the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC, which may result in injury or death to humans. Residual munitions items may potentially remain in place in other areas of Kahana Valley. However, given the historical site use of the remaining areas for maneuvers only and the dense vegetation and steep and rugged terrain of most of the site (rendering most areas difficult to access), the potential for a human encounter with MEC is considered extremely low. Therefore, the overall rating for Alternative 3 for long-term effectiveness and permanence is excellent.

5.2.1.3.4 Alternative 3: Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 3 includes removal of MEC items found in the identified target area and destruction of the MEC item through explosive demolition. Explosive demolition permanently reduces the mobility, toxicity, and volume from the site in the area with the greatest potential volume of MEC. The mobility, toxicity, and volume of MEC items in areas of the site that are not cleared would not be reduced; however, minimal MEC is anticipated in these areas. Therefore, the overall rating for reduction of mobility, toxicity, or volume through treatment is excellent.

5.2.1.3.5 Alternative 3: Short-Term Effectiveness

Alternative 3 presents no additional hazard to the public during implementation because public access would be prohibited within areas undergoing removal activities in accordance with federal

guidance. Alternative 3 presents minimal risk to site workers during implementation because UXO-trained personnel would perform the removal, which includes removal of surface and subsurface MEC, in accordance with federal safety guidelines. Furthermore, prior to completion of the remedial action, signage educating the public on the potential presence and hazards of MEC and the appropriate response actions if MEC is identified will be installed to effectively warn the public in the short-term. Alternative 3 would impact the environment by clearing vegetation up to 10.58 acres. Removal activities in KVB would likely be completed within a 6-week duration. Therefore, the overall rating for Alternative 3 for short-term effectiveness of complete removal within KVB is very good.

5.2.1.3.6 Alternative 3: Implementability

Alternative 3 would be technically feasible and moderately difficult to implement. Trained technical personnel and equipment are readily available. However, additional logistical preparation, coordination, and time would be required to implement the removal action because of the remoteness of KVB and the ruggedness of the terrain. The overall rating for Alternative 3 for implementability is good.

5.2.1.3.7 Alternative 3: Cost

The total cost for Alternative 3 is $1,057,589. The overall rating for Alternative 3 for cost is good.

5.2.1.3.8 Alternative 3: Summary

Alternative 3 would permanently remove explosive hazards from the area of Kahana Valley with the greatest potential volume of MEC, thereby significantly reducing both the probability of a human encounter with MEC and the unintentional detonation of MEC in Kahana Valley. Given the historical site use of the remaining areas for maneuvers only and the dense vegetation and steep and rugged terrain of most of the site (rendering most areas difficult to access), the potential for a human encounter with MEC is considered extremely low. Alternative 3 would result in a UU/UE determination for Kahana Valley. Therefore, an overall rating of very good was assigned to Alternative 3.

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Table 5-1. Kahana Valley - Comparison of Remedial Alternatives with CERCLA Criteria

Alternative	Threshold Criteria		Balancing Criteria				
	Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Mobility, Toxicity, or Volume through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost**
	Parameters considered: • Overall protectiveness • Adequacy and reliability of controls	Parameters considered: • Compliance with ARARs during and following implementation of alternative	Parameters considered: • Magnitude of residual risks • Adequacy and reliability of controls	Parameters considered: • Anticipated capability to reduce toxicity, mobility, or volume of contamination through treatment	Parameters considered: • Exposure of the community during implementation • Exposure of the workers during remedial action, environmental effects • Environmental effects • Time required to achieve RAOs	Parameters considered: • Technical and administrative feasibility of implementing the alternative • Availability of required resources and materials • Availability of equipment and specialists • Reliability of the technology • Monitoring considerations	Parameters considered: • Capital costs • Operations and maintenance costs • Periodic costs
Alternative 1: No Action	Not Protective	Not Applicable	Poor	Poor	Poor	Excellent	Excellent
	Not protective of human health or the environment	No response action would occur under this alternative; therefore, ARARs do not apply.	Potential exposure to MEC would not be addressed because no response would be taken, therefore the alternative is ineffective and there is no permanent remedial action.	Does not include a treatment component that would reduce the mobility, toxicity, or volume of MEC.	No further action would not pose any additional risks to the public or the environment; however, this alternative will never achieve the RAOs.	Easily implemented because no action is necessary.	No costs incurred.
Alternative 2: LUCs	Protective	Complies	Moderate	Poor	Moderate	Excellent	Very Good
	LUCs would reduce the probability of a human encounter with MEC and the potential for an unintended detonation by restricting site access and activities and educating the public on MEC awareness, safety, and response.	Action- and location-specific ARARs could readily be met during and after alternative implementation. Chemical-specific ARARs are not applicable.	MEC would remain in place at the site and could still potentially be encountered by residents, recreational users (i.e., campers, hikers, hunters), and occupational workers (i.e., trail and utility maintenance). Adequacy of LUCs depends on monitoring and maintenance of administrative mechanisms and engineering controls.	Does not include a treatment component that would reduce the mobility, toxicity, or volume of MEC.	LUCs would not result in increased public or site worker exposure during implementation nor impact the environment. Initial implementation of LUCs would likely be completed within 6 months. This alternative, however, does not fully achieve the Remedial Action Objective of reducing explosive hazard exposure to receptors in a reasonable period of time.	Technically feasible and easily implemented because the proposed administrative mechanisms (i.e., permit and lease conditions and educational programs) and engineering controls (i.e., installation of warning signs) are conventional and commonplace activities.	$541,075
Alternative 3: Removal of MEC from Target Area	Protective	Complies	Excellent	Excellent	Very Good	Good	Good
	Complete removal of MEC within KVB target area will significantly reduce the potential for a human encounter with MEC resulting in an unintended detonation	Action- and location-specific ARARs could readily be met during and after alternative implementation. Chemical-specific ARARs are not applicable.	Permanently removes MEC in the area with the greatest potential volume of MEC; thereby, significantly reducing the probability of a human encounter with MEC.	Mobility and volume of MEC and toxicity of MC within MEC would be permanently reduced within the target area through treatment by demolition.	Limited removal in the target area would not present an increased hazard to the public or site workers during implementation. UXO-trained personnel, following federal safety guidelines, would be used during the removal. This alternative would result in 10.58 acres of vegetation clearance in the bunker area. Limited removal activities would likely be completed within 6 weeks.	Limited removal in the target area is technically feasible and moderately difficult to implement. Trained technical personnel and equipment are readily available. However, additional logistical preparation, coordination, and time would be required to implement the removal action due to the remoteness of the removal area and ruggedness of the terrain.	$1,057,589

Notes:
ARARs = applicable or relevant and appropriate requirements
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
KVB = Kahana Valley Bunkers
LUCs = land use controls
MC = munitions constituents
MEC = munitions and explosives of concern
RAOs = remedial action objectives
UXO = unexploded ordnance

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5.2.2 Punaluu Valley

5.2.2.1 Punaluu Valley, Alternative 1 – No Action

Under Alternative 1, no remedial action would be taken. Potential MEC within Punaluu Valley would remain in place as-is, without implementing any LUCs or remedial actions.

5.2.2.1.1 Alternative 1: Overall Protection of Human Health and the Environment

MEC items pose a potential hazard to human health and the environment. Alternative 1 would not address these hazards; therefore, the rating for Alternative 1 for the overall protection of human health and the environment is not protective.

5.2.2.1.2 Alternative 1: Compliance with ARARs

There is no need to identify ARARs for the no-action alternative because ARARs apply to "any removal or remedial action conducted entirely on-site" and "no action" is not a removal or remedial action. CERCLA § 121 (42 USC § 9621) cleanup standards for selection of a remedy, including the requirement to meet ARARs, are not triggered by the no-action alternative (EPA, 1988). Therefore, a discussion of compliance with ARARs is not applicable for this alternative.

5.2.2.1.3 Alternative 1: Long-Term Effectiveness and Permanence

Under the no-action alternative, potential MEC would remain in place. No LUCs would be implemented to further restrict public access or reduce the probability of a human encounter with MEC or the potential for unintentional MEC detonation. Based on this evaluation and the accessibility of the site to the public, the overall rating for Alternative 1 for long-term effectiveness and permanence is poor.

5.2.2.1.4 Alternative 1: Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 1 does not provide a reduction in volume of MEC. Therefore, the overall rating for reduction in the mobility, toxicity, or volume through treatment of MEC is poor.

5.2.2.1.5 Alternative 1: Short-Term Effectiveness

Under Alternative 1, no remedial action would occur. As a result, the public and environment would not be exposed to additional hazards from a remedial action but would remain exposed to MEC currently on site. However, the no action alternative would never achieve the RAOs. Therefore, the overall rating for Alternative 1 for short-term effectiveness is poor.

5.2.2.1.6 Alternative 1: Implementability

Implementability includes technical and administrative feasibility and availability of required resources. No action would be required to implement this alternative; therefore, Alternative 1 would be very easy to implement and the overall rating for implementability is excellent.

5.2.2.1.7 Alternative 1: Cost

No costs are associated with Alternative 1; therefore, the overall rating for Alternative 1 for cost is excellent.

5.2.2.1.8 Alternative 1: Summary

The overall rating for Alternative 1 is poor because it fails to meet one or more of the threshold criteria and would not meet the RAOs.

5.2.2.2 Punaluu Valley, Alternative 2 – Land Use Controls

Alternative 2 includes implementation of LUCs to reduce the probability of a human encounter with MEC and the potential for an unintentional MEC detonation in Punaluu Valley. LUCs include administrative mechanisms (right-of-entry permit and lease conditions and educational programs [i.e., community outreach; visitor education, and safety and awareness training for Kamehameha Schools staff]) and engineering controls (i.e., warning signs). Because this alternative will not reach UU/UE, statutory five-year reviews are required, though not part of the remedy. The cost of 5-year reviews are included in the cost analysis of this remedy.

5.2.2.2.1 Alternative 2: Overall Protection of Human Health and the Environment

Potential MEC items remaining in Punaluu Valley pose an explosive hazard to humans. The implementation of LUCs would reduce the probability of a human encounter with MEC and the potential for an unintended MEC detonations. Alternative 2 would reduce site hazards by restricting site access and activities and educating the public on MEC awareness, safety, and response. Therefore, the rating for Alternative 2 for the overall protection human health and the environment is protective.

5.2.2.2.2 Alternative 2: Compliance with ARARs

Action- and location-specific ARARs apply to this alternative and could readily be met during and after implementation. No chemical-specific ARARs were identified for the site. This alternative complies with ARARs.

5.2.2.2.3 Alternative 2: Long-Term Effectiveness and Permanence

The factors evaluated under long-term effectiveness and permanence are the magnitude of residual hazards and adequacy and reliability of controls. Under Alternative 2, hazards related to potential onsite MEC would be reduced by educating residents, recreational users (i.e., hikers and hunters), agricultural workers, and occupational workers (i.e., road and utility workers) on the potential presence and hazards of MEC and the appropriate response actions if MEC items are identified. The LUCs would reduce both the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC. However, under Alternative 2, potential MEC would remain in place in Punaluu Valley in accessible areas and could still be encountered by workers and recreational users. The adequacy and reliability of the

LUCs depend on monitoring and maintenance of the administrative mechanisms and engineering controls. The overall rating for Alternative 2 for long-term effectiveness and permanence is moderate.

5.2.2.2.4 Alternative 2: Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 2 does not provide a reduction in volume of MEC. Therefore, the overall rating for reduction in the mobility, toxicity, or volume through treatment of MEC is poor.

5.2.2.2.5 Alternative 2: Short-Term Effectiveness

Alternative 2 presents minimal hazard to the public or site workers during implementation and would have minimal impact on the environment. Implementation of the LUCs (i.e., community outreach events and installation of signs) would likely be completed within 6 months. However, because the remedial action objective is never fully achieved under this alternative, the effectiveness of this remedy in the short-term is inadequate. The overall rating for Alternative 2 for short-term effectiveness of LUCs is moderate.

5.2.2.2.6 Alternative 2: Implementability

Implementability includes technical and administrative feasibility and availability of required resources. Alternative 2 would be technically feasible and implementable because the proposed mechanisms such as providing informational material with right-of-entry permits and lease agreements can be readily implemented by Kamehameha Schools. The administrative mechanisms (right-of-entry permit and lease conditions and educational programs [i.e., community outreach; visitor education, and safety and awareness training for Kamehameha Schools staff]) and engineering controls (i.e., warning signs) are conventional and commonplace activities that would be easily implemented. The overall rating for Alternative 2 for implementability is excellent.

5.2.2.2.7 Alternative 2: Cost

The total cost for Alternative 2 is $282,832. The overall rating for Alternative 2 for cost is very good.

5.2.2.2.8 Alternative 2: Summary

Under Alternative 2, potential MEC would remain in place in Punaluu Valley and could still be encountered by residents, agricultural workers, and occupational workers; however, both the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC, which may result in injury or death to humans, would be reduced through site use restrictions and public education. Therefore, the overall rating for Alternative 2 is moderate.

5.2.2.3 Punaluu Valley, Alternative 3 – Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs

Alternative 3 is the removal of surface and subsurface MEC and MD from three identified accessible areas (two target areas and one high anomaly density area) in the front of Punaluu Valley and includes approximately 18.83 acres (Appendix A, Figure A4-2). This alternative also includes LUCs (including five-year reviews) to reduce the probability of a human encounter with MEC and unintentional detonation in areas of the site not covered under the removal action. Administrative controls include right-of-entry and lease conditions and educational programs (i.e., signage, community outreach, visitor education, and safety and awareness training for Kamehameha Schools staff) and engineering controls (i.e., warning signs).

5.2.2.3.1 Alternative 3: Overall Protection of Human Health and the Environment

Potential MEC items remaining in Punaluu Valley pose an explosive hazard to humans. Implementation of a limited surface removal in identified removal areas would reduce the probability of a human encounter with MEC in accessible areas with the greatest potential volume of MEC. The implementation of LUCs would further reduce the risk of a human encounter with MEC and associated unintentional detonation. Therefore, the rating for Alternative 3 for overall protection of human health and the environment is protective.

5.2.2.3.2 Alternative 3: Compliance with ARARs

Action- and location-specific ARARs apply to this alternative and could readily be met during and after alternative implementation. No chemical-specific ARARs were identified for the site. This alternative complies with ARARs.

5.2.2.3.3 Alternative 3: Long-Term Effectiveness and Permanence

Under Alternative 3, hazards related to potential onsite MEC would be reduced by removing MEC from the accessible areas with the greatest potential volume of MEC (i.e., two target areas and one high anomaly density areas) and by educating the public and Kamehameha Schools' staff on the potential presence and hazards of MEC and the appropriate response actions if MEC items are identified. These activities would significantly reduce both the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC. Under this alternative, residual MEC may potentially remain in place in other target areas or elevated anomaly density areas in inaccessible areas of Punaluu Valley. However, given the lack of access roads, dense vegetation, and steep and rugged terrain (rendering these interior areas difficult to access), the potential for a human encounter with MEC is considered very low. Therefore, the overall rating for Alternative 3 for long-term effectiveness and permanence is very good.

5.2.2.3.4 Alternative 3: Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 3 includes removal and demolition of MEC items found in identified target areas. This alternative would permanently reduce the mobility, toxicity, and volume of MEC from the accessible areas of the site. The mobility, toxicity, and volume of MEC items in areas of that site that are not cleared would not be reduced; however, the MEC items in these areas are generally inaccessible and the explosive hazard related to these items is minimal due to the lack of human exposure. Therefore, the overall rating for reduction of mobility, toxicity, or volume through treatment is very good.

5.2.2.3.5 Alternative 3: Short-Term Effectiveness

Alternative 3 presents no additional hazard to the public during implementation because public access would be prohibited within areas undergoing removal activities in accordance with federal guidance. Alternative 3 presents minimal risk to site workers during implementation because UXO-trained personnel would perform the removal, which includes removal of surface and subsurface MEC, in accordance with federal safety guidelines. Alternative 3 would impact the environment by clearing vegetation over 18.83 acres in accessible areas towards the front of the valley. Limited removal activities in accessible areas would likely be completed within a 14-week duration. Therefore, the overall rating for Alternative 3 for short-term effectiveness of limited removal with LUCs is good.

5.2.2.3.6 Alternative 3: Implementability

The limited removal portion of Alternative 3 would be technically feasible and moderately difficult to implement. Trained technical personnel and equipment would be readily available. However, additional logistical preparation, coordination, and time would be required to implement the limited removal action because of the remoteness of the removal areas, vegetation clearance requirements, and the ruggedness of the terrain. Administrative controls include right-of-entry and lease conditions and educational programs (i.e., community outreach; visitor education, and safety and awareness training for Kamehameha Schools staff), and engineering controls (i.e., warning signs) are conventional and commonplace activities that would be easily implemented. The overall rating for Alternative 3 for implementability is good.

5.2.2.3.7 Alternative 3: Cost

The total cost for Alternative 3 is $2,435,483. The overall rating for Alternative 3 for cost is good.

5.2.2.3.8 Alternative 3: Summary

Alternative 3 would permanently remove explosive hazards from identified accessible target areas and high anomaly density areas (which includes the target area in the current active agricultural fields), thereby reducing both the probability of a human encounter with MEC and the unintentional detonation of MEC in Punaluu Valley. Under Alternative 3, MEC would remain in place in the remaining interior areas of Punaluu Valley. However, the probability of a human

encounter with MEC and an unintentional detonation would be further reduced through implementation of LUCs that restrict site access and activities and educate the public on MEC awareness, safety, and response. Therefore, the overall rating for Alternative 3 is very good.

5.2.2.4 Punaluu Valley, Alternative 4 – Complete Removal of MEC from Target Areas and High Anomaly Density Areas

Alternative 4 includes an expanded removal of surface and subsurface MEC and MD from three identified target areas and two high density anomaly areas in Punaluu Valley and includes approximately 38.87 acres (Appendix A, Figure A4-3). The removal actions would occur in areas with slopes less than 18 degrees for safety reasons. Alternative 4 achieves UU/UE.

5.2.2.4.1 Alternative 4: Overall Protection of Human Health and the Environment

Potential MEC items remaining at Punaluu Valley pose an explosive hazard to humans. Implementation of an expanded removal in the three identified target areas and two high anomaly density areas would significantly reduce, if not eliminate, the probability of a human encounter with MEC and the potential for unintentional MEC detonation resulting in injury or death to humans and/or damage to cultural or ecological resources. Therefore, the rating for Alternative 4 for overall protection of human health and the environment is protective.

5.2.2.4.2 Alternative 4: Compliance with ARARs

Action- and location-specific ARARs apply to this alternative and could readily be met during alternative implementation. No chemical-specific ARARs were identified for the site. This alternative complies with ARARs.

5.2.2.4.3 Alternative 4: Long-Term Effectiveness and Permanence

Alternative 4 would remove MEC from the three identified target areas and two high anomaly density areas, thereby significantly reducing, if not eliminating, the probability of a human encounter with MEC and the probability that such an encounter would result in an unintended detonation of MEC, which may result in injury or death to humans. The overall rating for Alternative 4 for long-term effectiveness and permanence is excellent.

5.2.2.4.4 Alternative 4: Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 4 includes removal and demolition of MEC items found in identified target areas and high anomaly density areas. This alternative would permanently reduce the mobility, toxicity, and volume from the site in the areas with the greatest potential volume of MEC. The mobility, toxicity, and volume of MEC items in areas of that site that are not cleared would not be reduced. However, based on the lower anomaly densities in these areas, few MEC items are anticipated to be present. Therefore, the overall rating for reduction of mobility, toxicity, or volume through treatment is excellent.

5.2.2.4.5 Alternative 4: Short-Term Effectiveness

Alternative 4 presents no additional hazard to the public during implementation because public access would be prohibited within areas undergoing removal activities in accordance with federal guidance. Alternative 4 presents minimal risk to site workers during implementation because UXO-trained personnel would perform the expanded removal, which includes removal of surface and subsurface MEC, in accordance with federal safety guidelines. However, Alternative 4 would have a significant impact to the environment by clearing vegetation over 38.87 acres. Although measures would be taken to avoid damage to cultural and natural resources in the more remote locations (specifically, Target Area 3 at the rear of the Punaluu Valley), the potential for incidental damage to sensitive cultural and natural resources is far greater for Alternative 4 than Alternative 3 because the additional areas included in this alternative are situated in otherwise remote, secluded, and unspoiled portions of the valley. Furthermore, by constructing roads in the dense vegetation to enable access to the more remote locations, the remedy may increase public exposure to these areas. Removal activities would likely be completed within a 21-week duration. Therefore, the overall rating for Alternative 4 for short-term effectiveness of LUCs is moderate.

5.2.2.4.6 Alternative 4: Implementability

Alternative 4 would be technically feasible and difficult to implement. While trained technical personnel and equipment are readily available, additional logistical preparation, coordination, and time would be required to implement the expanded removal because of the remoteness of the additional areas undergoing remediation in Punaluu Valley and the extreme ruggedness of the terrain. Vegetation clearance to reach Target Area 3 and the high anomaly density areas 1 and 2 in the back of the valley is a significant undertaking, requiring heavy equipment to cut in roads and construct temporary bridges to cross over streams. The overall rating for Alternative 4 for implementability is moderate.

5.2.2.4.7 Alternative 4: Cost

The total cost for Alternative 4 is $3,401,580. The overall rating for Alternative 4 for cost is moderate.

5.2.2.4.8 Alternative 4: Summary

Alternative 4 would permanently remove explosive hazards from the areas of Punaluu Valley with the greatest potential MEC presence, thereby significantly reducing, if not eliminating, both the probability of a human encounter with MEC and the unintentional detonation of MEC, which may result in injury or death to humans. However, removal activities in the identified target areas and high anomaly density areas in the inaccessible areas would require significantly more logistical preparation, coordination, and time because of the remoteness of the removal areas and ruggedness of the terrain. Residual munitions items may potentially remain in place in the remaining areas of the site; however, given the lower anomaly densities in those areas, few MEC items are anticipated to be present and the ruggedness of the terrain and dense vegetation render these areas relatively

inaccessible. Therefore, the probability of a human encounter with MEC in the remaining areas of Punaluu Valley is extremely low. The potential impacts to the cultural and natural resources resulting from removal actions in the more remote locations included in the expanded would be significant. Heavy equipment used to cut in roads and remove vegetation may cause irreparable damage to the habitat and increase exposure to these otherwise inaccessible areas. Alternative 4 would result in a UU/UE determination for Punaluu Valley. Therefore, the overall rating for Alternative 4 is good.

Table 5-2. Punaluu Valley - Comparison of Remedial Alternatives with CERCLA Criteria

Alternative	Threshold Criteria		Balancing Criteria				
	Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Mobility, Toxicity, or Volume through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost**
	Parameters considered: • Overall protectiveness • Adequacy and reliability of controls	Parameters considered: • Compliance with ARARs during and following implementation of alternative	Parameters considered: • Magnitude of residual risks • Adequacy and reliability of controls	Parameters considered: • Anticipated capability to reduce toxicity, mobility, or volume of contamination through treatment	Parameters considered: • Exposure of the community during implementation • Exposure of the workers during remedial action, environmental effects • Environmental effects • Time required to achieve RAOs	Parameters considered: • Technical and administrative feasibility of implementing the alternative • Availability of required resources and materials • Availability of equipment and specialists • Reliability of the technology • Monitoring considerations	Parameters considered: • Capital costs • Operations and maintenance costs • Periodic costs
Alternative 1: No Action	Not Protective	Not Applicable	Poor	Poor	Poor	Excellent	Excellent
	Not protective of human health or the environment	No response action would occur under this alternative; therefore, ARARs do not apply.	Potential exposure to MEC would not be addressed because no response would be taken, therefore the alternative is ineffective and there is no permanent remedial action.	Does not include a treatment component that would reduce the mobility, toxicity, or volume of MEC.	No further action would not pose any additional risks to the public or the environment; however, this alternative will never achieve the RAOs.	Easily implemented because no action is necessary.	No costs incurred.
Alternative 2: LUCs	Protective	Complies	Moderate	Poor	Moderate	Excellent	Very Good
	LUCs would reduce the probability of a human encounter with MEC and the potential for an unintended detonation by restricting site access and activities and educating the public on MEC awareness, safety, and response.	Action- and location-specific ARARs could readily be met during and after alternative implementation. Chemical-specific ARARs are not applicable.	MEC would remain in-place at the site and could still potentially be encountered by residents, recreational users (i.e., hikers and hunters), agricultural workers, and occupational workers (i.e., road and utility workers). Adequacy of LUCs depends on monitoring and maintenance of administrative mechanisms and engineering controls.	Does not include a treatment component that would reduce the mobility, toxicity, or volume of MEC.	LUCs would not result in increased public or site worker exposure during implementation nor impact the environment. Initial implementation of LUCs would likely be completed within 6 months. This alternative, however, does not fully achieve the Remedial Action Objective of reducing explosive hazard exposure to receptors in a reasonable period of time.	Technically feasible and easily implemented because the proposed administrative mechanisms (i.e., permit and lease conditions and educational programs) and engineering controls (i.e., installation of warning signs) are conventional and commonplace activities.	$282,832
Alternative 3: Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs	Protective	Complies	Very Good	Very Good	Good	Good	Good
	Complete removal of MEC within identified target areas will significantly reduce the potential for a human encounter with MEC resulting in an unintended detonation. LUCs will further reduce the probability of a human encounter with MEC and the potential for an unintended detonation, in the remaining high	Action- and location-specific ARARs could readily be met during and after alternative implementation. Chemical-specific ARARs are not applicable.	Permanently removes MEC in accessible areas with the greatest potential volume of MEC; thereby, significantly reducing the probability of a human encounter with MEC. However, MEC may still remain in-place at the site in less accessible high anomaly density areas and could still potentially be encountered by residents, recreational users (i.e., hikers and hunters), agricultural workers, and occupational workers (i.e., road and utility workers).	Mobility and volume of MEC and toxicity of MC within MEC would be permanently reduced in accessible high anomaly density areas through treatment by demolition.	Limited removal in target areas and accessible high anomaly density areas would not present an increased hazard to the public or site workers during implementation. UXO-trained personnel, following federal safety guidelines, would be used during the removal. This alternative would result in 18.83 acres of vegetation. Removal activities would likely be completed within 14 weeks.	Removal in the accessible target areas and high anomaly density areas is technically feasible and moderately difficult to implement. Trained technical personnel and equipment are readily available. However, additional logistical preparation, coordination, and time would be required to implement the remedial action because the remoteness of the removal areas and ruggedness of the terrain.	$2,435,483

Alternative	Threshold Criteria		Balancing Criteria				
	Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**Long-Term Effectiveness and Permanence**	**Reduction of Mobility, Toxicity, or Volume through Treatment**	**Short-Term Effectiveness**	**Implementability**	**Cost**
Alternative 3: Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs (continued)	anomaly density areas, by restricting site access and activities and educating the public on MEC awareness, safety, and response.		Adequacy of LUCs depends on monitoring and maintenance of administrative mechanisms and engineering controls.		clearance, which may impact sensitive natural resources. Limited removal activities would likely be completed within 14 weeks.		
Alternative 4: Complete Removal of MEC from Target Areas and High Anomaly Density Areas	Protective	Complies	Excellent	Excellent	Moderate	Moderate	Moderate
	Complete removal of MEC within identified target areas and high anomaly density areas would significantly reduce, if not eliminate, the potential for a human encounter with MEC.	Action- and location-specific ARARs could readily be met during and after alternative implementation. Chemical-specific ARARs are not applicable.	Permanently removes MEC in target areas and all high anomaly density areas; thereby significantly reducing, if not eliminating, the potential for a human encounter with MEC.	Mobility and volume of MEC and toxicity of MC within MEC would be permanently reduced within target areas and high anomaly density areas through treatment by demolition.	Limited removal in target areas and high anomaly density areas would not present an increased hazard to the public or site workers during implementation. UXO-trained personnel, following federal safety guidelines, would be used during the removal. This alternative would result in 38.87 acres of vegetation clearance, some of which is likely to impact natural and cultural resources in otherwise remote and unspoiled areas. Removal activities would likely be completed within 21 weeks.	Conducting clearance in inaccessible areas is technically feasible; however, it is difficult to implement due to the remote location, rugged terrain, and lack of access roads. Trained technical personnel and equipment are readily available to perform the fieldwork; however, implementation would require significantly more logistical preparation, coordination, and time than work performed in accessible areas.	$3,401,580

Notes:
ARARs = applicable or relevant and appropriate requirements
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
LUCs = land use controls
MC = munitions constituents
MEC = munitions and explosives of concern
RAOs = remedial action objectives
UXO = unexploded ordnance

5.3 Comparison of Remedial Alternatives

This section compares the remedial alternatives with one another for each valley. The discussion of each evaluation criterion generally proceeds from the alternative that best satisfies the criterion to the one that least satisfies the criterion.

5.3.1 Kahana Valley

5.3.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is a threshold criterion. Protection is not measured by degree; rather, each alternative is considered as either protective or not protective. Alternatives 2 and 3 are protective. Alternative 1 is not protective.

5.3.1.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion. An alternative must either comply with ARARs or provide grounds for a waiver. Alternatives 2 and 3 comply with ARARs. Alternative 1 does not include any response action, thus ARARs are not applicable.

5.3.1.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of Alternative 3 is rated the highest with a rating of excellent because it would remove surface and subsurface MEC from the identified target area, thereby permanently eliminating explosive hazards to the public and environment from MEC in the area of the site with the greatest potential volume of MEC. Interim signage is also included to provide reduction in the probability for human interaction with explosive hazards associated with MEC prior to completion of the remedial action. Alternative 2 is rated moderate because MEC are not removed from the site, and the long-term effectiveness and permanence of LUCs is dependent on the monitoring and maintenance of the administrative mechanisms and engineering controls. Alternative 1 is rated poor because it does not achieve a reduction in risk to humans from explosive hazards at the site through MEC removal or other means.

5.3.1.4 Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 3 is rated highest with a rating of excellent because it would remove surface and subsurface MEC from the identified target area and permanently remove the mobility, toxicity, and volume of MEC through on site demolition. Alternatives 1 and 2 were rated poor because they do not include a treatment component that would reduce the mobility, toxicity, and volume of MEC.

5.3.1.5 Short-Term Effectiveness

Alternative 3 is rated very good because it can be completed within a reasonable timeframe and does not endanger the public or trained workers complying with the federal standards for munitions response. However, it would take longer to implement than Alternative 2 and would include

environmental impacts, specifically clearance of 10.58 acres of vegetation. Alternative 2 is rated lower than Alternative 3 with a rating of good for short-term effectiveness because it does not achieve the RAOs in a reasonable timeframe. LUCs could be implemented within 6 months and worker and public exposure to explosive hazards would not be increased during implementation. There would be no environmental effects during implementation. Alternative 1 is rated poor for short-term effectiveness because, by undertaking no response action, explosive hazards to the public would remain from MEC potentially present at the site.

5.3.1.6 Implementability

Alternatives 1 and 2 were rated excellent for implementability because they would be easy to implement; technically feasible; the alternatives are conventional and commonplace; and the technical expertise, labor, equipment, and materials would be readily available. Alternative 3 was rated good because it would be moderately easy to implement; technically feasible; the alternatives are conventional and commonplace; and the technical expertise, labor, equipment, and materials would be readily available. However, because of the remoteness of the removal area and the ruggedness of the terrain, additional logistical preparation, coordination, and time would be required to implement the alternative.

5.3.1.7 Cost

Alternative 1 requires no action; therefore, no costs are associated with this alternative and it is rated excellent. Alternative 2 is rated very good, with the least total cost of $541,075. Alternative 3 is rated good, with a total cost of $1,057,589.

5.3.1.8 Summary of Alternatives

5.3.1.8.1 Alternative 3, Complete Removal of MEC from Target Area, received the highest rating with an overall rating of very good. This alternative, when compared against the other two alternatives, presents the best alternative for achieving overall protection of human health and the environment in compliance with ARARs. Alternative 3 would permanently reduce the mobility, toxicity, and volume of MEC within the identified target area; thereby, significantly reducing the potential for a human encounter with MEC and associated unintentional detonation within Kahana Valley. Given the historical site use of the remaining areas for maneuvers only and the dense vegetation and steep and rugged terrain of most of the site (rendering most areas difficult to access), the potential for a human encounter with MEC is considered extremely low. Short-term effectiveness was rated very good because remedial activities would not increase exposure of workers or the community during implementation and could be completed within 6 weeks. However, environmental impacts would occur, specifically vegetation clearance of 10.58 acres. Costs for implementation are moderate. Following completion of remedial activities, the Kahana Valley section would be eligible for a UU/UE determination.

5.3.8.2 Alternative 2, LUCs, received an overall rating of moderate. While the alternative is easier and less costly to implement than Alternative 3 and would not have any environmental impacts, it

does not reduce the mobility, toxicity, or volume of MEC at the site and long-term effectiveness is dependent on the LUCs being effectively administered. However, Alternative 2 would reduce the probability of a human encounter with MEC and the potential for an unintended MEC detonation, which could result in injury or death to humans through site access and use restrictions and public education.

5.3.8.3 Alternative 1, No Action, is the least costly and easiest alternative to implement; however, it would not reduce risks posed to the public by explosive hazards through removal of MEC or other means; therefore, it received an overall rating of poor.

5.3.2 Punaluu Valley

5.3.2.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is a threshold criterion. Protection is not measured by degree; rather, each alternative is considered as either protective or not protective. Alternatives 2, 3, and 4 are protective. Alternative 1 is not protective.

5.3.2.2 Compliance with ARARs

Compliance with ARARs is a threshold criterion. An alternative must either comply with ARARs or provide grounds for a waiver. Alternatives 2, 3, and 4 comply with ARARs. Alternative 1 does not include any response action, thus ARARs are not applicable.

5.3.2.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of Alternative 4 is rated the highest with a rating of excellent because it would remove surface and subsurface MEC from the identified target areas and high anomaly density areas, thereby permanently reducing explosive hazards to the public and environment from these areas (i.e., 38.87 acres). Alternative 3 is rated very good because it would significantly reduce the risk of a human encounter with MEC and associated unintentional detonation by removing surface and subsurface MEC from the identified target and anomaly areas in the accessible areas of the site. It also provides additional risk reduction from residual MEC in areas outside of the identified target areas through implementation of LUCs; although the effectiveness and permanence of LUCs is dependent on monitoring and maintenance of the administrative mechanisms and engineering controls. Alternative 2 was rated good because, while it does not include removal of MEC from Punaluu Valley, LUCs would reduce the probability of a human encounter with MEC and associated unintentional detonation through site access and use restrictions and by educating the public on the potential presence of MEC, MEC safety, and MEC response. Alternative 1 is rated poor because it would not achieve a reduction in risk to humans from explosive hazards at the site through MEC removal or any other means.

5.3.2.4 Reduction of Mobility, Toxicity, or Volume through Treatment

Alternative 4 is rated highest with a rating of excellent because it would remove surface and subsurface MEC from 38.87 acres, thereby significantly reducing the mobility, toxicity, and volume of MEC in Punaluu Valley. Alternative 3 is rated very good because it would remove surface and subsurface MEC from the accessible areas of the site (18.83 acres). Alternatives 1 and 2 were rated poor because they do not include a treatment component that would reduce the mobility, toxicity, and volume of MEC.

5.3.2.5 Short-Term Effectiveness

Alternative 3 was rated very good because, while worker and public exposure are not increased during implementation, the field activities are limited to areas that are currently more accessible and vegetation clearance would be performed over only 18.83 acres, less than half of the area required under Alternative 4. Alternative 4 was rated moderate, substantially lower than Alternative 3, because it requires significantly more vegetation clearance and access road construction that will likely impact sensitive natural and cultural resources. Alternative 2 is rated moderate for short-term effectiveness because while worker and public exposure would not be increased during implementation and there are no environmental effects during implementation, the LUCs would not achieve the RAOs in a reasonable timeframe. Alternative 1 is rated poor for short-term effectiveness because, by undertaking no response action, explosive hazards to the public would remain from MEC potentially present at the site.

5.3.2.6 Implementability

Alternatives 1 and 2 were rated excellent for implementability because they would be easy to implement; technically feasible; the alternatives are conventional and commonplace; and the technical expertise, labor, equipment, and materials would be readily available. Alternative 3 was rated good because it is implementable; technically feasible; the alternatives are conventional and commonplace; and the technical expertise, labor, equipment, and materials would be readily available. However, because of the remoteness of the removal areas and the ruggedness of the terrain, additional logistical preparation, coordination, and time would be required to implement Alternative 3. Likewise, implementation of Alternative 4, which expands the areas to be remediated into significantly less accessible areas, would require substantially more logistical preparation and coordination as compared to Alternative 3. Furthermore, the alternative would be implemented over an additional 20.04 acres and would require additional vegetation removal and time to complete, potentially impacting sensitive natural and cultural resources. Therefore, Alternative 4 was rated moderate.

5.3.2.7 Cost

Alternative 1 requires no action; therefore, no costs are associated with this alternative and it is rated excellent. Alternative 2 is rated very good, with the least total cost of $282,832.

Alternative 3, is rated good, with a total cost of $2,435,483. Alternative 4, is rated moderate with a total cost of $3,401,580.

5.3.2.8 Summary of Alternatives

5.3.2.8.1 Alternative 3, Removal of MEC from Accessible Target Areas and High Anomaly Density Areas and LUCs, received the highest rating with an overall rating of very good. This alternative, when compared against the other three alternatives, presents the best alternative for achieving overall protection of human health and the environment in compliance with ARARs. Alternative 3 would permanently reduce the mobility, toxicity, and volume of MEC within the identified accessible target areas and high anomaly density areas (i.e., 18.83 acres), thereby significantly reducing the potential for human encounter with MEC and associated unintentional detonation within Punaluu Valley. Although munitions items could potentially remain in place in other areas of Punaluu Valley under this alternative, given the relative inaccessibility of the remaining areas (due to dense vegetation and ruggedness of terrain) and the lower anomaly densities in these areas, the probability of a human encounter with MEC in the remaining areas is considered extremely low. When compared against Alternative 4, this alternative is less costly to complete, requiring less time to implement, and resulting in less environmental impact (only 18.83 acres would be required). In addition, LUCs implemented under Alternative 3 would provide additional reduction in risk from residual MEC in other areas of the site.

5.3.2.8.2 Alternative 4, Complete Removal of MEC from Target Areas and High Anomaly Density Areas, received an overall rating of good. Short-term effectiveness was rated moderate because remedial activities would not increase exposure of workers or the community during implementation and could be completed within 21 weeks. However, significant environmental impacts would occur, specifically vegetation clearance of 38.87 acres. Costs for implementation are high. Following completion of Alternative 4, the Punaluu Valley section would be eligible for a UU/UE determination.

5.3.2.8.3 Alternatives 2, LUCs, received an overall rating of moderate. While the alternative is easier and cheaper to implement than Alternative 3 and would not have any environmental impacts, it would not reduce the mobility, toxicity, or volume of MEC at the site and long-term effectiveness would be dependent on the LUCs being effectively administered. However, Alternative 2 would reduce the probability of a human encounter with MEC and the potential for an unintended MEC detonation, which could result in injury or death to humans through site access and use restrictions and public education.

5.3.2.8.4 Alternative 1, No Action, is cheapest and easiest to implement; however, it would not reduce risks posed to the public by explosive hazards through removal of MEC or other means; therefore, it received an overall rating of poor.

Table 5-3 Cost Estimate Summary

Remedial Alternative	Total Cost (Kahana Valley)	Total Cost (Punaluu Valley)
1	$0	$0
2	$541,075	$282,832
3	$1,057,589	$2,435,483
4	N/A	$3,401,580

Notes:
N/A = not applicable

6.0 References

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Appendix A Figures

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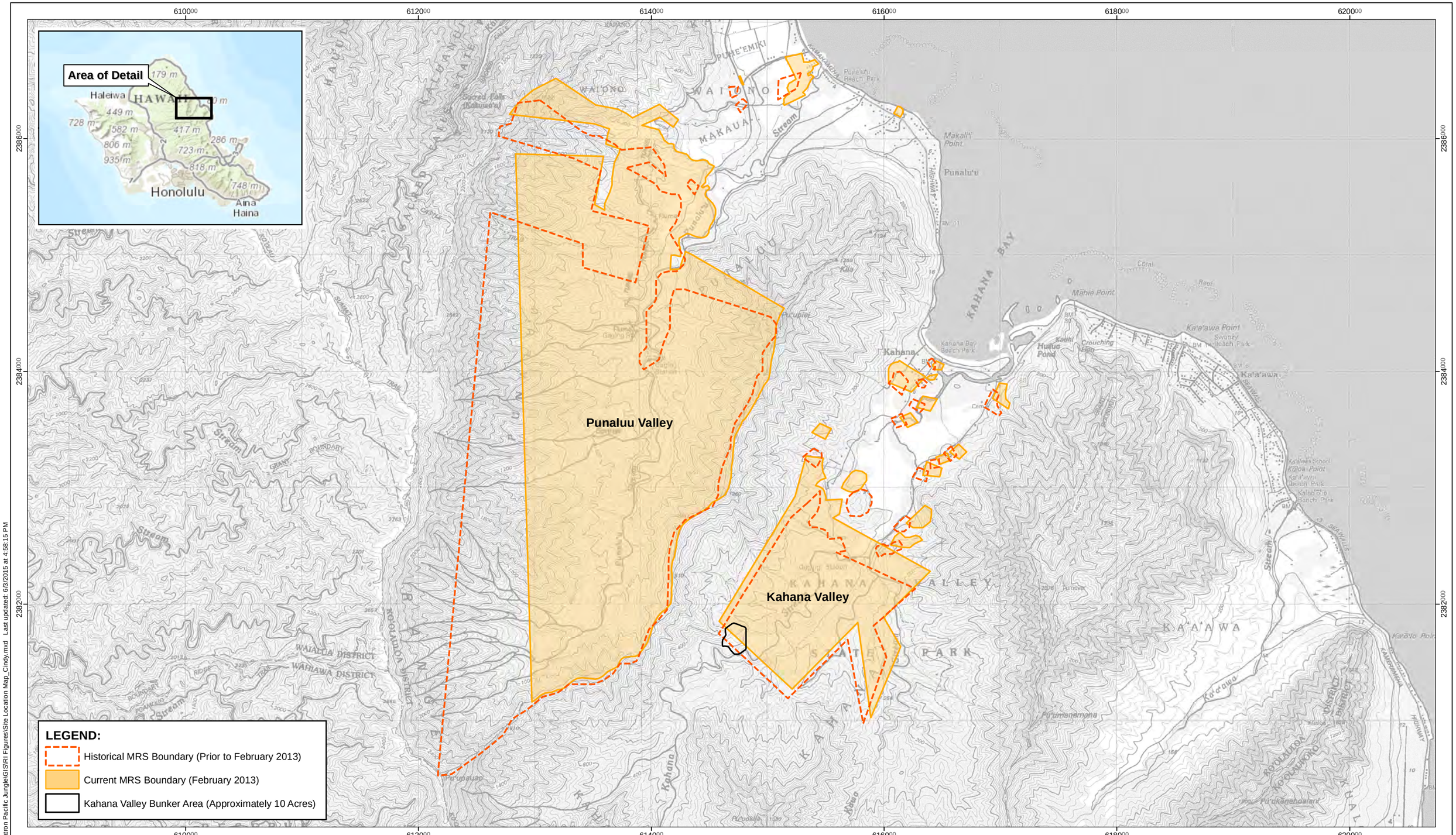

LEGEND:

- Historical MRS Boundary (Prior to February 2013)
- Current MRS Boundary (February 2013)
- Kahana Valley Bunker Area (Approximately 10 Acres)

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers
References:

1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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SCALE: 1 INCH = 2,500 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401				SITE LOCATION MAP
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: MKH 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. A1-1

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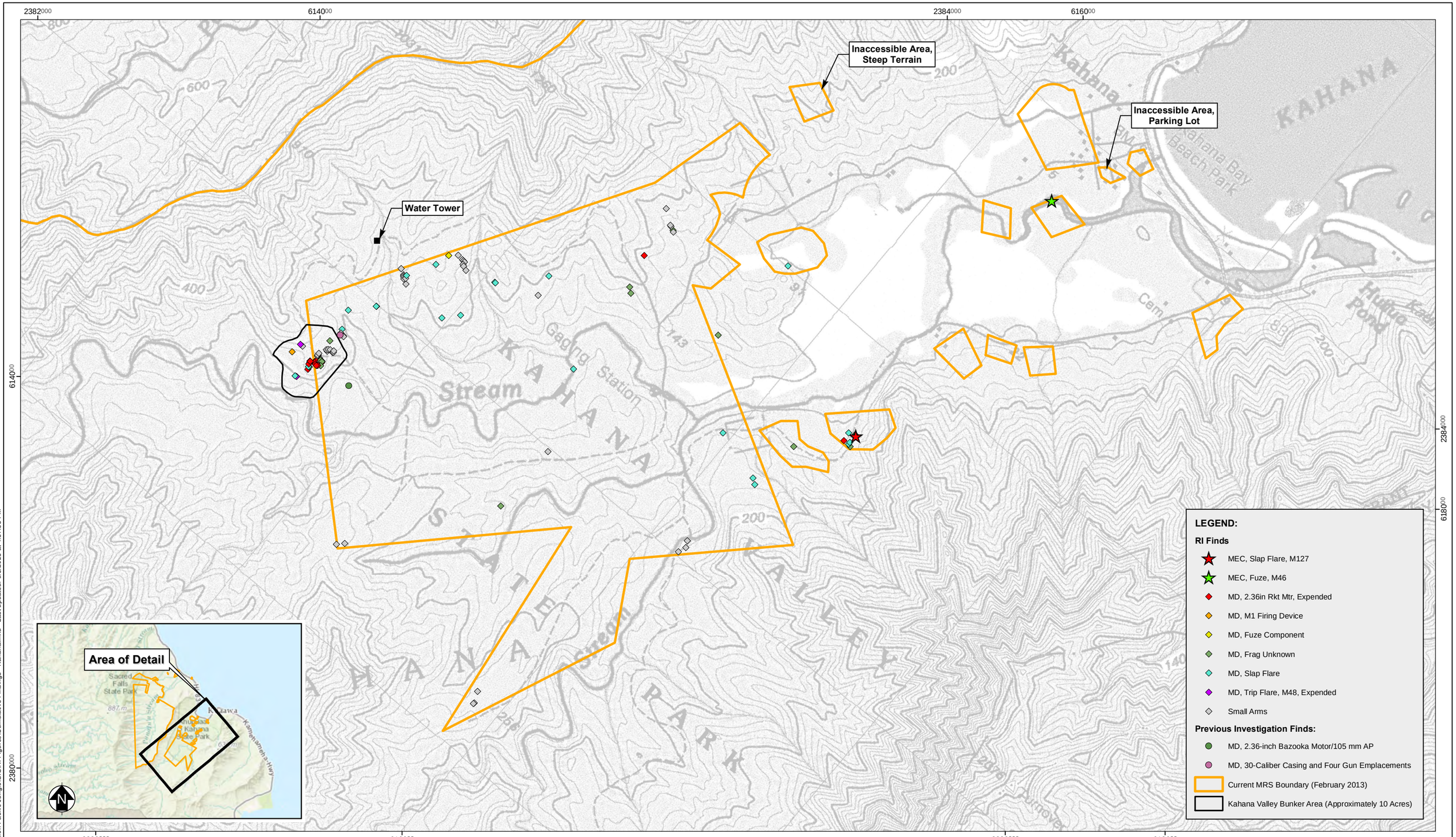

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Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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SCALE: 1 INCH = 1,000 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	CUMULATIVE FINDINGS – KAHANA VALLEY			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: JC 1/4/2015	CHECKED BY: CAL 1/4/2015	PROJECT NO. 2012-127	FIG NO. A1-2

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81mm Mortar, M56 (2 total)

81mm Mortar, M56 (2 total)
60mm Mortar, M49A2 (2 total)

2.36in HEAT Rkt, M6A1 (7 total)

2.36in HEAT Rkt, M6A1 (1 total)
60mm Mortar, M49A2 (1 total)
M9A1 Rifle Grenade (4 total)

Area of Detail

LEGEND:

RI Finds:

- MEC, 2.36in HEAT Rocket
- MEC, 60mm Mortar, M49A2
- MEC, M9A1 Rifle Grenade
- MEC, Hand Grenade, MK II
- MEC, Fuze, Type 88
- MEC, 81mm Mortar, M56
- MEC, 60mm Mortar, M49A2
- MEC, Slap Flare, M127A1
- Two 1/2-lb TNT Demolition Block
- MD, 2.36in Rkt Mtr, Expended
- MD, M6A1 2.36in Rocket
- MD, 60mm Mortar, Tail Boom
- MD, 81mm Mortar Tail Boom
- MD, Fuze Component
- MD, Frag Unknown
- MD, Hand Grenade, Practice, MK1
- MD, Projectile, Lifting Lug
- MD, Slap Flare
- Small Arms

Previous Investigation Finds:

- MEC, 75 mm AP or HE
- MEC, 81 mm Mortor
- M6 Heat Rocket
- TNT Block
- MEC, Unexpened Smoke Grenade
- MD, 30-Caliber Casing and Four Gun Emplacements
- MD, 2.36-inch Bazooka Motor/105 mm AP
- MD, M1,M2 Cartridges/Unexpended .30 Caliber Bullet
- Current MRS Boundary (February 2013)

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Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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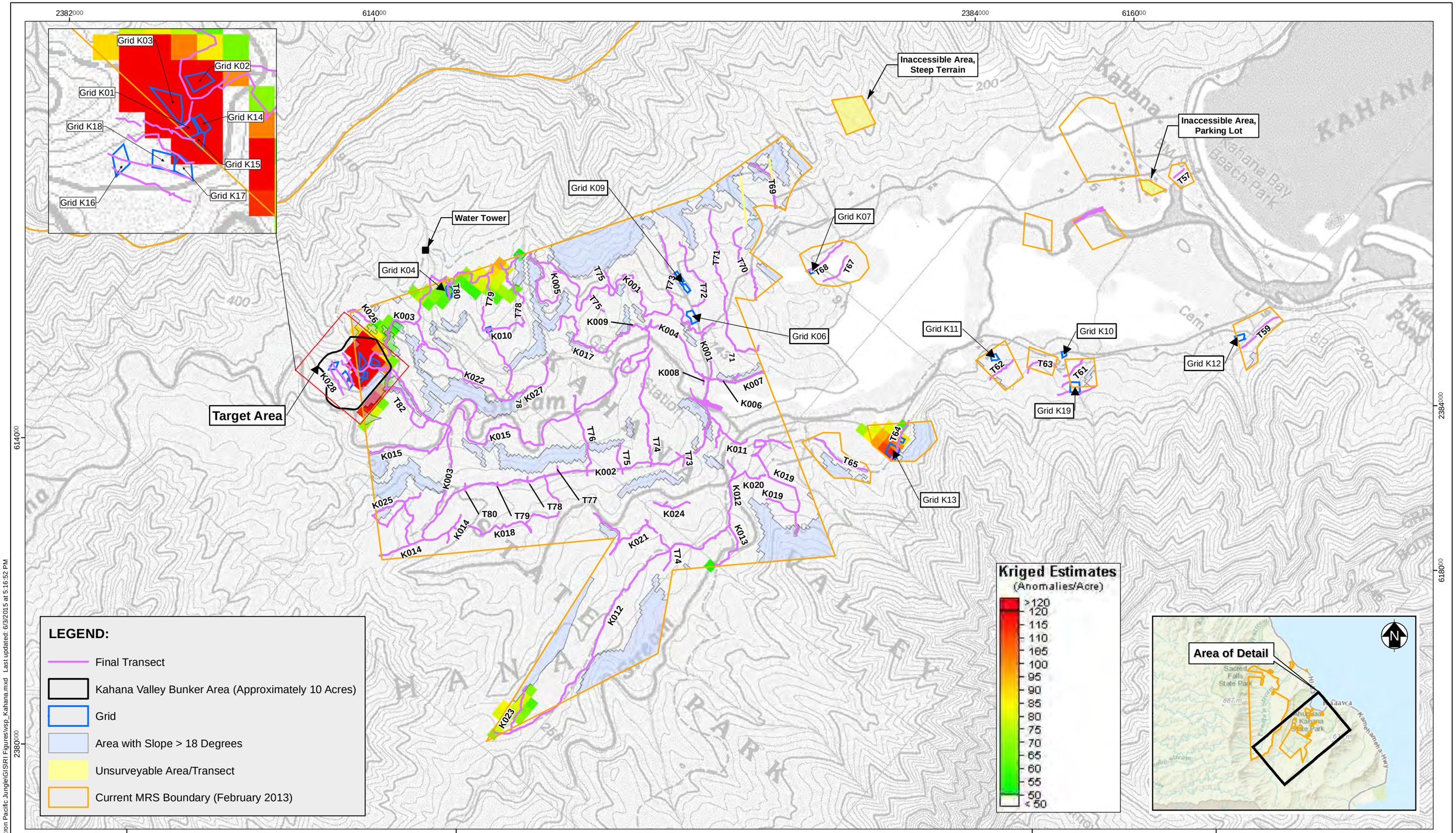
SCALE: 1 INCH = 1,300 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	CUMULATIVE FINDINGS – PUNALUU VALLEY			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: JC 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. A1-3



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Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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SCALE: 1 INCH= 1,000 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	RI ANOMALY DENSITY MAP - KAHANA VALLEY		
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. A1-4

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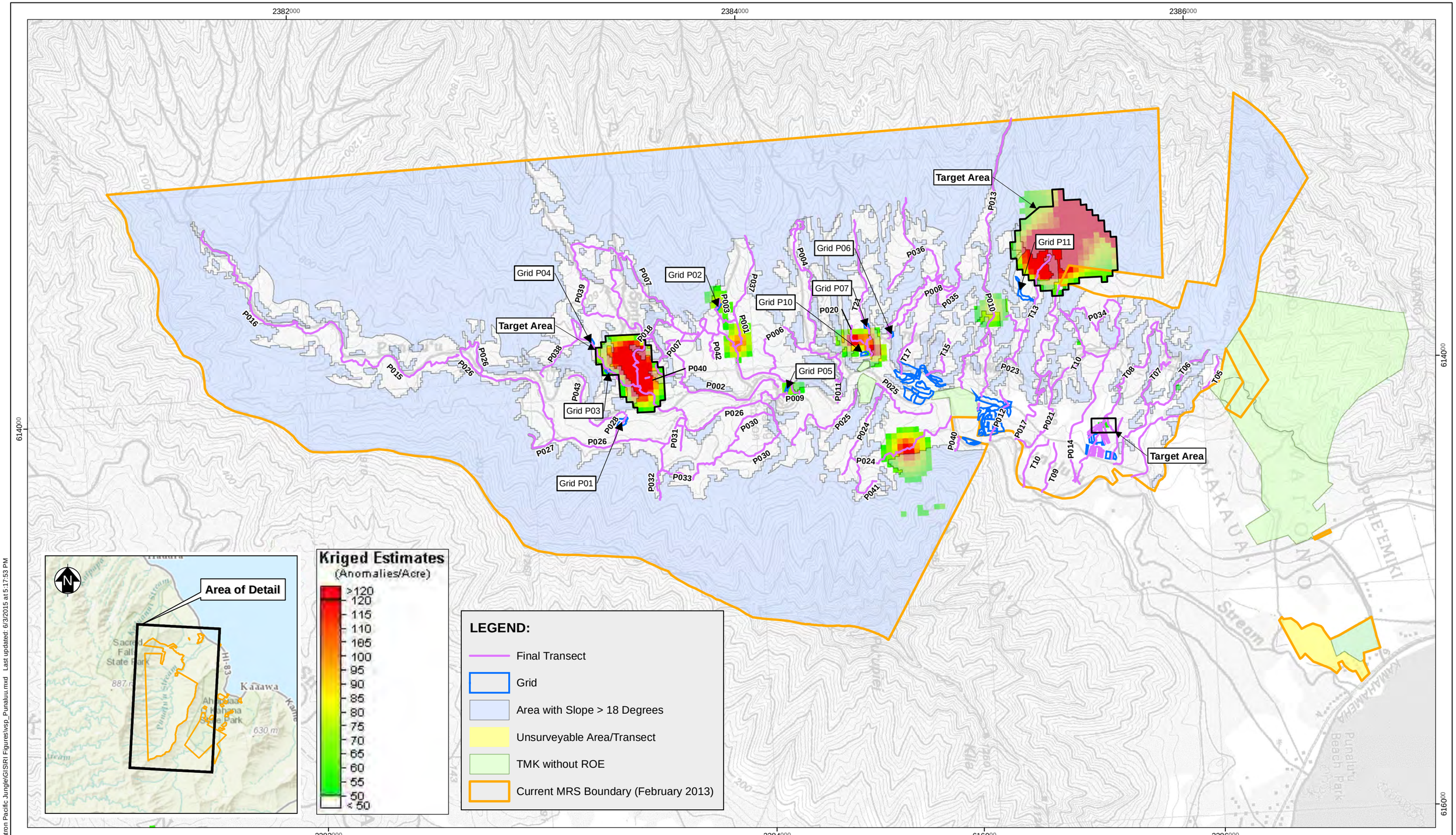

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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SCALE: 1 INCH = 1,300 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401				**RI ANOMALY DENSITY MAP - PUNALUU VALLEY**
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. **A1-5**

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Area of Detail

Haleiwa
Honolulu
Aina Haina

75 mm AP or HE

M1, M2 cartridges / Unexpended .30 caliber bullets

81 mm mortar

TNT Block

Location of gun emplacement

M6 Heat Rocket

Location of an unexpended smoke grenade near a combat tank used for target practice

Punaluu Valley

Kahana Valley

Location of spent 30-caliber casings and four gun emplacements

2.36-inch bazooka motor / 105 mm AP

LEGEND:

- Munitions and Explosives of Concern Location[1]
- Munitions Debris Location[1]
- Qualitative Reconnaissance Track - 2008 SI
- Historical MRS Boundary (Prior to February 2013)
- Current MRS Boundary (February 2013)

Note:

[1] Locations from 1993 Inventory Project Report are approximate and have been adjusted to better correspond with updated MRS boundaries (see figure A2-1)

6100000 6120000 6140000 6160000 6180000 6200000

2386000 2384000 2382000

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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SCALE: 1 INCH = 2,500 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	LOCATIONS OF PREVIOUSLY FOUND MEC AND MD (1993-2012)			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: JJC 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. A2-1

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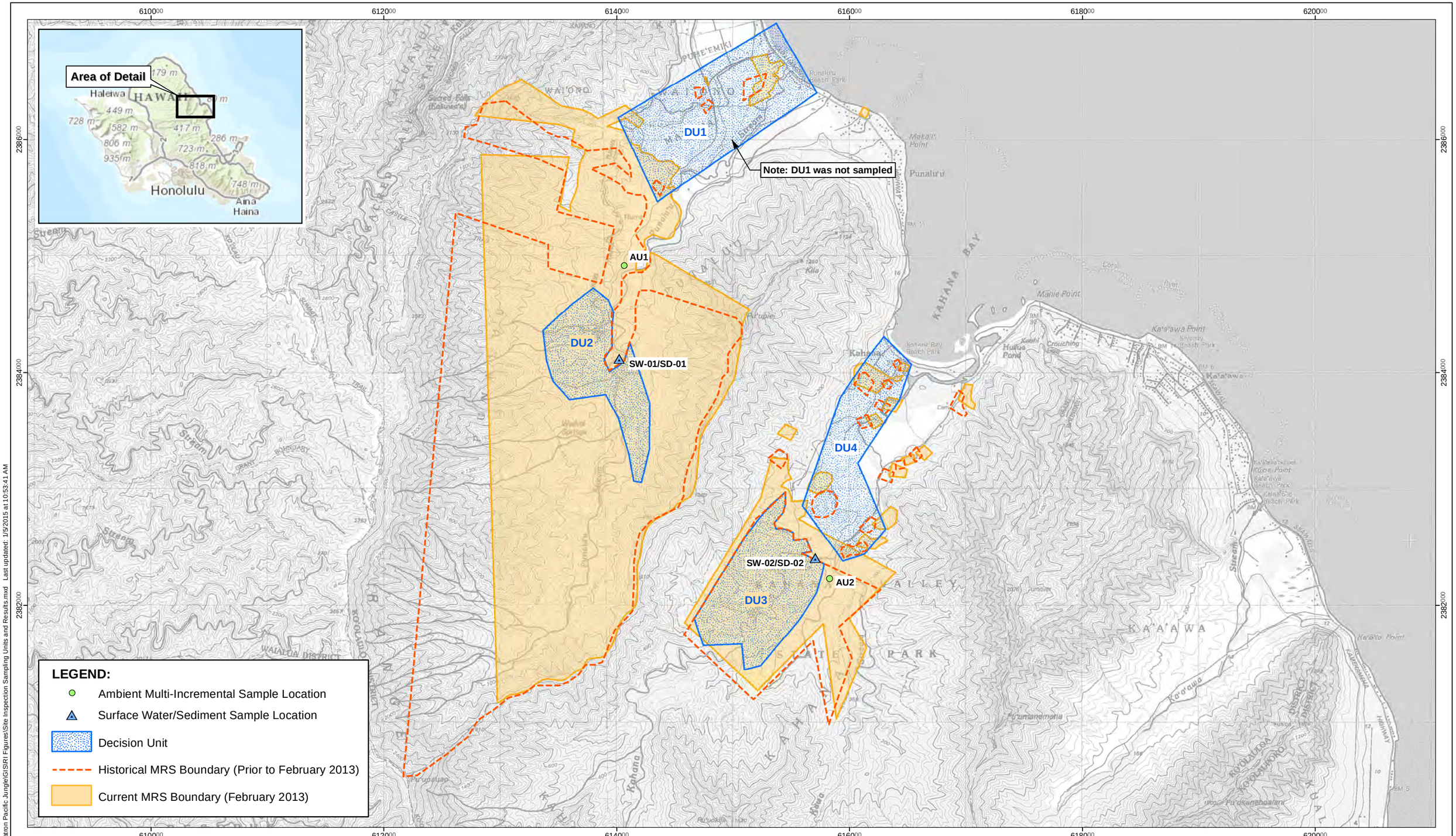

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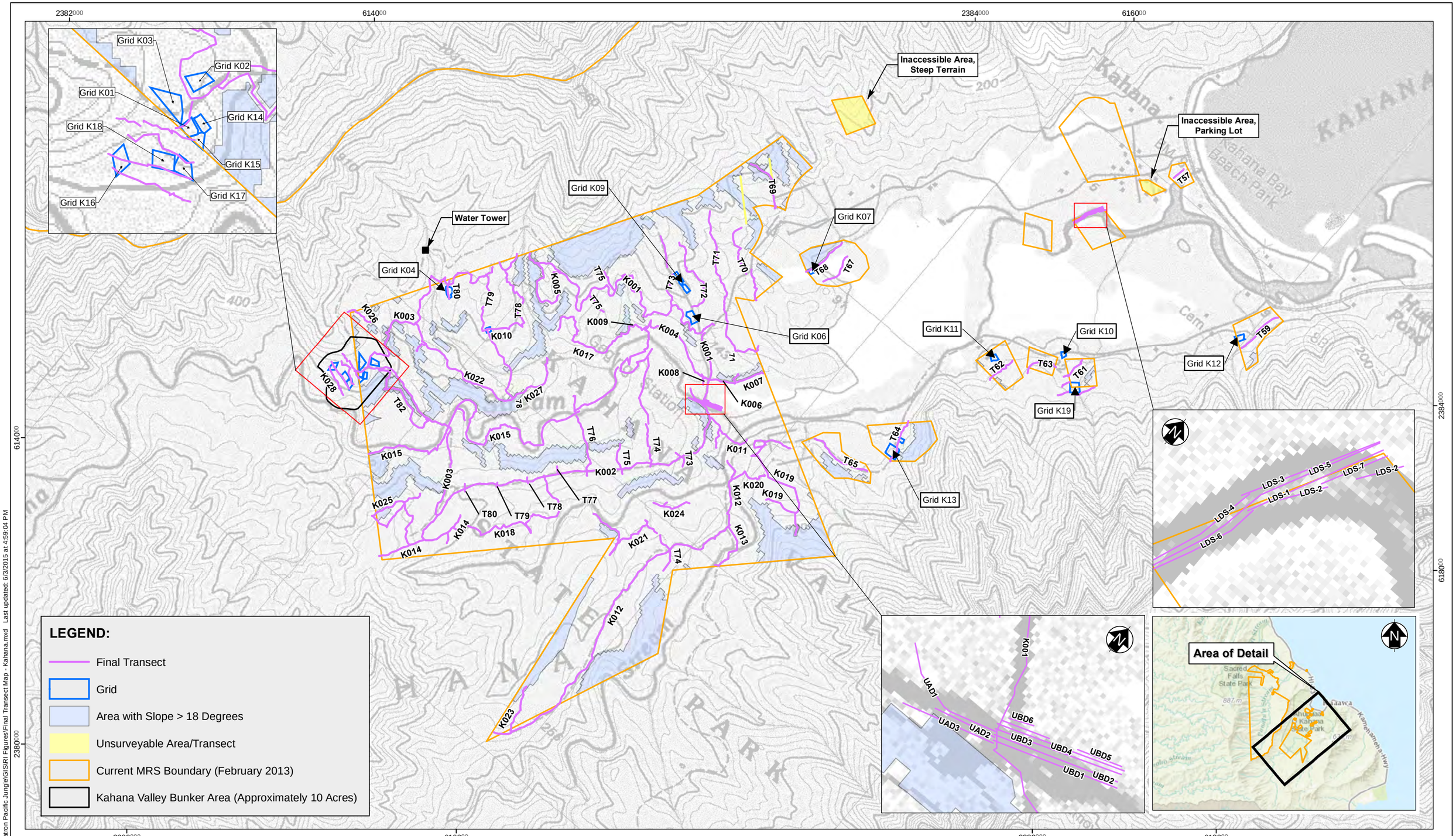
Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**2008 SITE INSPECTION SAMPLING UNITS AND RESULTS**			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: MKH 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. **A2-2**



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Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

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SCALE: 1 INCH= 1,000 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**2014 RI FINAL TRANSECT AND GRID COVERAGE MAP – KAHANA VALLEY**			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. **A2-3**

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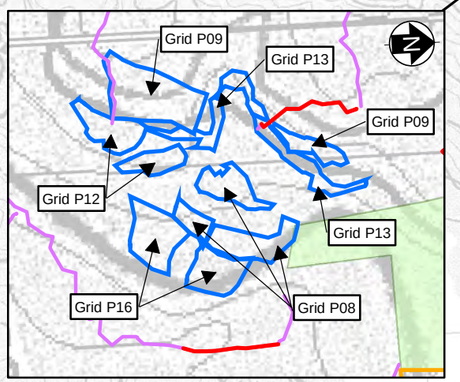
Grid P01 Grid P02 Grid P03 Grid P04 Grid P05 Grid P06 Grid P07 Grid P10 Grid P11

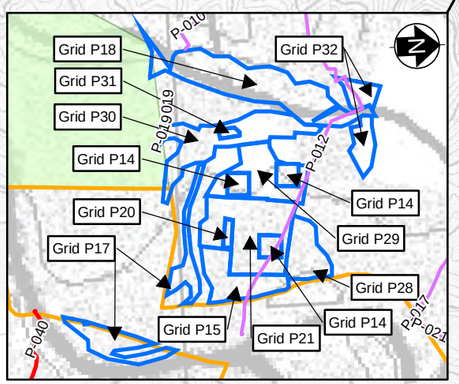
P001 P002 P003 P004 P006 P007 P008 P009 P010 P011 P012 P013 P014 P015 P016 P017 P018 P019 P020 P021 P022 P023 P024 P025 P026 P027 P028 P030 P031 P032 P033 P034 P035 P036 P037 P038 P039 P040 P041 P042 P043

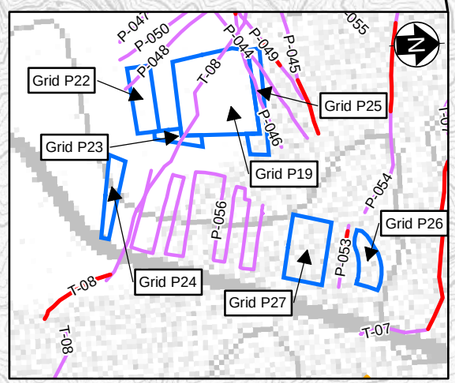
T05 T06 T07 T08 T09 T10 T13 T15 T17 T21

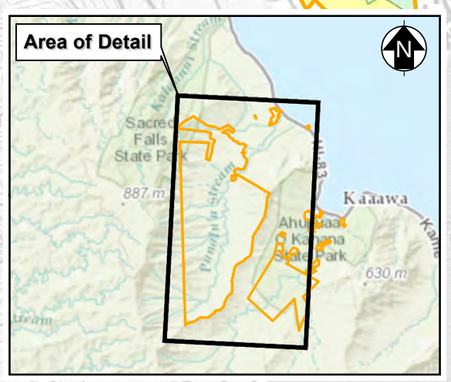
LEGEND:

- Final Transect
- Dynamic Repeatability Area
- Grid
- Area with Slope > 18 Degrees
- Unsurveyable Area/Transect
- TMK without ROE
- Current MRS Boundary (February 2013)









Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

0 1,300
SCALE: 1 INCH = 1,300 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	2014 RI FINAL TRANSECT AND GRID COVERAGE MAP – PUNALUU VALLEY			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. A2-4

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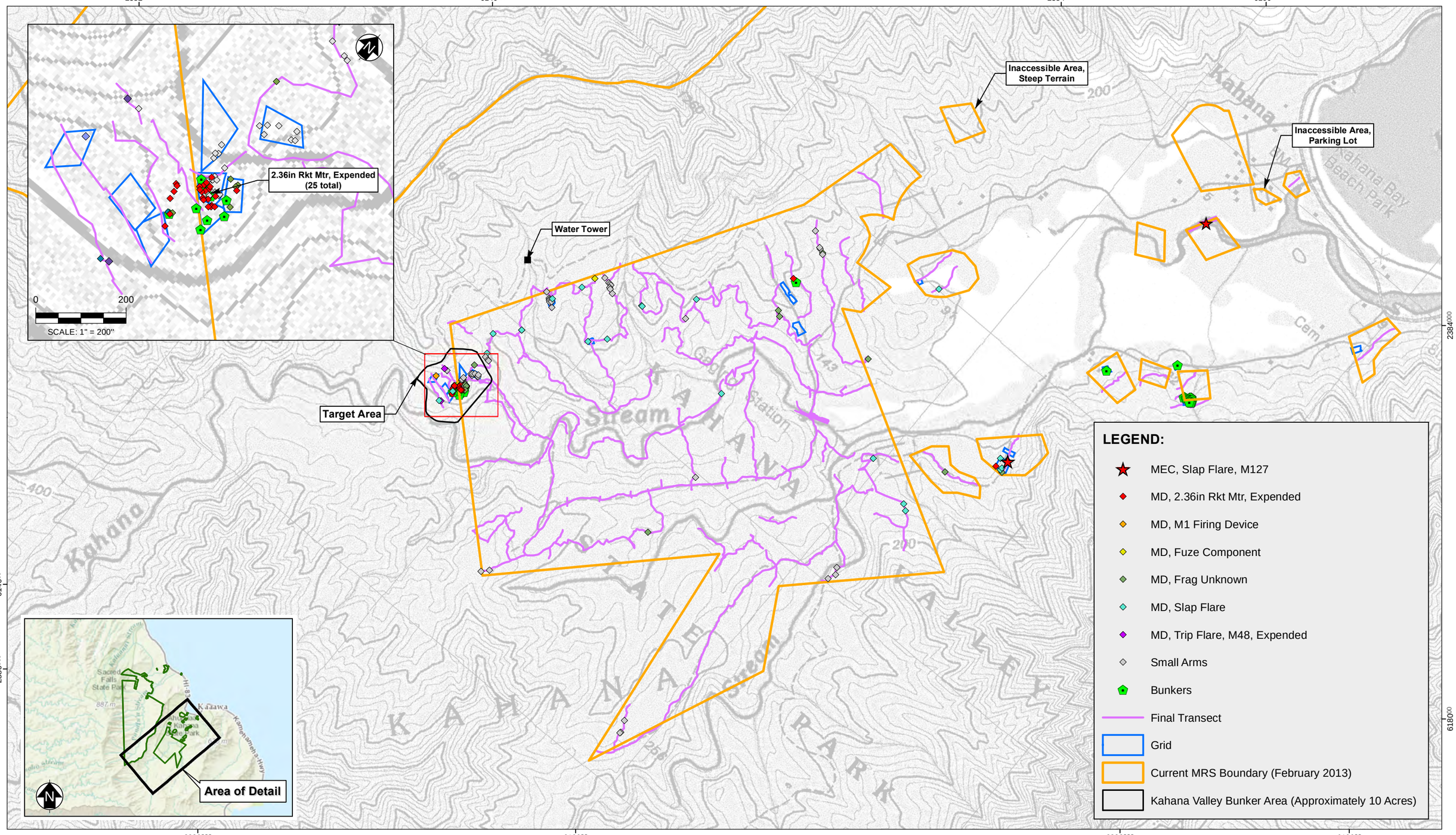

W:\2012\2012-127 Pelatron Pacific Jungle\GIS\RI Figures\RI Findings - Kahana_NEW.mxd Last updated: 6/3/2015 at 5:14:31 PM

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**2014 RI FINDINGS - KAHANA VALLEY**			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 12/01/2014	CHECKED BY: CAL 12/01/2014	PROJECT NO. 2012-127	FIG NO. **A2-5**

2382000 2384000 2386000

6140000

Elevated Density Area 1

Target Area 1

2.36in HEAT Rkt, M6A1 (7 total)

2.36in HEAT Rkt, M6A1
60mm Mortar, M49A2
M9A1 Rifle Grenades

Fuze, Type 88; Hand Grenade, MKII; and Slap Flare

High Density Area 1

2.36 HEAT Rocket (DMM)

High Density Area 2

Small Arms Only

Target Area 3

81mm Mortars, M56
60mm Mortars, M49A2

Target Area 2

Small Arms Only

1/2-lb TNT Demolition Block (2 total)

High Density Area 3

Area of Detail

Sacred Falls State Park

887 m

Hill 83

Punalu'u Stream

Ahupua'a Kahana State Park

N

LEGEND:

- MEC, 2.36in HEAT Rocket
- MEC, 60mm Mortar, M49A2
- MEC, M9A1 Rifle Grenade
- MEC, Hand Grenade, MK II
- MEC, Fuze, Type 88
- MEC, 81mm Mortar, M56
- MEC, Slap Flare, M127A1
- MEC, 1/2-lb TNT Demolition Block
- MD, 2.36in Rkt Mtr, Expended
- MD, M6A1 2.36in Rocket
- MD, 60mm Mortar, Tail Boom
- MD, 81mm Mortar Tail Boom
- MD, Fuze Component
- MD, Frag Unknown
- MD, Hand Grenade, Practice, MK1
- MD, Projectile, Lifting Lug
- MD, Slap Flare
- Small Arms
- Final Transect
- Grid
- Current MRS Boundary (February 2013)
- Target Area Boundary

6160000 2382000 2384000 2386000

6160000

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

0 1,300
SCALE: 1" = 1,300'

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**2014 RI FINDINGS - PUNALUU VALLEY**
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: JJC 01/16/2014 · CHECKED BY: CAL 01/16/2014 · PROJECT NO.: 2012-127 · FIG NO.: **A2-6**

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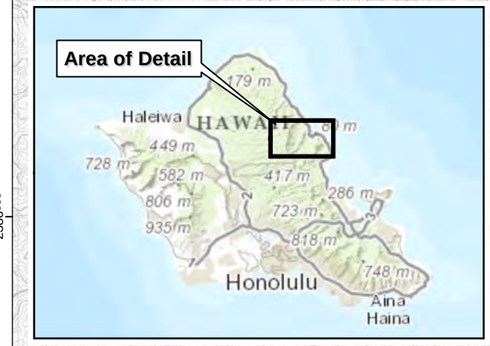
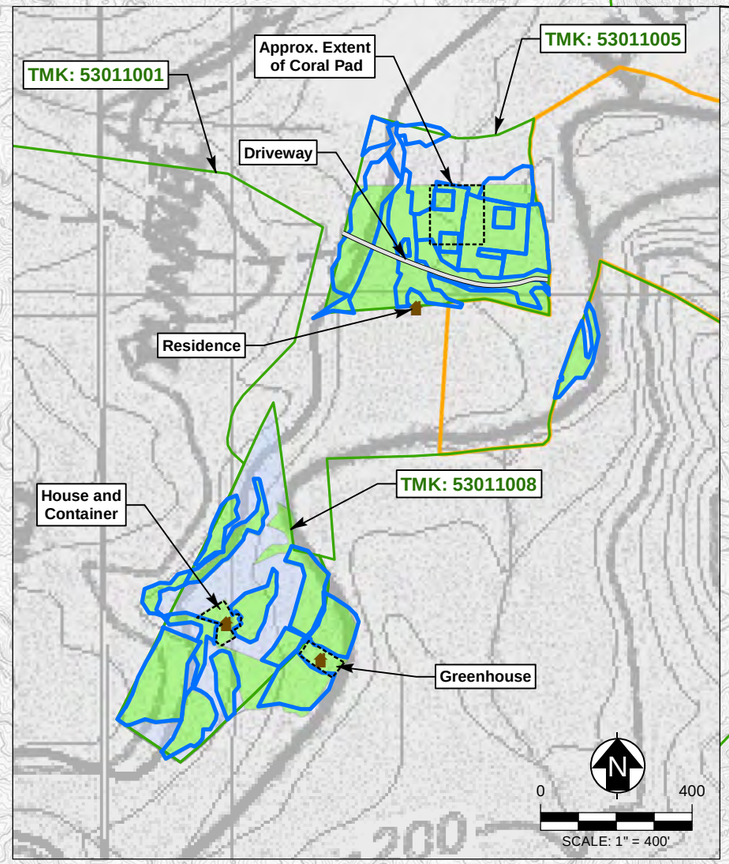
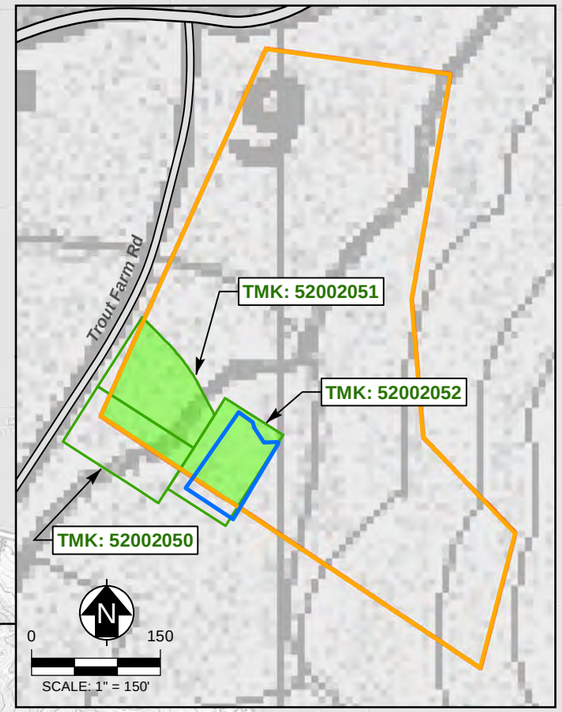






TMK	Acres for Residential-type Use	Grids	
		Grid Number	Acres Swept
52002050	0.061	K12	0.150
52002051	0.211		
52002052	0.167		
53004002	2.010	N/A	N/A
53011005	3.983	P14	0.172
		P15	0.292
		P17	0.149
		P18	0.755
		P20	0.026
		P21	0.606
		P28	0.234
		P29	0.330
		P30	0.499
		P31	0.019
		P32	0.217
53011008	2.929	P08	0.718
		P09	0.850
		P12	0.468
		P13	0.113
53011001	1.239	P13	0.377
		P16	0.717
		P17	0.224
TOTAL	**10.599**		**6.917**

LEGEND:

- Building/House Location (as identified in the field)
- Swept Grid
- TMK Property Boundary
- Residential Area (0.1 UXO/acre)
- Area with Slope > 18 Degrees
- Current MRS Boundary (February 2013)

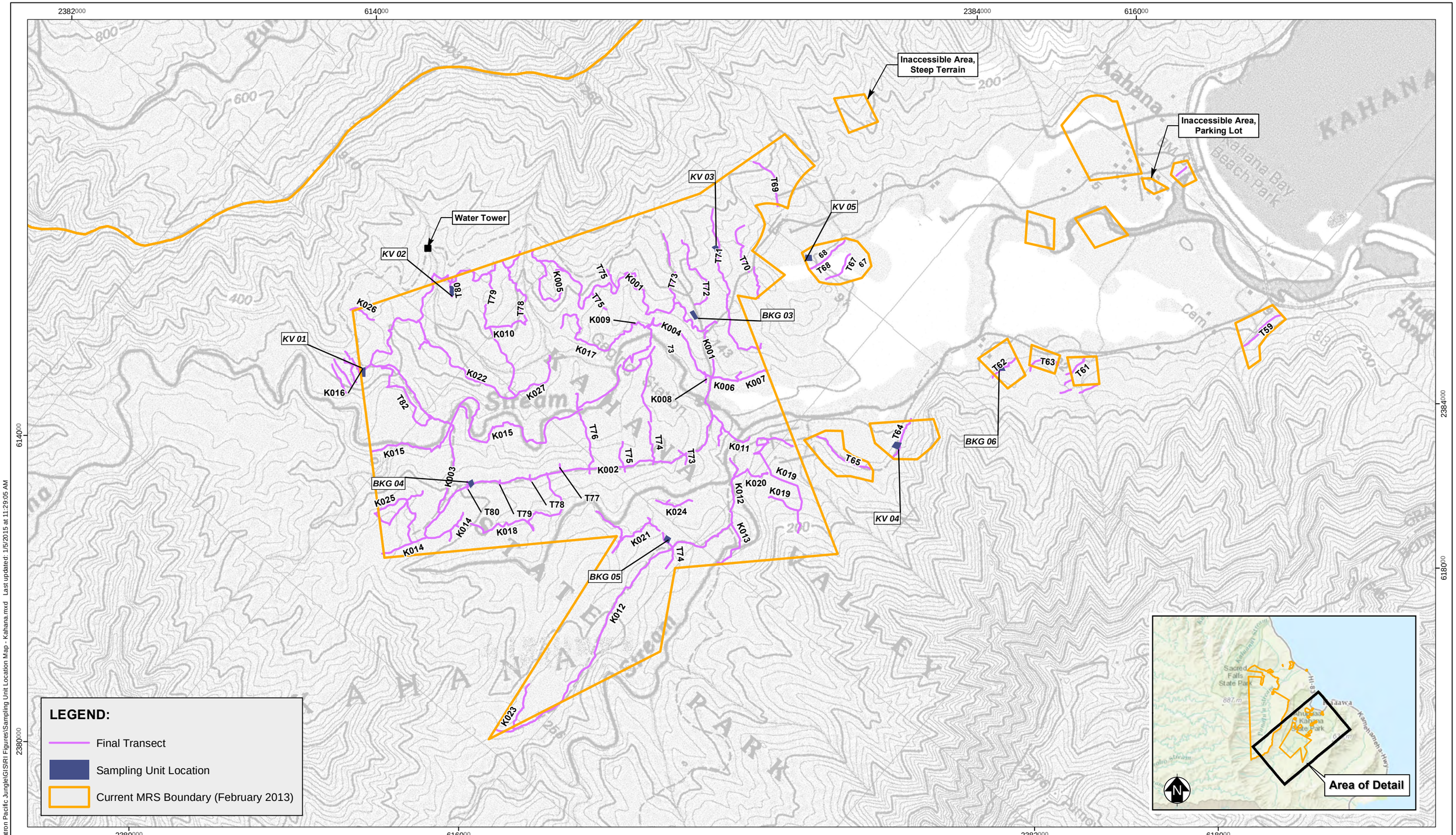
6100000 6120000 6140000 6160000 6180000 6200000
2386000 2384000 2382000

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; City and County of Honolulu; www.honolulupropertytax.com
References: "Final Site Inspection Report, Pacific Jungle Combat Training Center," December 2008, prepared by Parsons

0 2,500
SCALE: 1 INCH = 2,500 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**2014 RI UXO ESTIMATOR RESIDENTIAL-USE MAP**		
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: JC 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-128	FIG NO. **A2-7**

W:\2012\2012-127 Pelatron Pacific Jungle\GIS\RI Figures\Residential Areas.mxd Last updated: 1/5/2015 at 10:44:27 AM

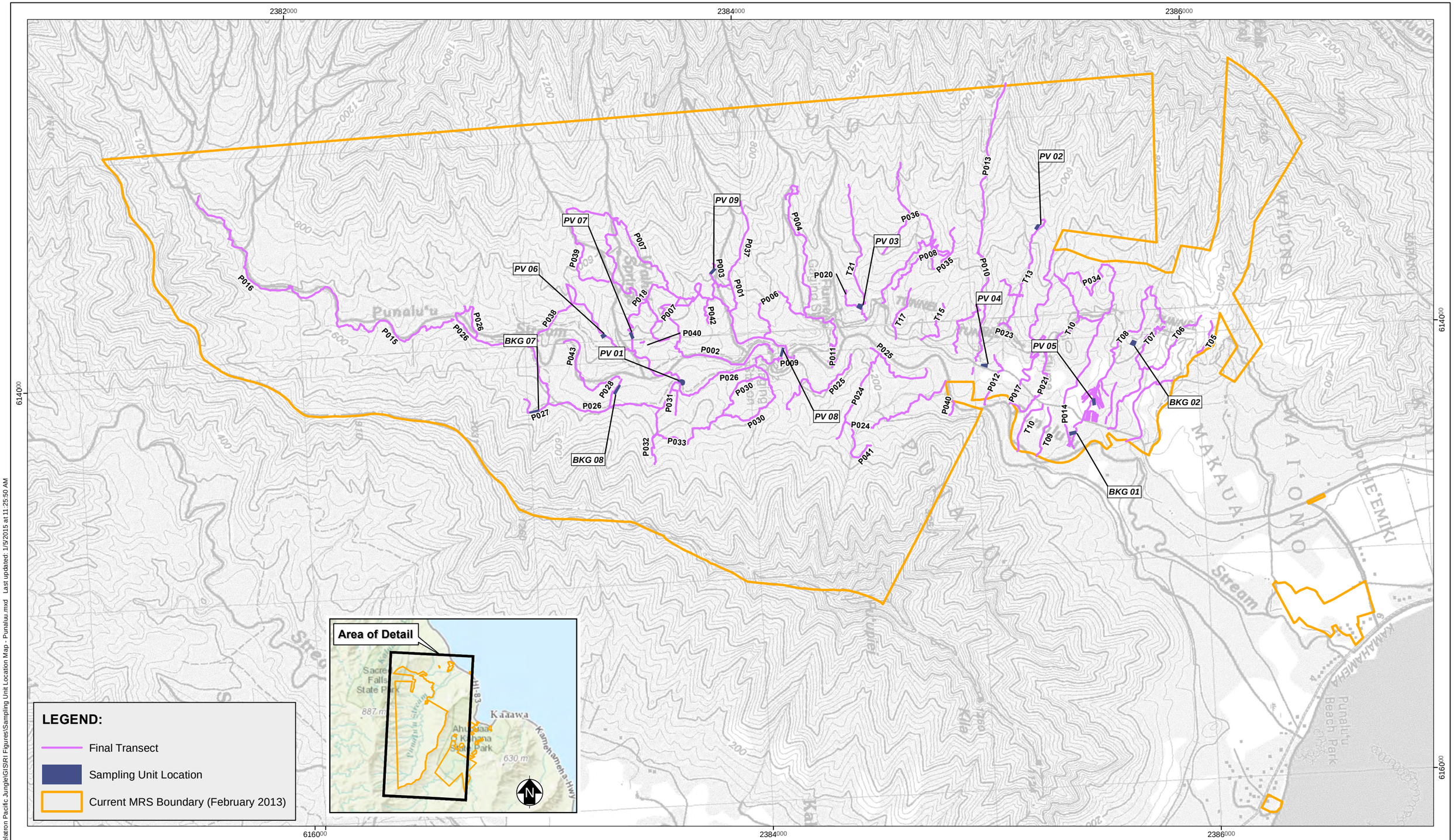


Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

0 1,000
SCALE: 1 INCH = 1,000 FEET

PROJECT:	2014 RI SOIL SAMPLING UNIT LOCATIONS - KAHANA VALLEY			
Pacific Jungle Combat Training Center FUDS Project No. H09HI027401				
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: MKH 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. A2-8

W:\2012\2012-127 Pelatron Pacific Jungle\GIS\RI Figures\Sampling Unit Location Map - Kahana.mxd Last updated: 1/5/2015 at 11:29:05 AM

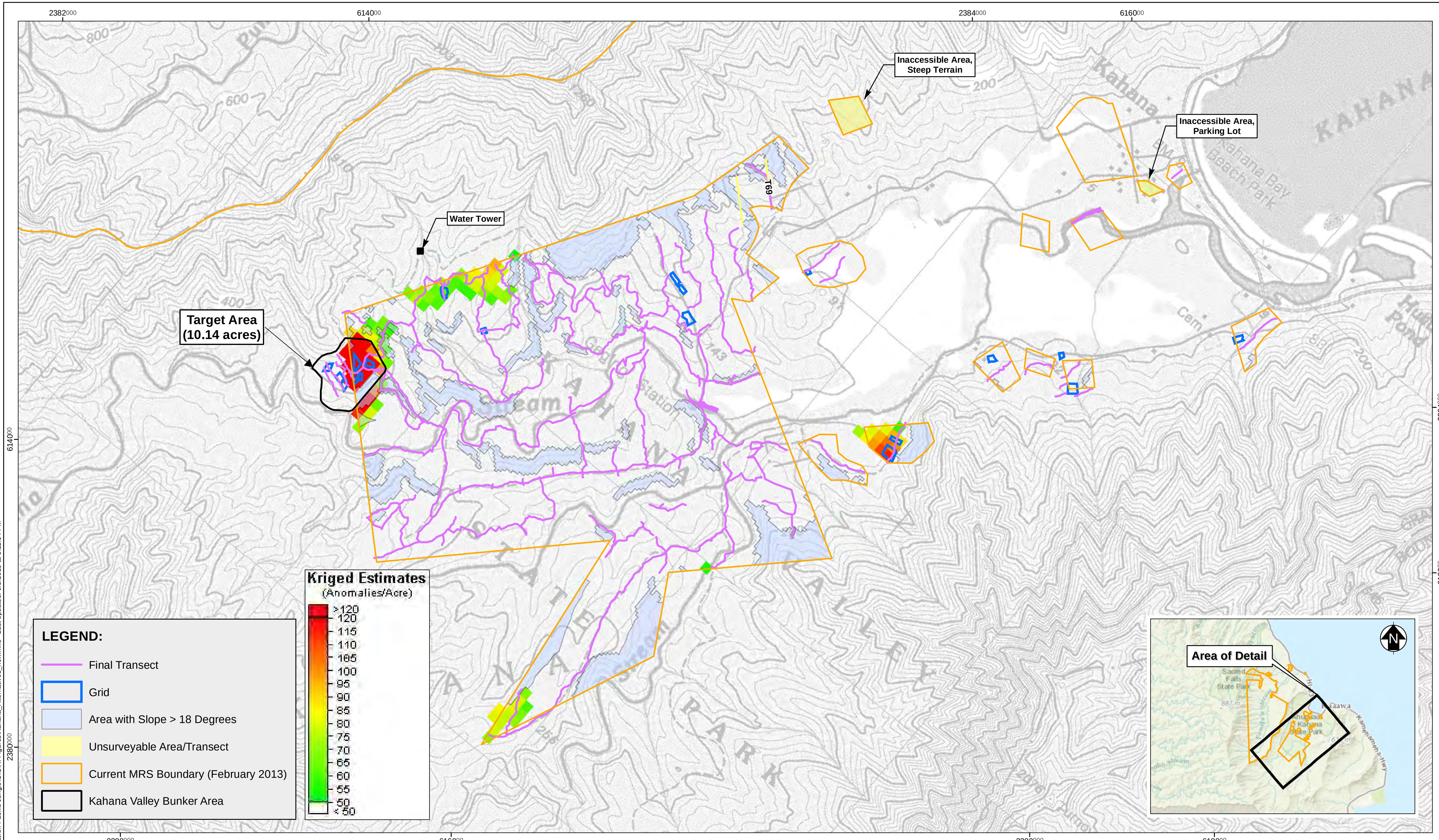


Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

0 1,300
SCALE: 1 INCH = 1,300 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**2014 RI SOIL SAMPLING UNIT LOCATIONS - PUNALUU VALLEY**			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: MKH 1/4/2015	CHECKED BY: DE 1/4/2015	PROJECT NO. 2012-127	FIG NO. **A2-9**

W:\2012\2012-127 Pelatron Pacific Jungle\GIS\RI Figures\Sampling Unit Location Map - Punaluu.mxd Last updated: 1/5/2015 at 11:25:50 AM



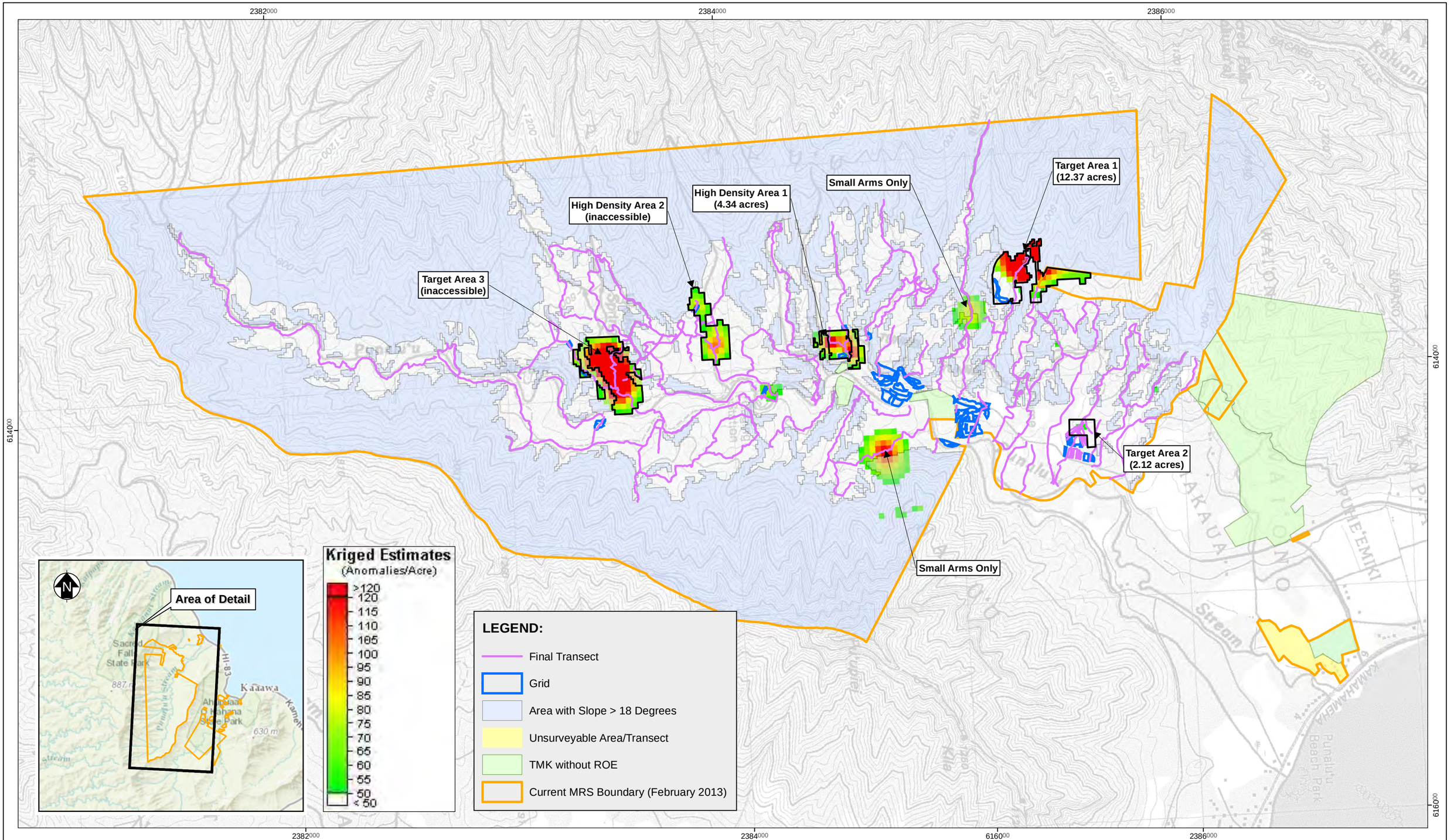
Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

References:
1. High density area located in noncontiguous parcel to the east is associated with an anomalous single discarded military munition (i.e. slap flare) and not considered to present a risk to the public. Removal action in this area is not included in this alternative.

0 1,000
SCALE: 1 INCH= 1,000 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	KAHANA VALLEY - ALTERNATIVE 3: COMPLETE REMOVAL OF MEC IN HIGH ANOMALY DENSITY AREAS AND SIGNAGE			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 1/12/2015	CHECKED BY: DE 1/12/2015	PROJECT NO. 2012-127	FIG NO. A4-1

W:\2012\2012-127 Pelatron Pacific Jungle\GIS\RI Figures\Kahana_Alternative3_new.mxd Last updated: 6/3/2015 at 5:11:54 PM

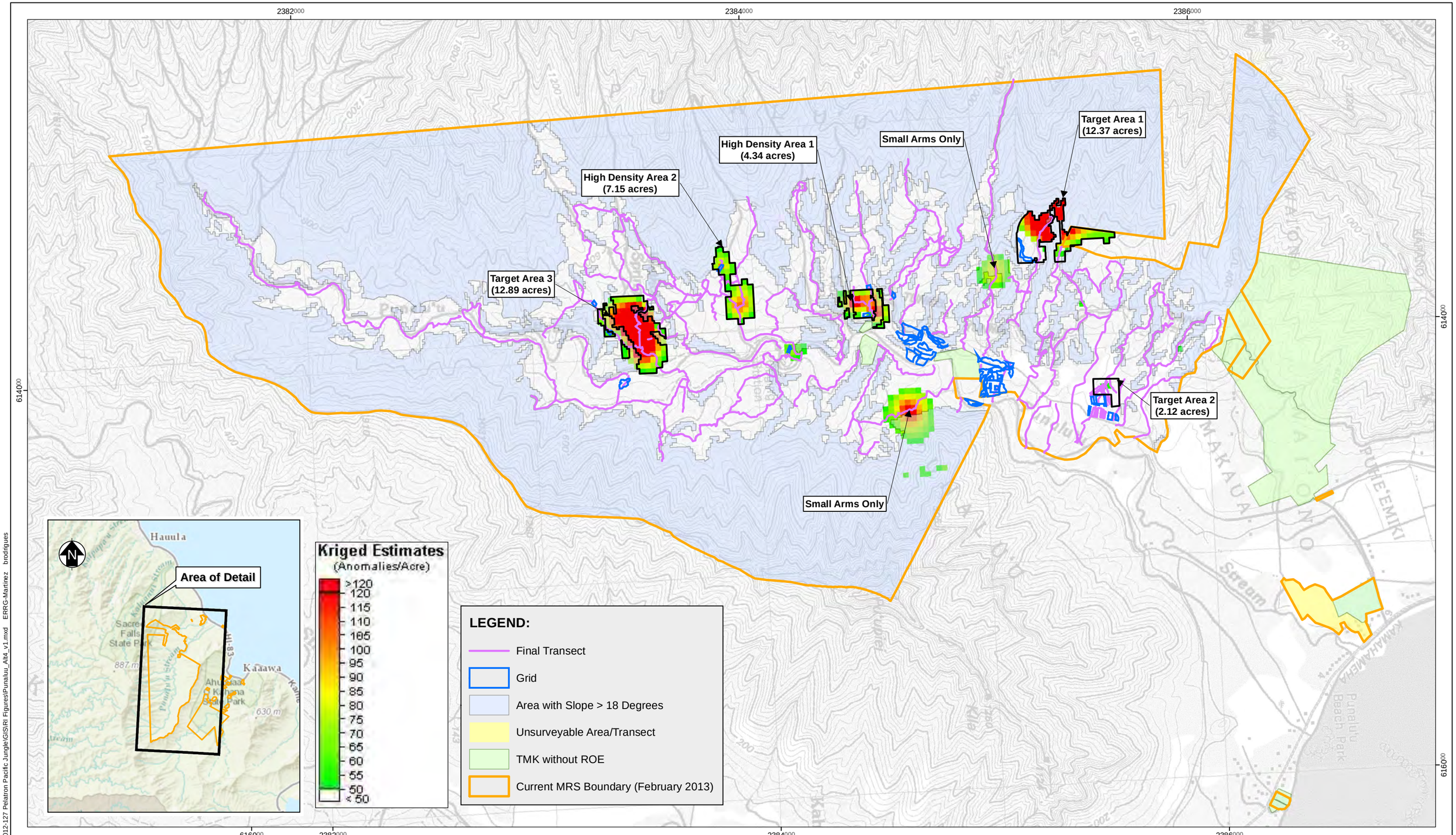


Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

0 1,300
SCALE: 1 INCH = 1,300 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	PUNALUU VALLEY - ALTERNATIVE 3: REMOVAL OF MEC IN ACCESSIBLE HIGH ANOMALY DENSITY AREAS AND LUCS			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: BR 11/03/2015	CHECKED BY: CL 11/03/2015	PROJECT NO. 2012-127	FIG NO. A4-2

11/3/2015 W:\2012\2012-127 Pelatron Pacific Jungle\GIS\RI Figures\Punaluu_Alt3_v1.mxd ERRG-Martinez brodrigues



Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North
Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; Honolulu Land Information System (HOLIS), C&C of Honolulu, April 2013.
References:
1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," prepared by Parsons, December 2008.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

Note:
1. High density area located on east side of valley is associated with small arms finds and does not present a risk to the public. Removal action in this area is not included in this alternative.

0 1,300
SCALE: 1 INCH = 1,300 FEET

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	PUNALUU VALLEY - ALTERNATIVE 4: COMPLETE REMOVAL OF MEC IN HIGH DENSITY AREAS			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 1/12/2015	CHECKED BY: DE 1/12/2015	PROJECT NO. 2012-127	FIG NO. A4-3

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Appendix B MEC HA Worksheets

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MEC HA Summary Information

		Comments
Site ID:	H09HI027401	
Date:	11/13/2015	

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Kahana Valley Main - Oahu, Hawaii

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Wil Chee Planning, 1993. Inventory Project Report
2	USACE, 2004. INPR Supplement
3	Parsons, 2008. Final Site Inspection Report
4	Huikala, 2014. Draft RI Report
5	Huikala, 2015. Draft FS Report

B. Briefly describe the site:

		Comments
1. Area (include units):	480.09	Excludes Kahana Valley Bunkers subarea (10.14 acres)

2. Past munitions-related use:

Maneuver Areas

3. Current land-use activities (list all that occur):

Residential, undeveloped forest, recreational (hiking, hunting), agricultural, educational.

4. Are changes to the future land-use planned? No

5. What is the basis for the site boundaries?

The MRS boundaries are based on historical and current real estate records.

Basic jungle warfare training was conducted at Kahana Valley (Blue and Red Courses). Live ammunition was reportedly utilized during jungle warfare training scenarios. The Army reportedly constructed Japanese villages and pillboxes for training purposes.

6. How certain are the site boundaries?

Boundary discrepancies were noted at the start of the 2013 RI. The boundaries established during the 1993 INRP and used through the 20008 SI did not align with historical real estate records. In February 2013, CEPOH aligned the MRS boundaries to match the real estate records. As a result, a portion of the southern bunker complex is now outside of the current MRS boundary.

Reference(s) for Part B:

[redacted]

Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2014. Draft RI Report

C. Historical Clearances

1. Have there been any historical clearances at the site? No, none

[redacted]

D. Attach maps of the site below (select 'Insert/Picture' on the menu bar.)

Site ID: **H09HI027401**
Date: **11/13/2015**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Rockets	2.36	inches	M6A1	High Explosive	UNK	Impact	UNK	0	Surface and Subsurface	Found as MD only.
2	Pyrotechnic			Signal, Illumination, Ground M127A1 Slap Flare	Pyrotechnic	No			0	Surface and Subsurface	Found as MEC and MD.
3	Pyrotechnic			Trip Flare, M48	Pyrotechnic	No			0	Surface and Subsurface	Found as MD only.
4	Fuzes			Component (unidentified)	High Explosive				0	Surface and Subsurface	Fuze components found as MD during RI.
5	Fuzes			PD, M46	High Explosive		Impact		0	Subsurface Only	Found as MEC underwater.

Reference(s) for table above:

[redacted]

Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2014. Draft RI Report

Bulk Explosive Information

Item No.	Explosive Type	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Reference(s) for table above:

[redacted]

Site ID: **H09HI027401**
Date: **11/13/2015**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Residential	0	0		2	There are 3 residential lots in the MRS but are currently unoccupied
2	Agricultural	1	1,040	**1,040**	2	1 ppl x 4hrs/day x 260 days/yr
3	Occupational (trail maintenance,BWS maintenance)	5	120	**600**	2	5 ppl x 10 hrs/mth x 12 mths
4	Recreational (hikers, hunters)	18,370	3	**55,110**	0	50 ppl/day x 365 days/yr (hikers) plus 10hrs/mth x 12 mths (hunters)
5	Educational	1,200	6	**7,200**	2	100 ppl/mth x 12 mths
			Total Potential Contact Time (receptor hrs/yr):	**63,950**		
			Maximum intrusive depth at site (ft):		**2**	

Reference(s) for table above:
Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report

Site ID: **H09HI027401**
Date: **11/13/2015**

Planned Remedial or Removal Actions

Response Action No.	Response Action Description	Expected Resulting Minimum MEC Depth (ft)	Expected Resulting Site Accessibility	Will land use activities change if this response action is implemented?	What is the expected scope of cleanup?	Comments
1	No Action	0	Moderate Accessibility	No	No MEC cleanup	Retained as an alternative in accordance with CERCLA. Accessibility is moderate based on existing natural barriers (i.e., ruggedness of terrain and dense vegetation in most areas of the valley).
2	Land Use Controls	0	Limited Accessibility	No	No MEC cleanup	Includes implementation of administrative mechanisms (i.e., right of entry permit and lease conditions), engineering controls (i.e., warning signs), and educational controls (i.e., community outreach, visitor education, and MEC safety and awareness training for DLNR staff.) Also includes 5-year reviews in accordance with 40 CFR 300.430(f)(4)(ii). Accessibility is limited based on existing natural barriers in conjunction with access restrictions imposed under the LUCs.

According to the 'Summary Info' worksheet, no future land uses are planned. For those alternatives where you answered 'No' in Column E, the land use activities will be assessed

Reference(s) for table above:

Huikala, 2015. Draft FS Report

Site ID: **H09HI027401**
Date: **11/13/2015**

This worksheet needs to be completed for each remedial/removal action alternative listed in the 'Remedial-Removal Action' worksheet that will cause a change in land use.

H09HI02740
Site ID: 1
Date: 11/13/2015

Energetic Material Type Input Factor Categories

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

Score

Baseline Conditions: **100**
Surface Cleanup: **100**
Subsurface Cleanup: **100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 2111 feet
2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes
3. Please describe the facility or feature.

Kahana Valley includes public trails, agricultural plots, residences . There are residential areas outside of the MRS but within the ESQD.

MEC Item(s) used to calculate the ESQD for current use activities

Item #1. Rockets (2.36inches, High Explosive)

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.'

Score

Baseline Conditions: **30**
Surface Cleanup: **30**
Subsurface Cleanup: **30**

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities

Score

Select the category that best describes the site accessibility under the current use scenario:

Moderate Accessibility

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Comments

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities:

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **63,950** receptor hrs/yr

Based on the table above, this corresponds to a input factor score for baseline conditions of: **40** Score

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Maneuver Areas

Baseline Conditions: **115**
Surface Cleanup: **15**
Subsurface Cleanup: **5**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft
The deepest intrusive depth: **2** ft
The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95
Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.' For 'Current Use Activities', only Baseline Conditions are considered. **240** ***Score***

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? Yes

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

steep slopes, erosion caused by overland water flow

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Possible.'

	Score
Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**10**

Reference(s) for above information:

Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2014. Draft RI Report

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Maneuver Areas'. It is assumed that the MEC items in this MRS are DMM.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: Yes

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

None of the items listed in the 'Munitions, Bulk Explosive Info' Worksheet were identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

Fuzed DMM Special Case	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'Fuzed DMM Special Case'.

	Score
Baseline Conditions:	**105**
Surface Cleanup:	**105**
Subsurface Cleanup:	**105**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Small

	Score
Baseline Conditions:	**40**
Surface Cleanup:	**40**
Subsurface Cleanup:	**40**

Scoring Summary

Site ID:	H09HI027401	a. Scoring Summary for Current Use Activities	
Date:	11/13/2015	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Maneuver Areas	115
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		Fuzed DMM Special Case	105
IX. MEC Size		Small	40
		Total Score	755
		Hazard Level Category	2

Site ID:	H09HI027401	c. Scoring Summary for Response Alternative 1: No Action	
Date:	11/13/2015	Response Action Cleanup:	No MEC cleanup
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Maneuver Areas	115
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		Fuzed DMM Special Case	105
IX. MEC Size		Small	40
		Total Score	755
		Hazard Level Category	2

Site ID:	H09HI027401	d. Scoring Summary for Response Alternative 2: Land Use Controls	
Date:	11/13/2015	Response Action Cleanup:	No MEC cleanup
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Limited Accessibility	15
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Maneuver Areas	115
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		Fuzed DMM Special Case	105
IX. MEC Size		Small	40
		Total Score	715
		Hazard Level Category	3

MEC HA Hazard Level Determination		
Site ID: H09HI027401 **Date:** 11/13/2015	**Hazard Level Category**	**Score**
a. Current Use Activities	2	755
c. Response Alternative 1: No Action	2	755
d. Response Alternative 2: Land Use Controls	3	715
e. Response Alternative 3:		
f. Response Alternative 4:		
g. Response Alternative 5:		
h. Response Alternative 6:		
Characteristics of the MRS		
Is critical infrastructure located within the MRS or within the ESQD arc?	No	
Are cultural resources located within the MRS or within the ESQD arc?	Yes	
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes	

MEC HA Summary Information

		Comments
Site ID:	H09HI027401	
Date:	11/13/2015	

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Kahana Valley Bunkers - Oahu, Hawaii

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Wil Chee Planning, 1993. Inventory Project Report
2	USACE, 2004. INPR Supplement
3	Parsons, 2008. Final Site Inspection Report
4	Huikala, 2015. Draft RI Report
5	Huikala, 2015. Draft FS Report

B. Briefly describe the site:

		Comments
1. Area (include units):	10.14 acres	Excludes Kahana Valley Main Subarea (474.8 acres)

2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

Undeveloped forest, recreational (hiking, hunting), educational.

4. Are changes to the future land-use planned? No

5. What is the basis for the site boundaries?

The MRS boundaries are based on historical and current real estate records.

Basic jungle warfare training was conducted at Kahana Valley (Blue and Red Courses). Live ammunition was reportedly utilized during jungle warfare training scenarios. The Army reportedly constructed Japanese villages and pillboxes for training purposes.

The basis for the Kahana Valley Bunkers area is based on field findings and observations. A portion of the target area is outside of the official MRS boundaries.

6. How certain are the site boundaries?

Boundary discrepancies were noted at the start of the 2013 RI. The boundaries established during the 1993 INRP and used through the 20008 SI did not align with historical real estate records. In February 2013, CEPOH aligned the MRS boundaries to match the real estate records. As a result, a portion of the southern bunker complex is now outside of the current MRS boundary.

Reference(s) for Part B:
Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2014. Draft RI Report

C. Historical Clearances

1. Have there been any historical clearances at the site? No, none

D. Attach maps of the site below (select 'Insert/Picture' on the
Refer to Appendix A, Figure A1-1

Site ID: **H09HI027401**
Date: **11/13/2015**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Rockets	2.36	inches	M6A1	High Explosive	UNK	Impact	UNK	0	Surface and Subsurface	Found as MD only.
2	Pyrotechnic			Slap Flare, M12A1	Pyrotechnic	No			0	Surface and Subsurface	Found as MD only.
3	Pyrotechnic			Trip Flare, M48	Pyrotechnic	No			0	Surface and Subsurface	Found as MD only.
4				M1 Firing Device							Found as MD only.

Reference(s) for table above:
Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2015. Draft RI Report

[redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Reference(s) for table above:

[redacted]

Site ID: **H09HI027401**
Date: **11/13/2015**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Occupational (trail maintenance,BWS maintenance)	5	120	**600**	2	5 ppl x 10 hrs/mth x 12 mths
2	Recreational (hikers, hunters)	18,370	3	**55,110**	0	50 ppl/day x 365 days/yr (hikers) plus 10hrs/mth x 12 mths (hunters)
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
	Total Potential Contact Time (receptor hrs/yr):			**55,710**		
	Maximum intrusive depth at site (ft):				**2**	

Reference(s) for table above:

[redacted]

Site ID: **H09HI027401**
Date: **11/13/2015**

Planned Remedial or Removal Actions

Response Action No.	Response Action Description	Expected Resulting Minimum MEC Depth (ft)	Expected Resulting Site Accessibility	Will land use activities change if this response action is implemented?	What is the expected scope of cleanup?	Comments
1	No Action	0	Moderate Accessibility	No	No MEC cleanup	Retained as an alternative in accordance with CERCLA. Accessibility is moderate based on existing natural barriers (i.e., ruggedness of terrain and dense vegetation in most areas of the valley).
2	Land Use Controls	0	Very Limited Accessibility	Yes	No MEC cleanup	Includes implementation of administrative mechanisms (i.e., right of entry permit and lease conditions), engineering controls (i.e., warning signs), and educational controls (i.e., community outreach, visitor education, and MEC safety and awareness training for DLNR staff.) Also includes 5-year reviews in accordance with 40 CFR 300.430(f)(4)(ii). Accessibility is limited based on existing natural barriers in conjunction with access restrictions imposed under the LUCs.
3	Removal Action	4	Full Accessibility	No	cleanup of MECs located both on the surface and subsurface	Surface and subsurface removal of MEC within the Kahana Valley Bunkers subarea (approximately 9.2 acres)using visual and analog methods.

According to the 'Summary Info' worksheet, no future land uses are planned. For those alternatives where you answered 'No' in Column E, the land use activities will be assessed against current land uses.

Reference(s) for table above:

Huikala, 2015. Draft FS Report

Site ID: **H09HI027401**
Date: **11/13/2015**

[redacted]

Land Use Activities Planned After Response Alternative #2: Land Use Controls

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Occupational (trail maintenance,BWS maintenance)	0	0	**0**	0	Under Alternative #2, hiking trails through Kahana Valley Bunker area would be closed and trail maintenance would cease.
2	Recreational (hikers, hunters)	184	3	**0**	0	Under Alternative #2, hiking trails through Kahana Valley Bunker area would be closed and trail maintenance would cease. Numbers shown are for trespassers who ignore the trail closure.
	Total Potential Contact Time (receptor hrs/yr):			**552**		
	Maximum intrusive depth at site (ft):				**0**	

Reference(s) for table above:

[redacted]

Site ID: **H09HI027401**
Date: **11/13/2015**

Energetic Material Type Input Factor Categories

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

	Score
Baseline Conditions:	**100**
Surface Cleanup:	**100**
Subsurface Cleanup:	**100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 2111 feet
2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes
3. Please describe the facility or feature.

A public trail runs through the bunker area, within the ESQD.

MEC Item(s) used to calculate the ESQD for current use activities

[redacted]

Item #1. Rockets (2.36inches, High Explosive)

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.' ***Score***

Baseline Conditions:	**30**
Surface Cleanup:	**30**
Subsurface Cleanup:	**30**

[redacted]

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Comments

This was based on MD of a 105-mm projectile found during previous investigation. Previous investigation noted that the MD item could have been from a 2.36-inch rocket.

Current Use Activities ***Score***

Select the category that best describes the site accessibility under the current use scenario:

Moderate Accessibility

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities:

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **55,710** hrs/yr receptor
Based on the table above, this corresponds to a input factor score for baseline conditions of: **40** Score

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

Target Area

Baseline Conditions: **180**
Surface Cleanup: **120**
Subsurface Cleanup: **30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft
The deepest intrusive depth: **2** ft
The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95
Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.' For 'Current Use Activities', only Baseline Conditions are considered. **240** ***Score***

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? Yes
If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

steep slopes, erosion caused by overland water flow

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Possible.' ***Score***

Baseline Conditions: **30**
Surface Cleanup: **30**
Subsurface Cleanup: **10**

Reference(s) for above information:

Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2014. Draft RI Report

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: No

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

The following table is used to determine scores associated with MEC classification categories:

UXO	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO'.

	Score
Baseline Conditions:	**110**
Surface Cleanup:	**110**
Subsurface Cleanup:	**110**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Small

	Score
Baseline Conditions:	**40**
Surface Cleanup:	**40**
Subsurface Cleanup:	**40**

Scoring Summary

Site ID:	H09HI027401	a. Scoring Summary for Current Use Activities	
Date:	11/13/2015	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	825
		Hazard Level Category	2

Site ID:	H09HI027401	c. Scoring Summary for Response Alternative 1: No Action	
Date:	11/13/2015	Response Action Cleanup:	No MEC cleanup
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	825
		Hazard Level Category	2

Site ID:	H09HI027401	d. Scoring Summary for Response Alternative 2: Land Use Controls	
Date:	11/13/2015	Response Action Cleanup:	No MEC cleanup
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Very Limited Accessibility	5
IV. Potential Contact Hours		<10,000 receptor-hrs/yr	15
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	750
		Hazard Level Category	2

Site ID:	H09HI027401	e. Scoring Summary for Response Alternative 3: Removal Action	
Date:	11/13/2015	Response Action Cleanup:	cleanup of MECs located both on the surface and subsurface
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Full Accessibility	80
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	10
V. Amount of MEC		Target Area	30
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	25
VII. Migration Potential		Possible	10
VIII. MEC Classification		UXO	110
IX. MEC Size		Small	40
		Total Score	435
		Hazard Level Category	4

MEC HA Hazard Level Determination		
Site ID: H09HI027401 **Date:** 11/13/2015	**Hazard Level Category**	**Score**
a. Current Use Activities	2	825
c. Response Alternative 1: No Action	2	825
d. Response Alternative 2: Land Use Controls	2	750
e. Response Alternative 3: Removal Action	4	435
f. Response Alternative 4:		
g. Response Alternative 5:		
h. Response Alternative 6:		
Characteristics of the MRS		
Is critical infrastructure located within the MRS or within the ESQD arc?	No	
Are cultural resources located within the MRS or within the ESQD arc?	No	
Are significant ecological resources located within the MRS or within the ESQD arc?	No	

MEC HA Summary Information

		Comments
Site ID:	H09HI027401	
Date:	11/13/2015	

Please identify the single specific area to be assessed in this hazard assessment. From this point forward, all references to "site" or "MRS" refer to the specific area that you have defined.

A. Enter a unique identifier for the site:

Punaluu Valley, Oahu, Hawaii

Provide a list of information sources used for this hazard assessment. As you are completing the worksheets, use the "Select Ref(s)" buttons at the ends of each subsection to select the applicable information sources from the list below.

Ref. No.	Title (include version, publication date)
1	Wil Chee Planning, 1993. Inventory Project Report
2	USACE, 2004. INPR Supplement
3	Parsons, 2008. Final Site Inspection Report
4	HPD, 2012. Bomb Incident Log
5	Huikala, 2013. RI Work Plan
6	Huikala, 2015. Draft RI Report
7	Huikala, 2015. Draft Feasibility Study
8	
9	
10	
11	
12	

B. Briefly describe the site:

1. Area (include units): 1903
2. Past munitions-related use:

Target Area

3. Current land-use activities (list all that occur):

educational.

4. Are changes to the future land-use planned? No
5. What is the basis for the site boundaries?

The MRS boundaries are based on historical and current real estate records.

Advanced jungle warfare training and the Instructor Jungle Training School were conducted Punaluu Valley (Green Course). Live ammunition was reported utilized during jungle warfare training scenarios.

6. How certain are the site boundaries?

Boundary discrepancies were noted at the start of the 2013 RI. The boundaries established during the 1993 INRP and used through the 20008 SI did not align with historical real estate records. In February 2013, CEPOH aligned the MRS boundaries to match the real estate records. As a result, the 75-mm AP or HE projectile found during the 1993 INPR is now outside of the current MRS boundary.

Reference(s) for Part B:

Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
Huikala, 2015. Draft RI Report
Huikala, 2015. Draft Feasibility Study

C. Historical Clearances

1. Have there been any historical clearances at the site? No, none
2. If a clearance occurred:
   a. What year was the clearance performed?
   b. Provide a description of the clearance activity (e.g., extent, depth, amount of munitions-related items removed, types and sizes of removed items, and whether metal detectors were used):

Reference(s) for Part C:

D. Attach maps of the site below (select 'Insert/Picture' on the menu bar.)

Site ID: **H09HI027401**
Date: **11/13/2015**

Cased Munitions Information

Item No.	Munition Type (e.g., mortar, projectile, etc.)	Munition Size	Munition Size Units	Mark/ Model	Energetic Material Type	Is Munition Fuzed?	Fuzing Type	Fuze Condition	Minimum Depth for Munition (ft)	Location of Munitions	Comments (include rationale for munitions that are "subsurface only")
1	Mortars	60	mm	M49A2	High Explosive	Yes	Impact	Armed	0	Surface and Subsurface	
2	Mortars	81	mm	M56	High Explosive	Yes	Impact	Armed	0	Surface and Subsurface	
3	Fuzes	88	Fuze (N/A)	Type 88	High Explosive		Impact	Armed	0	Surface and Subsurface	
4	Grenades			Hand Grenade, MK II	High Explosive	Yes	Time		0	Surface and Subsurface	
5	Rockets	2.36	inches	M6A1	High Explosive	Yes	Impact	Armed	0	Surface and Subsurface	
6	Artillery			M9A1 Rifle Grenade	High Explosive	Yes	Impact	Armed	0	Surface and Subsurface	
7	Artillery	75	mm		High Explosive	UNK	UNK	UNK	0	Surface and Subsurface	Found only during 1993 INRP.
8	Artillery	105	mm		High Explosive	UNK	UNK	UNK	0	Surface and Subsurface	Found in Kahana Valley only during 1993 INRP. It is being listed for Punaluu since the ESQD is based on this munition.
9	Pyrotechnic			Signal, Illumination, Ground M127A1 Slap Flare	Pyrotechnic				0	Surface and Subsurface	

Reference(s) for table above:
Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
HPD, 2012. Bomb Incident Log
Huikala, 2015. Draft RI Report

[redacted]

Bulk Explosive Information

Item No.	Explosive Type	Comments
1	TNT	TNT found during 2012 HDP response and 2014 RI.

Reference(s) for table above:

Huikala, 2014. Draft RI Report

[redacted]

Site ID: **H09HI027401**
Date: **11/13/2015**

Activities Currently Occurring at the Site

Activity No.	Activity	Number of people per year who participate in the activity	Number of hours per year a single person spends on the activity	Potential Contact Time (receptor hours/year)	Maximum intrusive depth (ft)	Comments
1	Residential	40	1,460	**58,400**	2	10 residential type structures
2	Agricultural	20	1,040	**20,800**	2	
3	Occupational (maintenance, construction)	5	120	**600**	3	waterline upgrades, clearing roads
4	Recreational (hikers, hunters)	50	72	**3,600**	0	Used "hunter" to determine yearly exposure. Six hours hunting/month.
5	Educational	1,200	6	**7,200**	2	100 ppl/mth
	Total Potential Contact Time (receptor hrs/yr):			**90,600**		
	Maximum intrusive depth at site (ft):				**3**	

Reference(s) for table above:

Wil Chee Planning, 1993. Inventory Project Report
USACE, 2004. INPR Supplement
Parsons, 2008. Final Site Inspection Report
HPD, 2012. Bomb Incident Log
Huikala, 2013. RI Work Plan
Huikala, 2015. Draft RI Report
Huikala, 2015. Draft Feasibility Study

Site ID: **H09HI027401**
Date: **11/13/2015**

Planned Remedial or Removal Actions

Response Action No.	Response Action Description	Expected Resulting Minimum MEC Depth (ft)	Expected Resulting Site Accessibility	Will land use activities change if this response action is implemented?	What is the expected scope of cleanup?	Comments
1	No Action	0	Moderate Accessibility	No	No MEC cleanup	Retained as an alternative in accordance with CERCLA. Accessibility is moderate based on existing natural barriers (i.e., ruggedness of terrain and dense vegetation in most areas of the valley).
2	Land Use Controls (LUCs)	0	Moderate Accessibility	No	No MEC cleanup	Includes implementation of administrative mechanisms (i.e., right-of-entry permit and lease conditions), engineering controls (i.e., warning signs), and educational controls (i.e., community outreach and MEC safety and awareness training for Kamehameha Schools staff). Also includes 5-year reviews in accordance with 40 CFR 300.430(f)(4)(ii). Accessibility remains moderate because of existing natural barriers and private ownership of the majority of land within Kahana Valley Main.
3	Limited Removal Action and LUCs	4	Moderate Accessibility	No	cleanup of MECs located both on the surface and subsurface	Surface and subsurface removal of MEC performed within the three target areas identified during the RI (approxiamtely 24.90 acres)and implementation of LUCs listed above. Accessibility remains moderate because of existing natural barriers and private ownership of the majority of land within Kahana Valley Main.
4	Removal Action	4	Moderate Accessibility	No	cleanup of MECs located both on the surface and subsurface	Surface and subsurface removal of MEC performed within the three target areas and two high densitya anomaly areas identified during the RI (approxiamtely 40.30 acres. Accessibility remains moderate because of existing natural barriers and private ownership of the majority of land within Kahana Valley Main.

According to the 'Summary Info' worksheet, no future land uses are planned. For those alternatives where you answered 'No' in Column E, the land use activities will be assessed

Reference(s) for table above:

[redacted]

Site ID: **H09HI027401**
Date: **11/13/2015**

This worksheet needs to be completed for each remedial/removal action alternative listed in the 'Remedial-Removal Action' worksheet that will cause a change in land use.

Site ID: H09HI0274 01
Date: #######

Energetic Material Type Input Factor Categories

The following table is used to determine scores associated with the energetic materials. Materials are listed in order from most hazardous to least hazardous.

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
High Explosive and Low Explosive Filler in Fragmenting Rounds	100	100	100
White Phosphorus	70	70	70
Pyrotechnic	60	60	60
Propellant	50	50	50
Spotting Charge	40	40	40
Incendiary	30	30	30

The most hazardous type of energetic material listed in the 'Munitions, Bulk Explosive Info' Worksheet falls under the category 'High Explosive and Low Explosive Filler in Fragmenting Rounds'.

Score

Baseline Conditions: **100**
Surface Cleanup: **100**
Subsurface Cleanup: **100**

Location of Additional Human Receptors Input Factor Categories

1. What is the Explosive Safety Quantity Distance (ESQD) from the Explosive Siting Plan or the Explosive Safety Submission for the MRS? 2111 feet
2. Are there currently any features or facilities where people may congregate within the MRS, or within the ESQD arc? Yes
3. Please describe the facility or feature.

The MRS includes private trails, agricultural plots, residences. There are residential and commercial areas outside of the MRS but within the ESQD.

MEC Item(s) used to calculate the ESQD for current use activities

Item #8. Artillery (105mm, High Explosive)

The following table is used to determine scores associated with the location of additional human receptors (current use activities):

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Inside the MRS or inside the ESQD arc	30	30	30
Outside of the ESQD arc	0	0	0

4. Current use activities are 'Inside the MRS or inside the ESQD arc', based on Question 2.'

Score

Baseline Conditions: **30**
Surface Cleanup: **30**
Subsurface Cleanup: **30**

Site Accessibility Input Factor Categories

The following table is used to determine scores associated with site accessibility:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Full Accessibility	No barriers to entry, including signage but no fencing	80	80	80
Moderate Accessibility	Some barriers to entry, such as barbed wire fencing or rough terrain	55	55	55
Limited Accessibility	Significant barriers to entry, such as unguarded chain link fence or requirements for special transportation to reach the site	15	15	15
Very Limited Accessibility	A site with guarded chain link fence or terrain that requires special equipment and skills (e.g., rock climbing) to access	5	5	5

Current Use Activities

Score

Select the category that best describes the site accessibility under the current use scenario:

Moderate Accessibility

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Comments

Response Alternative No. 1: No Action

Based on the 'Planned Remedial or Removal Actions' Worksheet, this alternative will lead to 'Moderate Accessibility'.

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Response Alternative No. 2: Land Use Controls (LUCs)

Based on the 'Planned Remedial or Removal Actions' Worksheet, this alternative will lead to 'Moderate Accessibility'.

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Response Alternative No. 3: Limited Removal Action and LUCs

Based on the 'Planned Remedial or Removal Actions' Worksheet, this alternative will lead to 'Moderate Accessibility'.

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Response Alternative No. 4: Removal Action

Based on the 'Planned Remedial or Removal Actions' Worksheet, this alternative will lead to 'Moderate Accessibility'.

Baseline Conditions: **55**
Surface Cleanup: **55**
Subsurface Cleanup: **55**

Potential Contact Hours Input Factor Categories

The following table is used to determine scores associated with the total potential contact time:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Many Hours	≥1,000,000 receptor-hrs/yr	120	90	30
Some Hours	100,000 to 999,999 receptor hrs/yr	70	50	20
Few Hours	10,000 to 99,999 receptor-hrs/yr	40	20	10
Very Few Hours	<10,000 receptor-hrs/yr	15	10	5

Current Use Activities:

Input factors are only determined for baseline conditions for current use activities. Based on the 'Current and Future Activities' Worksheet, the Total Potential Contact Time is: **90,600** receptor hrs/yr
Based on the table above, this corresponds to a input factor score for baseline conditions of: **40** Score

Response Alternative No. 1: No Action

Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.

Total Potential Contact Time, based on the contact time listed for current use activities (see 'Current and Future Activities' Worksheet) **90,600**
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions: **40**
Surface Cleanup: **20**
Subsurface Cleanup: **10**

Response Alternative No. 2: Land Use Controls (LUCs)

Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.

Total Potential Contact Time, based on the contact time listed for current use activities (see 'Current and Future Activities' Worksheet) **90,600**
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions: **40**
Surface Cleanup: **20**
Subsurface Cleanup: **10**

Response Alternative No. 3: Limited Removal Action and LUCs

Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.

Total Potential Contact Time, based on the contact time listed for current use activities (see 'Current and Future Activities' Worksheet) **90,600**
Based on the table above, this corresponds to input factor scores of: ***Score***
Baseline Conditions: **40**
Surface Cleanup: **20**
Subsurface Cleanup: **10**

Response Alternative No. 4: Removal Action

Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.

Total Potential Contact Time, based on the contact time listed for current use activities (see 'Current and Future Activities' Worksheet) **90,600**

Based on the table above, this corresponds to input factor scores of: ***Score***

Baseline Conditions: **40**
Surface Cleanup: **20**
Subsurface Cleanup: **10**

Amount of MEC Input Factor Categories

The following table is used to determine scores associated with the Amount of MEC:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Target Area	Areas at which munitions fire was directed	180	120	30
OB/OD Area	Sites where munitions were disposed of by open burn or open detonation methods. This category refers to the core activity area of an OB/OD area. See the "Safety Buffer Areas" category for safety fans and kick-outs.	180	110	30
Function Test Range	Areas where the serviceability of stored munitions or weapons systems are tested. Testing may include components, partial functioning or complete functioning of stockpile or developmental items.	165	90	25
Burial Pit	The location of a burial of large quantities of MEC items.	140	140	10
Maneuver Areas	Areas used for conducting military exercises in a simulated conflict area or war zone	115	15	5
Firing Points	The location from which a projectile, grenade, ground signal, rocket, guided missile, or other device is to be ignited, propelled, or released.	75	10	5
Safety Buffer Areas	Areas outside of target areas, test ranges, or OB/OD areas that were designed to act as a safety zone to contain munitions that do not hit targets or to contain kick-outs from OB/OD areas.	30	10	5
Storage	Any facility used for the storage of military munitions, such as earth-covered magazines, above-ground magazines, and open-air storage areas.	25	10	5
Explosive-Related Industrial Facility	Former munitions manufacturing or demilitarization sites and TNT production plants	20	10	5

Select the category that best describes the ***most hazardous*** amount of MEC: ***Score***

`Target Area`

Baseline Conditions: **180**
Surface Cleanup: **120**
Subsurface Cleanup: **30**

Minimum MEC Depth Relative to the Maximum Intrusive Depth Input Factor Categories

Current Use Activities

The shallowest minimum MEC depth, based on the 'Cased Munitions Information' Worksheet: **0** ft
The deepest intrusive depth: **3** ft
The table below is used to determine scores associated with the minimum MEC depth relative to the maximum intrusive depth:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240	150	95
Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	240	50	25
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth overlaps with minimum MEC depth.	150	N/A	95
Baseline Condition: MEC located only subsurface. Baseline Condition or After Cleanup: Intrusive depth does not overlap with minimum MEC depth.	50	N/A	25

Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth will overlap after cleanup. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.' For 'Current Use Activities', only Baseline Conditions are considered. **240** ***Score***

Future Use Activities

Deepest intrusive depth: ft

Not enough information has been entered to determine the input factor category. ***Score***

Response Alternative No. 1: No Action

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): **0** ft
Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.
Maximum Intrusive Depth, based on the maximum intrusive depth listed for current use activities (see 'Current and Future Activities' Worksheet) **3** ft
Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth overlaps. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.'

Score

Baseline Conditions: **240**
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 2: Land Use Controls (LUCs)

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): **0** ft
Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.
Maximum Intrusive Depth, based on the maximum intrusive depth listed for current use activities (see 'Current and Future Activities' Worksheet) **3** ft
Because the shallowest minimum MEC depth is less than or equal to the deepest intrusive depth, the intrusive depth overlaps. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.'

Score

Baseline Conditions: **240**
Surface Cleanup:
Subsurface Cleanup:

Response Alternative No. 3: Limited Removal Action and LUCs

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): **4** ft

Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.

Maximum Intrusive Depth, based on the maximum intrusive depth listed for current use activities (see 'Current and Future Activities' Worksheet) **3** ft

Because the shallowest minimum MEC depth is greater than the deepest intrusive depth, the intrusive depth does not overlap. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.'

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup: **25**

Response Alternative No. 4: Removal Action

Expected minimum MEC depth (from the 'Planned Remedial or Removal Actions' Worksheet): **4** ft

Based on the 'Planned Remedial or Removal Actions' Worksheet, land use activities will not change if this alternative is implemented.

Maximum Intrusive Depth, based on the maximum intrusive depth listed for current use activities (see 'Current and Future Activities' Worksheet) **3** ft

Because the shallowest minimum MEC depth is greater than the deepest intrusive depth, the intrusive depth does not overlap. MECs are located at both the surface and subsurface, based on the 'Munitions, Bulk Explosive Info' Worksheet. Therefore, the category for this input factor is 'Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.'

Score

Baseline Conditions:
Surface Cleanup:
Subsurface Cleanup: **25**

Migration Potential Input Factor Categories

Is there any physical or historical evidence that indicates it is possible for natural physical forces in the area (e.g., frost heave, erosion) to expose subsurface MEC items, or move surface or subsurface MEC items? Yes

If "yes", describe the nature of natural forces. Indicate key areas of potential migration (e.g., overland water flow) on a map as appropriate (attach a map to the bottom of this sheet, or as a separate worksheet).

steep slopes, erosion caused by overland water flow

The following table is used to determine scores associated with the migration potential:

	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Possible	30	30	10
Unlikely	10	10	10

Based on the question above, migration potential is 'Possible.' ***Score***

Baseline Conditions: **30**
Surface Cleanup: **30**
Subsurface Cleanup: **10**

Reference(s) for above information:

Huikala, 2014. Draft RI Report

MEC Classification Input Factor Categories

Cased munitions information has been inputed into the 'Munitions, Bulk Explosive Info' Worksheet; therefore, bulk explosives do not comprise all MECs for this MRS.

The 'Amount of MEC' category is 'Target Area'. It cannot be automatically assumed that the MEC items from this category are DMM. Therefore, the conservative assumption is that the MEC items in this MRS are UXO.

Has a technical assessment shown that MEC in the OB/OD Area is DMM?

Are any of the munitions listed in the 'Munitions, Bulk Explosive Info' Worksheet: Yes

- Submunitions
- Rifle-propelled 40mm projectiles (often called 40mm grenades)
- Munitions with white phosphorus filler
- High explosive anti-tank (HEAT) rounds
- Hand grenades
- Fuzes
- Mortars

At least one item listed in the 'Munitions, Bulk Explosive Info' Worksheet was identified as 'fuzed'.

The following table is used to determine scores associated with MEC classification categories:

UXO Special Case	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
UXO Special Case	180	180	180
UXO	110	110	110
Fuzed DMM Special Case	105	105	105
Fuzed DMM	55	55	55
Unfuzed DMM	45	45	45
Bulk Explosives	45	45	45

Based on your answers above, the MEC classification is 'UXO Special Case'.

	Score
Baseline Conditions:	**180**
Surface Cleanup:	**180**
Subsurface Cleanup:	**180**

MEC Size Input Factor Categories

The following table is used to determine scores associated with MEC Size:

	Description	Baseline Conditions	Surface Cleanup	Subsurface Cleanup
Small	Any munitions (from the 'Munitions, Bulk Explosive Info' Worksheet) weigh less than 90 lbs; small enough for a receptor to be able to move and initiate a detonation	40	40	40
Large	All munitions weigh more than 90 lbs; too large to move without equipment	0	0	0

Based on the definitions above and the types of munitions at the site (see 'Munitions, Bulk Explosive Info' Worksheet), the MEC Size Input Factor is: Small

	Score
Baseline Conditions:	**40**
Surface Cleanup:	**40**
Subsurface Cleanup:	**40**

Scoring Summary

Site ID:	H09HI027401	a. Scoring Summary for Current Use Activities	
Date:	11/13/2015	Response Action Cleanup:	No Response Action
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO Special Case	180
IX. MEC Size		Small	40
		Total Score	895
		Hazard Level Category	1

Site ID:	H09HI027401	c. Scoring Summary for Response Alternative 1: No Action	
Date:	11/13/2015	Response Action Cleanup:	No MEC cleanup
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO Special Case	180
IX. MEC Size		Small	40
		Total Score	895
		Hazard Level Category	1

Site ID:	H09HI027401	d. Scoring Summary for Response Alternative 2: Land Use Controls (LUCs)	
Date:	11/13/2015	Response Action Cleanup:	No MEC cleanup
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	40
V. Amount of MEC		Target Area	180
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface. After Cleanup: Intrusive depth overlaps with subsurface MEC.	240
VII. Migration Potential		Possible	30
VIII. MEC Classification		UXO Special Case	180
IX. MEC Size		Small	40
		Total Score	895
		Hazard Level Category	1

Site ID:	H09HI027401	e. Scoring Summary for Response Alternative 3: Limited Removal Action and LUCs	
Date:	11/13/2015	Response Action Cleanup:	cleanup of MECs located both on the surface and subsurface
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	10
V. Amount of MEC		Target Area	30
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	25
VII. Migration Potential		Possible	10
VIII. MEC Classification		UXO Special Case	180
IX. MEC Size		Small	40
		Total Score	480
		Hazard Level Category	4

Site ID:	H09HI027401	f. Scoring Summary for Response Alternative 4: Removal Action	
Date:	11/13/2015	Response Action Cleanup:	cleanup of MECs located both on the surface and subsurface
Input Factor		Input Factor Category	Score
I. Energetic Material Type		High Explosive and Low Explosive Filler in Fragmenting Rounds	100
II. Location of Additional Human Receptors		Inside the MRS or inside the ESQD arc	30
III. Site Accessibility		Moderate Accessibility	55
IV. Potential Contact Hours		10,000 to 99,999 receptor-hrs/yr	10
V. Amount of MEC		Target Area	30
VI. Minimum MEC Depth Relative to Maximum Intrusive Depth		Baseline Condition: MEC located surface and subsurface, After Cleanup: Intrusive depth does not overlap with subsurface MEC.	25
VII. Migration Potential		Possible	10
VIII. MEC Classification		UXO Special Case	180
IX. MEC Size		Small	40
		Total Score	480
		Hazard Level Category	4

MEC HA Hazard Level Determination		
Site ID: H09HI027401 **Date:** 11/13/2015	**Hazard Level Category**	**Score**
a. Current Use Activities	1	895
b. Future Use Activities	3	530
c. Response Alternative 1: No Action	1	895
d. Response Alternative 2: Land Use Controls (LUCs)	1	895
e. Response Alternative 3: Limited Removal Action and LUCs	4	480
f. Response Alternative 4: Removal Action	4	480
g. Response Alternative 5:		
h. Response Alternative 6:		

Characteristics of the MRS	
Is critical infrastructure located within the MRS or within the ESQD arc?	Yes
Are cultural resources located within the MRS or within the ESQD arc?	Yes
Are significant ecological resources located within the MRS or within the ESQD arc?	Yes

Appendix C Remedial Alternatives Cost Estimates

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Table C-1. Cost Estimate Summary

MRS Section	Remedial Alternative	Total Capital Cost	Total O&M Cost	Total Periodic Cost	Period of Analysis[(1)]	Total Cost[(2)]	Present Value[(3)]
Kahana Valley	1	$0	$0	$0	30 years	$0	$0
	2	$154,317	$40,867	$255,713	30 years	$541,075	$460,228
	3	$881,324	$0	$0	30 years	$1,057,589	$1,057,589
Punaluu Valley	1	$0	$0	$0	30 years	$0	$0
	2	$102,883	$1,410	$131,400	30 years	$282,832	$246,015
	3	$1,940,801	$628	$88,140	30 years	$2,435,483	$2,411,191
	4	$2,834,650	$0	$0	30 years	$3,401,580	$3,401,580

Notes:

All costs include the Hawaii General Excise Tax

(1) Period of Analysis assumes base year is 2015

(2) Total cost includes a 20 percent contingency factor (i.e., 10% scope contingency + 10 % bid contingency)

(3) Based on a -1.4% discount factor for projects with a 30-year duration, as specified for federal facility sites in Appendix C of Office of Management and Budget Circular A-94 (effective December 2013) at http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

Table C-2. Kahana Valley, Alternative 2 - Land Use Controls - Present Value Analysis

Year	Capital Costs	O&M Costs	Periodic Costs	Annual Costs	Total Present Value[(1)(2)]	Remarks
0	$154,317	$0	–	$154,317	$185,180	Community outreach meetings; RAB meetings; preparation of a land use control work plan; preparation of a training video for DLNR staff; preparation of UXO ID booklets for DLNR staff, initial installation of educational signs, warning signs, and pamphlet stations; provision of educational pamphlets and training DVDs
1	–	$1,362	–	$1,362	$1,612	Replacement of educational pamphlets and training DVDs
2	–	$1,362	–	$1,362	$1,590	Replacement of educational pamphlets and training DVDs
3	–	$1,362	–	$1,362	$1,568	Replacement of educational pamphlets and training DVDs
4	–	$1,362	–	$1,362	$1,546	Replacement of educational pamphlets and training DVDs
5	–	$1,362	$7,962	$9,324	$10,438	Five-year review, RAB meeting, replacement of pamphlet stations, replacement of educational pamphlets and training DVDs
6	–	$1,362	–	$1,362	$1,504	Replacement of educational pamphlets and training DVDs
7	–	$1,362	–	$1,362	$1,483	Replacement of educational pamphlets and training DVDs
8	–	$1,362	–	$1,362	$1,463	Replacement of educational pamphlets and training DVDs
9	–	$1,362	–	$1,362	$1,442	Replacement of educational pamphlets and training DVDs
10	–	$1,362	$75,082	$76,444	$79,827	Five-year review, RAB meeting, replacement of UXO ID booklets for DLNR staff, replacement of educational signs, warning signs, and pamphlet stations, replacement of educational pamphlets and training DVDs
11	–	$1,362	–	$1,362	$1,403	Replacement of educational pamphlets and training DVDs
12	–	$1,362	–	$1,362	$1,383	Replacement of educational pamphlets and training DVDs
13	–	$1,362	–	$1,362	$1,364	Replacement of educational pamphlets and training DVDs
14	–	$1,362	–	$1,362	$1,346	Replacement of educational pamphlets and training DVDs
15	–	$1,362	$11,252	$12,614	$12,288	Five-year review, RAB meeting, replacement of pamphlet stations, replacement of educational pamphlets, preparation of updated training video for DLNR staff and provision of training DVDs
16	–	$1,362	–	$1,362	$1,309	Replacement of educational pamphlets and training DVDs
17	–	$1,362	–	$1,362	$1,291	Replacement of educational pamphlets and training DVDs
18	–	$1,362	–	$1,362	$1,273	Replacement of educational pamphlets and training DVDs
19	–	$1,362	–	$1,362	$1,255	Replacement of educational pamphlets and training DVDs
20	–	$1,362	$75,082	$76,444	$69,465	Five-year review, RAB meeting, replacement of UXO ID booklets for DLNR staff, replacement of educational signs, warning signs, and pamphlet stations, replacement of educational pamphlets and training DVDs
21	–	$1,362	–	$1,362	$1,221	Replacement of educational pamphlets and training DVDs
22	–	$1,362	–	$1,362	$1,204	Replacement of educational pamphlets and training DVDs
23	–	$1,362	–	$1,362	$1,187	Replacement of educational pamphlets and training DVDs
24	–	$1,362	–	$1,362	$1,171	Replacement of educational pamphlets and training DVDs
25	–	$1,362	$7,962	$9,324	$7,904	Five-year review, RAB meeting, replacement of pamphlet stations, replacement of educational pamphlets and training DVDs
26	–	$1,362	–	$1,362	$1,139	Replacement of educational pamphlets and training DVDs
27	–	$1,362	–	$1,362	$1,123	Replacement of educational pamphlets and training DVDs
28	–	$1,362	–	$1,362	$1,108	Replacement of educational pamphlets and training DVDs
29	–	$1,362	–	$1,362	$1,092	Replacement of educational pamphlets and training DVDs
30	–	$1,362	$78,372	$79,734	$63,050	Five-year review, RAB meeting, replacement of UXO ID booklets for DLNR staff, replacement of educational signs, warning signs, and pamphlet stations, replacement of educational pamphlets, preparation of updated training video for DLNR staff and provision of training DVDs
Totals	**$154,317**	**$40,867**	**$255,713**	**$450,896**	**$460,228**	

Notes:
All costs include the Hawaii General Excise Tax
(1) Total Present Value includes a 10% scope contingency and 10% bid contingency

(2) Total Present Value was caluclated based on a -1.4% discount factor for projects with a 30-year duration, as specified for federal facility sites in Appendix C of Office of Management and Budget Circular A-94 (effective December 2014) at http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

Table C-3. Kahana Valley, Alternative 2 - Land Use Controls - Capital Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Comments
CAPITAL COSTS			**CAPITAL COSTS SUBTOTAL =**	**$147,375.32**	**Includes labor and LUCs**
Labor			**Labor Subtotal =**	**$58,060.80**	
LUC Outreach	80	hours	$224.82	$17,985.60	Assumes 32 hours of preparation and two people attending 4 hour meeting (includes travel). Two outreach meetings in total. Average combined hourly rate for Senior Project Manager and Technical Staff.
RAB Meetings	48	hours	$224.82	$10,791.36	Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Two RAB meetings in total. Average combined hourly rates for Senior Project Manager and Technical Staff.
Trainer for Video	32	hours	$133.87	$4,283.84	Assumes 32 hours of preparation for video. Average hourly rate for Project Manager
LUC WP	1	LS	$25,000.00	$25,000.00	Includes preparation of draft and final copies of land use control work plan detailing the specifics of the adopted institutional controls and their implementation. Costs
Material and Other Direct Costs			**Material and Other Direct Costs Subtotal =**	**$88,514.52**	
Aluminum Danger Signs (with posts)	50	unit	$150.80	$7,540.00	18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety Systems Signs Division. Assume 50 aluminum danger signs and posts installed.
Delivery/Shipment of Aluminum Signs and Posts	50	unit	$124.63	$6,231.50	Replace all 50 signs every ten years. Assumed 10 signs per year.
Educational Signs with Post	5	unit	$9,000.00	$45,000.00	KVO porcelain enamel with watering steel; ~$9000 for the first sign includes design, manufacturing, installation; 10 yrs durability; replacement signs ~$7000.; quote from Meacham
Delivery/Shipment of Educational Signs and Posts	1	unit	$1,154.06	$1,154.06	Assumes shipment of 2 boxes (40"x24"x6") of 100lb each from Parlin, CO to Oahu, HI by UPS Ground. Packages contain 5 educational signs and are insured for $1100 each. www.ups.com (2-21-14).
Pamphlet Repro (B&W)	20,000	sheet	$0.06	$1,200.00	Assumes 20,000 black and white pamphlets (quote is from Arc Pacific in Honolulu, HI)
Courier Delivery (pamphlets)	1	LS	$56.08	$56.08	Two deliveries per year
Pamphlet Station with Post	5	unit	$124.63	$623.15	Assumes 5 pamphlet boxes with a hinged top, sturdy 1/8" thick plexiglass material and a 6" x 6" x 9' metal post. www.woodproductsigns.cor
Delivery/Shipment of Pamphlet Sation and Posts	1	unit	$1,086.58	$1,086.58	Assumes shipment of 1 box (30"x30"x32") of 100lb from Parlin, CO to Oahu, HI by UPS Ground. Package contains 5 pamphlet stations and is insured for $450.
UXO ID Booklets	10	unit	$37.39	$373.90	Assumes 10 books every 10 years (i.e. 40 books) with 3% annual inflation markup (quote is from Arc Pacific). Each book assumed to be 20 pages, half sheet (i.e., 8.5" by 5.5") double sided, fully laminated and bound.
Delivery of UXO ID Booklets	1	unit	$30.00	$30.00	Assumes shipment of 1 large FedEx box to DLNR
Training DVDs	1	LS	$44.87	$44.87	Assumes 5 copies to be made each year. Includes cost of DVDs, cases, and shipping fees.
Community Outreach Materials	400	person	$49.85	$19,940.00	Includes RRR branded giveaways (e.g., bags, notepads, water bottles, etc) and costs for shipping and preparation of gift bags.
Community Meeting Posters	10	unit	$124.63	$1,246.30	Assumes 10 posters for events (e.g., community meetings, farmers markets, etc.)
Meeting Costs	8	unit	$498.51	$3,988.08	Includes meeting room rental, audio/visual equipment rental. Eight meetings total (4 IC outreach and 4 RAB)
Subcontractors			**Subcontractors Subtotal =**	**$800.00**	
Videographer (Training Video)	1	ea	$800.00	$800.00	Filming the training video for DLNR Staff (recording in person training events to cover staff turnover)

CAPITAL COSTS SUBTOTAL =	**$147,375.32**
CAPITAL COSTS (4.71% Tax) =	**$154,316.70**

Note:

DLNR = State of Hawaii Department of Land and Natural Resources
IC = Institutional Controls

O&M = Operation and Maintenance

RAB = Restoration Advisory Board

Table C-4. Kahana Valley, Alternative 2 - Land Use Controls - O&M and Periodic Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Comments
O&M COSTS (ANNUAL)		**O&M COSTS (annual) Subtotal =**		**$ 1,301**	**Includes labor and LUCs**
Material and Other Direct Costs		**Material and Other Direct Costs Subtotal =**		**$ 1,301**	
Pamphlet Repro (B&W)	20,000	sheet	$0.06	$ 1,200	Assumes 20,000 black and white pamphlets (quote is from Arc Pacific in Honolulu, HI)
Courier Delivery (pamphlets)	1	LS	$56.08	$ 56	Delivery twice a year for 30 years
Training DVDs	1	LS	$44.87	$ 45	Assumes 5 copies to be made each year. Includes cost of DVDs, cases, and shipping fees. Assumes one FedEx box sent from Honolulu, HI to Honolulu, HI. www.fedex.com
PERIODIC COSTS (EVERY 5 YEARS)		**PERIODIC COSTS (EVERY 5 YEARS) Subtotal =**		**$7,604**	
Labor			**Labor Subtotal =**	**$5,396**	
5-Year Review/Inspection of LUCs	48	hours	$87.77	$4,213	Assumes 48 hours of work including site inspection, desk top review of LUCs, and preparation of 5-year review report. Assumes six reviews over 30 years. Average hourly rate for mid-level technical staff.
RAB Meetings	24	hours	$224.82	$5,396	Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Average combined hourly rates for Senior Project Manager and Technical Staff.
Material and Other Direct Costs		**Material and Other Direct Costs Subtotal =**		**$ 2,208**	
Pamphlet Station with Post	5	unit	$124.63	$623	Assumes 5 pamphlet boxes with a hinged top, sturdy 1/8" thick plexiglass material and a 6" x 6" x 9' metal post
Delivery/Shipment of Pamphlet Staion and Posts	1	unit	$1,086.58	$1,087	Assumes shipment of 1 box (30"x30"x32") of 100lb from Parlin, CO to Honolulu, HI by UPS Ground. Package contains 5 pamphlet stations and is insured for $450. www.ups.com (2-21-14).
Meeting Costs (RAB)	1	unit	$498.51	$499	Includes meeting room rental, audio/visual equipment rental
PERIODIC COSTS (EVERY 10 YEARS)		**PERIODIC COSTS (EVERY 10 YEARS) Subtotal =**		**$64,101**	
Material and Other Direct Costs		**Material and Other Direct Costs Subtotal =**		**$64,101**	
Educational Signs with Post	5	unit	$7,000.00	$35,000	KVO porcelain enamel with watering steel; ~$9000 for the first sign includes design, manufacturing, installation; 10 yrs
Delivery/Shipment of Educational Signs and Posts	1	unit	$1,154.06	$1,154	Replace signs every 10 years.
Aluminum Danger Signs (with posts)	100	unit	$150.80	$15,080	18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety
Delivery/Shipment of Signs and Posts	100	unit	$124.63	$12,463	Replace all 50 signs every ten years.
UXO ID Booklets	10	unit	$37.39	$374	10 books every 10 years (i.e. 40 books) (quote is from Arc Pacific). Each book assumed to be 20 pages, half sheet (i.e., 8.5" by 5.5") double sided, fully laminated and bound.
Delivery of UXO ID Booklets	1	LS	$30.00	$30	Assumes shipment of 1 large FedEx box to DLNR.
PERIODIC COSTS (EVERY 15 YEARS)		**PERIODIC COSTS (EVERY 15 YEARS) Subtotal =**		**$3,142**	
Labor			**Labor Subtotal =**	**$2,142**	
Trainer for Video	16	hours	$133.87	$2,142	Assumes 16 hours of preparation for video. Average hourly rate for Project Manager
Subcontractors		**Subcontractors Subtotal =**		**$1,000**	
Videographer (Training Video)	1	ea	$1,000.00	$1,000	Filming the updated version of the training video after 15 years (recording in person training events to cover staff turnover)

O&M COSTS SUBTOTAL =	**$1,300.95**
O&M COSTS (4.71% Tax) =	**$1,362.22**
PERIODIC COSTS (EVERY 5 YEARS) SUBTOTAL =	**$7,603.92**
PERIODIC COSTS (EVERY 5 YEARS) (4.71% Tax) =	**$7,962.06**
PERIODIC COSTS (EVERY 10 YEARS) SUBTOTAL =	**$64,100.96**
PERIODIC COSTS (EVERY 10 YEARS) (4.71% Tax) =	**$67,120.12**
PERIODIC COSTS (EVERY 15 YEARS) SUBTOTAL =	**$3,141.92**
PERIODIC COSTS (EVERY 15 YEARS) (4.71% Tax) =	**$3,289.90**

Note:
DLNR = State of Hawaii Department of Land and Natural Resources
O&M = Operation and Maintenance
RAB = Restoration Advisory Board

Table C-5. Kahana Valley, Alternative 3. Limited Removal Action with Signage - Capital Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Comments
CAPITAL COSTS			**CAPITAL COSTS SUBTOTAL =**	**$841,681**	Includes labor, equipment, materials, and other direct costs for suface and subsurface removal of MEC and MD over 9.20 acres with a contingency of 15% for a total of 10.58 acres.
Labor			**Labor Subtotal =**	**$522,977**	
Senior Project Geologist (offsite PM)	192	hour	$131.51	$25,250	Offsite PM (financial mgmt, project support, client coordination). Assumed 16 hour per month for 12 months
Senior Project Manager (MEC Operations)	100	hour	$163.54	$16,354	2 Site Visits
Project Manager (onsite)	110	hour	$157.60	$17,336	Assumes 22 days, 5 hours/day
SUXOS	120	hour	$96.41	$11,569	Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 4 hour/day to and from for 20 days.
SUXOS 4%	60	hour	$100.26	$6,016	Assumes 10 6-hour days inside MRS.
SUXOS 8%	60	hour	$104.12	$6,247	Assumes 10 6-hour days inside MRS.
UXOQC	120	hour	$91.54	$10,985	Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 4 hour/day tvl to and from for 20 days.
UXOQC 4%	60	hour	$95.20	$5,712	Assumes 10 6-hour days inside MRS.
UXOQC 8%	60	hour	$98.86	$5,932	Assumes 10 6-hour days inside MRS.
UXOSO	112	hour	$91.54	$10,252	Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 4 hour/day tvl to and from for 20 days.
UXOSO 4%	60	hour	$95.20	$5,712	Assumes10 6-hour days inside MRS.
UXOSO 8%	60	hour	$98.86	$5,932	Assumes10 6-hour days inside MRS.
UXO Tech III Base	240	hour	$80.25	$19,260	Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 4 hour/day tvl to and from for 20 days for 2 Techs.
UXO Tech III 4%	120	hour	$83.46	$10,015	Assumes 10 6-hour days inside MRS for 2 Techs.
UXO Tech III 8%	120	hour	$86.67	$10,400	Assumes 10 6-hour days inside MRS for 2 Techs.
UXO Tech II Base	960	hour	$66.96	$64,282	Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 4 hour/day outside of MRS for 20 days for 6 Techs.
UXO Tech II 4%	360	hour	$96.64	$34,790	Assumes 10 6-hour days inside MRS for 6 Techs.
UXO Tech II 8%	360	hour	$72.32	$26,034	Assumes 10 6-hour days inside MRS for 6 Techs.
UXO Tech I Base	720	hour	$55.35	$39,852	Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 4 hour/day outside of MRS for 20 days for 3 Techs.
UXO Tech I 4%	360	hour	$57.56	$20,722	Assumes 10 6-hour days inside MRS for 6 Techs.
UXO Tech I 8%	360	hour	$59.78	$21,520	Assumes 10 6-hour days inside MRS for 6 Techs.
CADD Operator	90	hour	$68.44	$6,160	Real-time GIS support; Assume 3 hour per day and 5 days per week (based on past projects of similar size and scope)
Project Administrator	160	hour	$81.54	$13,046	Hiring and project support
Senior Project Accountant	40	hour	$95.19	$3,808	Assume project opening and closeout and 12 invoices
Work Plan/SHSP	1	LS	$65,000.00	$65,000	Prepare work plan and safety plan for the limited removal action. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
Site-Specific Final Report	1	LS	$50,000.00	$50,000	Prepare site-specific final report documenting the limited removal action. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
RAB Meetings	48	hours	$224.82	$10,791	Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Two RAB meetings in total. Average combined hourly rates for Senior Project Manager and Technical Staff.
Subcontractor Labor			**Subcontractor Labor Subtotal =**	**$1,151**	
Security	36	hours	$31.96	$1,151	Assumes 3 days security (12hr shift) between MEC ID and transport of demo explosives. Quote is from Aerotek.
Equipment, Materials, and Other Direct Costs			**Equipment, Materials, and Other Direct Costs Subtotal =**	**$106,881**	
Crew Truck	7.5	month	$1,370.00	$10,275	Assumes 5 trucks for 6 weeks of work.
Fuel Crew Trucks	840	Gal	$6.61	$5,552	Assumes 5 trucks for 6 weeks, 28 gallons per week. Cost was used from a previous project with similar size and scope.
Office Trailer	1.5	Month	$1,120.41	$1,681	8 feet by 20 feet office trailer. Hawaii Modular Space.
Trailer Delivery/Return	1	Each	$4,041.61	$4,042	8 feet by 20 feet office trailer. Hawaii Modular Space.
Porta Johns	12	Week	$243.03	$2,916	Assumes 2 porta johns for weekly servicing for 6 weeks
Generator (20kw)	1.5	Month	$1,495.54	$2,243	FKS Rental 808-871-7171
Fuel Generator	300	Gal	$6.23	$1,869	Cost was used from a previous project with similar scope (i.e., 200 gallons per month).
55 gallon drum w/lid and ring	5	Each	$120.83	$604	http://www.grainger.com
Connex Delivery & Install (Equip Storage)	1.5	LS	$872.40	$1,309	Hawaii Modular Space
Connex Monthly Rental (Equip Storage)	1.5	Month	$311.57	$467	Hawaii Modular Space

Table C-5. Kahana Valley, Alternative 3. Limited Removal Action with Signage - Capital Cost Detail (continued)

Description	Quantity	Unit	Unit Price	Cost	Comments
Ice Chest	4	Each	$56.08	$224	Cost was used from a previous project with similar scope
ice/water	20	day	$28.03	$561	Cost was used from a previous project with similar scope.
Safety Supplies (PPE + sunscreen, bug spray, etc)	120	LS	$1.25	$150	Cost was used from a previous project with similar size and scope.
Replacement Boots (safety)	17	unit	$155.00	$2,635	Replacement boots (composite toe) for UXO personnel due to rugged terrain. Fukuda Seed store.
Chain Saw	10	unit	$600.00	$6,000	Assume 2 per team. $500 each. Quote from Aloha Power Equipment. Unit price includes oil and replacement blades.
Weed Wacker	8	unit	$2,765.00	$22,120	Assume 4 per team. Quote from Aloha Power Equipment and includes necessary accessories.
Fuel for Saws and Weed Whackers	120	Gal	$7.75	$930	Assume1 gallon of fuel per day per machine. Consumption rate is based on field experience with similar projects.
Two-Way Radios	66	Week	$7.48	$494	Assumes 11 radios. Cost was used from a previous project with similar scope.
Minelab SE	54	Week	$26.17	$1,413	Assumes 9 minelabs. Cost was used from a previous project with similar scope
Repeater Station	6	Week	$62.31	$374	Cost was used from a previous project with similar scope.
Office Supplies	1	Each	$373.88	$374	Cost was used from a previous project with similar scope.
Misc supplies	1	Each	$623.14	$623	Cost was used from a previous project with similar scope.
Scrapper Setup (Oxy/Propane) (delivery included)	1	Month	$2,075.86	$2,076	Cost was used from a previous project with similar scope.
Demolition materials and delivery	3	event	$6,231.41	$18,694	Cost was used from a previous project with similar scope.
FEDEX Freight (MD Shipping)	5	drums	$1,096.73	$5,484	FedEX
Aluminum Danger Signs (with posts)	50	unit	$150.80	$7,540	18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety Systems Signs Division. Assume 50 aluminum danger signs and posts installed.
Delivery/Shipment of Aluminum Signs and Posts	50	unit	$124.63	$6,232	Replace all 50 signs every ten years. Assumed 10 signs per year
Travel			**Travel Subtotal =**	**$210,672**	
Airfare Continental U.S. to Oahu	7	ea	$1,000.00	$7,000	Includes 1 round trip per UXO team member (1 SUXOS, 1 UXOQC, 1 UXOSO, 2 UXO Tech III) and 2 site visits..
Meals/Incidentals	732	ea	$111.00	$81,197	Assume 17 UXO staff working 24 days (2 travel, 2 onsite mobe/demobe, 20 clearance)
Lodging	732	ea	$177.00	$129,476	Assume 17 UXO staff working 24 days (2 travel, 2 onsite mobe/demobe, 20 clearance)
CAPITAL COSTS SUBTOTAL =	**$841,681.10**				
CAPITAL COSTS (4.71% Tax) =	**$881,324.28**				

Note:
O&M = Operation and Maintenance
RAB = Restoration Advisory Board
Labor is based on WD 05-2154 (Rev.-14) located at www.wdol.gov viewed on 09/14/2010.

Table C-6. Punaluu Valley, Alternative 2 - Land Use Controls - Present Value Analysis

Year	Capital Costs	O&M Costs	Periodic Costs	Annual Costs	Total Present Value[(1)(2)]	Remarks
0	$102,883	$0	–	$102,883	$123,460	Community outreach meetings; RAB meetings; preparation of a land use control work plan; preparation of a training video for DLNR and Kamehameha Schools staff and provision of training DVDs; preparation of UXO ID booklets for DLNR and Kamehameha Schools staff, initial installation of warning signs
1	–	$47	–	$47	$56	Replacement of training DVDs
2	–	$47	–	$47	$55	Replacement of training DVDs
3	–	$47	–	$47	$54	Replacement of training DVDs
4	–	$47	–	$47	$53	Replacement of training DVDs
5	–	$47	$6,172	$6,219	$6,961	Five-year review, RAB meeting, and replacement of training DVDs
6	–	$47	–	$47	$52	Replacement of training DVDs
7	–	$47	–	$47	$51	Replacement of training DVDs
8	–	$47	–	$47	$50	Replacement of training DVDs
9	–	$47	–	$47	$50	Replacement of training DVDs
10	–	$47	$35,435	$35,482	$37,052	Five-year review; RAB meeting; replacement of warning signs, UXO ID booklets for DLNR and Kamehameha Schools staff, and training DVDs
11	–	$47	–	$47	$48	Replacement of training DVDs
12	–	$47	–	$47	$48	Replacement of training DVDs
13	–	$47	–	$47	$47	Replacement of training DVDs
14	–	$47	–	$47	$46	Replacement of training DVDs
15	–	$47	$9,462	$9,509	$9,263	Five-year review, RAB meeting, preparation of updated training video for DLNR and Kamehameha Schools staff and provision of training DVDs
16	–	$47	–	$47	$45	Replacement of training DVDs
17	–	$47	–	$47	$45	Replacement of training DVDs
18	–	$47	–	$47	$44	Replacement of training DVDs
19	–	$47	–	$47	$43	Replacement of training DVDs
20	–	$47	$35,435	$35,482	$32,243	Five-year review; RAB meeting; replacement of warning signs, UXO ID booklets for DLNR and Kamehameha Schools staff, and training DVDs
21	–	$47	–	$47	$42	Replacement of training DVDs
22	–	$47	–	$47	$42	Replacement of training DVDs
23	–	$47	–	$47	$41	Replacement of training DVDs
24	–	$47	–	$47	$40	Replacement of training DVDs
25	–	$47	$6,172	$6,219	$5,272	Five-year review, RAB meeting, and replacement of training DVDs
26	–	$47	–	$47	$39	Replacement of training DVDs
27	–	$47	–	$47	$39	Replacement of training DVDs
28	–	$47	–	$47	$38	Replacement of training DVDs
29	–	$47	–	$47	$38	Replacement of training DVDs
30	–	$47	$38,725	$38,772	$30,659	Five-year review; RAB meeting; replacement of warning signs, UXO ID booklets for DLNR staff; and preparation of updated training video for DLNR and Kamehameha Schools staff and provision of training DVDs
Totals	**$102,883**	**$1,410**	**$131,400**	**$235,693**	**$246,015**	

Notes:
All costs include the Hawaii General Excise Tax
(1) Total Present Value includes a 10% scope contingency and 10% bid contingency

(2) Total Present Value was caluclated based on a -1.4% discount factor for projects with a 30-year duration, as specified for federal facility sites in Appendix C of Office of Management and Budget Circular A-94 (effective December 2014) at http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

Table C-7. Punaluu Valley, Alternative 2 - Land Use Controls - Capital Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Comments
CAPITAL COSTS			**CAPITAL COSTS SUBTOTAL =**	**$98,255.45**	**Includes labor and LUCs**
Labor			**Labor Subtotal =**	**$58,060.80**	
LUC Outreach	80	hours	$224.82	$17,985.60	Assumes 32 hours of preparation and two people attending 4 hour meeting (includes travel). Two outreach meetings in total. Average combined hourly rate for Senior Project Manager and Technical Staff.
RAB Meetings	48	hours	$224.82	$10,791.36	Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Two RAB meetings in total. Average combined hourly rates for Senior Project Manager and Technical Staff.
Trainer for Video	32	hours	$133.87	$4,283.84	Assumes 32 hours of preparation for video. Average hourly rate for Project Manager
LUC WP	1	LS	$25,000.00	$25,000.00	Includes preparation of draft and final copies of land use control work plan detailing the specifics of the adopted institutional controls and their implementation. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
Material and Other Direct Costs			**Material and Other Direct Costs Subtotal =**	**$39,394.65**	
Aluminum Danger Signs (with posts)	50	unit	$150.80	$7,540.00	18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety Systems Signs Division. Assume 50 aluminum danger signs and posts installed.
Delivery/Shipment of Aluminum Signs and Posts	50	unit	$124.63	$6,231.50	Replace all 50 signs every ten years. Assumed 10 signs per year.
UXO ID Booklets	10	unit	$37.39	$373.90	Assumes 10 books every 10 years (i.e. 40 books) with 3% annual inflation markup (quote is from Arc Pacific). Each book assumed to be 20 pages, half sheet (i.e., 8.5" by 5.5") double sided, fully laminated and bound.
Delivery of UXO ID Booklets	1	unit	$30.00	$30.00	Assumes shipment of 1 large FedEx box to Kamehameha Schools
Training DVDs	1	LS	$44.87	$44.87	Assumes 5 copies to be made each year. Includes cost of DVDs, cases, and shipping fees.
Community Outreach Materials	400	person	$49.85	$19,940.00	Includes RRR branded giveaways (e.g., bags, notepads, water bottles, etc) and costs for shipping and preparation of gift bags.
Community Meeting Posters	10	unit	$124.63	$1,246.30	Assumes 10 posters for events (e.g., community meetings, farmers markets, etc.)
Meeting Costs	8	unit	$498.51	$3,988.08	Includes meeting room rental, audio/visual equipment rental. Eight meetings total (4 IC outreach and 4 RAB).
Subcontractors			**Subcontractors Subtotal =**	**$800.00**	
Videographer (Training Video)	1	ea	$800.00	$800.00	Filming the training video for Kamehameha Schools Staff (recording in person training events to cover staff turnover)

CAPITAL COSTS SUBTOTAL =	**$98,255.45**
CAPITAL COSTS (4.71% Tax) =	**$102,883.28**

Note:
IC = Institutional Controls
O&M = Operation and Maintenance
RAB = Restoration Advisory Board

Table C-8. Punaluu Valley, Alternative 2 - Land Use Controls - O&M and Periodic Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Comments
O&M COSTS (ANNUAL)		**O&M COSTS (annual) Subtotal =**		**$ 45**	
Material and Other Direct Costs		**Material and Other Direct Costs Subtotal =**		**$ 45**	
Training DVDs	1	LS	$44.87	$ 45	Assumes 5 copies to be made each year. Includes cost of DVDs, cases, and shipping fees. Assumes one FedEx box sent from Honolulu, HI to Honolulu, HI. www.fedex.com
PERIODIC COSTS (EVERY 5 YEARS)		**PERIODIC COSTS (EVERY 5 YEARS) Subtotal =**		**$5,894**	
Labor			**Labor Subtotal =**	**$5,396**	
5-Year Review/Inspection of LUCs	48	hours	$87.77	$4,213	Assumes 48 hours of work including site inspection, desk top review of LUCs, and preparation of 5-year review report. Assumes six reviews over 30 years. Averag hourly rate for mid-level technical staff.
RAB Meetings	24	hours	$224.82	$5,396	Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Average combined hourly rates for Senior Project Manager and
Material and Other Direct Costs		**Material and Other Direct Costs Subtotal =**		**$ 499**	
Meeting Costs (RAB)	1	unit	$498.51	$499	Includes meeting room rental, audio/visual equipment rental
PERIODIC COSTS (EVERY 10 YEARS)		**PERIODIC COSTS (EVERY 10 YEARS) Subtotal =**		**$27,947**	
Material and Other Direct Costs		**Material and Other Direct Costs Subtotal =**		**$27,947**	
Aluminum Danger Signs (with posts)	100	unit	$150.80	$15,080	18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety
Delivery/Shipment of Signs and Posts	100	unit	$124.63	$12,463	Replace all 100 signs every ten years.
UXO ID Booklets	10	unit	$37.39	$374	10 books every 10 years (i.e. 40 books) (quote is from Arc Pacific). Each book assumed to be 20 pages, half sheet (i.e., 8.5" by 5.5") double sided, fully laminated and bound.
Delivery of UXO ID Booklets	1	LS	$30.00	$30	Assumes shipment of 1 large FedEx box to Kamehameha Schools.
PERIODIC COSTS (EVERY 15 YEARS)		**PERIODIC COSTS (EVERY 15 YEARS) Subtotal =**		**$3,142**	
Labor			**Labor Subtotal =**	**$2,142**	
Trainer for Video	16	hours	$133.87	$2,142	Assumes 16 hours of preparation for video. Average hourly rate for Project Manager
Subcontractors		**Subcontractors Subtotal =**		**$1,000**	
Videographer (Training Video)	1	ea	$1,000.00	$1,000	Filming the updated version of the training video after 15 years (recording in person training events to cover staff turnover)

O&M COSTS SUBTOTAL =	**$44.87**
O&M COSTS (4.71% Tax) =	**$46.98**
PERIODIC COSTS (EVERY 5 YEARS) SUBTOTAL =	**$5,894.19**
PERIODIC COSTS (EVERY 5 YEARS) (4.71% Tax) =	**$6,171.81**
PERIODIC COSTS (EVERY 10 YEARS) SUBTOTAL =	**$27,946.90**
PERIODIC COSTS (EVERY 10 YEARS) (4.71% Tax) =	**$29,263.20**
PERIODIC COSTS (EVERY 15 YEARS) SUBTOTAL =	**$3,141.92**
PERIODIC COSTS (EVERY 15 YEARS) (4.71% Tax) =	**$3,289.90**

Note:
O&M = Operation and Maintenance
RAB = Restoration Advisory Board

Table C-9. Punaluu Valley, Alternative 3 - Limited Removal Action and LUCs - Present Value Analysis

Year	Capital Costs	O&M Costs	Periodic Costs	Annual Costs	Total Present Value[(1)(2)]	Remarks
0	$1,940,801	$0	–	$1,940,801	$2,328,961	Removal of MEC and MD over 26.94 acres and preparation of final report, community outreach meetings; RAB meetings; preparation of a land use control work plan; preparation of a training video for DLNR staff and provision of training DVDs; preparation of UXO ID booklets for DLNR staff, initial installation of warning signs
1	–	$21	–	$21	$25	Replacement of training DVDs
2	–	$21	–	$21	$24	Replacement of training DVDs
3	–	$21	–	$21	$24	Replacement of training DVDs
4	–	$21	–	$21	$24	Replacement of training DVDs
5	–	$21	$6,172	$6,193	$6,932	Five-year review, RAB meeting, and replacement of training DVDs
6	–	$21	–	$21	$23	Replacement of training DVDs
7	–	$21	–	$21	$23	Replacement of training DVDs
8	–	$21	–	$21	$22	Replacement of training DVDs
9	–	$21	–	$21	$22	Replacement of training DVDs
10	–	$21	$21,015	$21,036	$21,967	Five-year review; RAB meeting; replacement of warning signs, UXO ID booklets for DLNR staff, and training DVDs
11	–	$21	–	$21	$22	Replacement of training DVDs
12	–	$21	–	$21	$21	Replacement of training DVDs
13	–	$21	–	$21	$21	Replacement of training DVDs
14	–	$21	–	$21	$21	Replacement of training DVDs
15	–	$21	$9,462	$9,483	$9,237	Five-year review, RAB meeting, preparation of updated training video for DLNR staff and provision of training DVDs
16	–	$21	–	$21	$20	Replacement of training DVDs
17	–	$21	–	$21	$20	Replacement of training DVDs
18	–	$21	–	$21	$20	Replacement of training DVDs
19	–	$21	–	$21	$19	Replacement of training DVDs
20	–	$21	$21,015	$21,036	$19,115	Five-year review; RAB meeting; replacement of warning signs, UXO ID booklets for DLNR staff, and training DVDs
21	–	$21	–	$21	$19	Replacement of training DVDs
22	–	$21	–	$21	$19	Replacement of training DVDs
23	–	$21	–	$21	$18	Replacement of training DVDs
24	–	$21	–	$21	$18	Replacement of training DVDs
25	–	$21	$6,172	$6,193	$5,249	Five-year review, RAB meeting, and replacement of training DVDs
26	–	$21	–	$21	$18	Replacement of training DVDs
27	–	$21	–	$21	$17	Replacement of training DVDs
28	–	$21	–	$21	$17	Replacement of training DVDs
29	–	$21	–	$21	$17	Replacement of training DVDs
30	–	$21	$24,305	$24,326	$19,236	Five-year review; RAB meeting; replacement of warning signs, UXO ID booklets for DLNR staff; and preparation of updated training video for DLNR staff and provision of training DVDs
Totals	**$1,940,801**	**$628**	**$88,140**	**$2,029,569**	**$2,411,191**	

Notes:

All costs include the Hawaii General Excise Tax

(1) Total Present Value includes a 10% scope contingency and 10% bid contingency

(2) Total Present Value was caluclated based on a -1.4% discount factor for projects with a 30-year duration, as specified for federal facility sites in Appendix C of Office of Management and Budget Circular A-94 (effective December 2014) at http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

Table C-10. Punaluu Valley, Alternative 3 - Limited Removal Action and LUCs - Capital Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Project Years	Comments
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**			**$1,853,501**	**0-2**	Includes labor, equipment, materials, and other direct costs for suface and subsurface removal of MEC and MD over 23.43 acres with a contingency of 15% for a total of 26.94 acres and LUCs.
Labor	**Labor Subtotal =**			**$1,149,894**		
Senior Project Geologist	224	hour	$131.51	$29,458		Offsite PM (financial mgmt, project support, client coordination). Assumed 16 hour per month for 14 months
Senior Projet Manager (MEC	150	hour	$163.54	$24,531		3 Site Visits
Project Manager (onsite)	280	hour	$157.60	$44,128		Assumes 56 days, 5 hours/day
SUXOS	202	hour	$96.41	$19,475		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 54 days.
SUXOS 4%	189	hour	$100.26	$18,949		Assumes 27 7-hour days inside MRS.
SUXOS 8%	189	hour	$104.12	$19,679		Assumes 27 7-hour days inside MRS.
UXOQC	202	hour	$91.54	$18,491		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 54 days.
UXOQC 4%	189	hour	$95.20	$17,993		Assumes 27 7-hour days inside MRS.
UXOQC 8%	189	hour	$98.86	$18,685		Assumes 27 7-hour days inside MRS.
UXOSO	202	hour	$91.54	$18,491		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 54 days.
UXOSO 4%	189	hour	$95.20	$17,993		Assumes 27 7-hour days inside MRS.
UXOSO 8%	189	hour	$98.86	$18,685		Assumes 27 7-hour days inside MRS.
UXO Tech III Base	404	hour	$80.25	$32,421		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 54 days for 2 Techs.
UXO Tech III 4%	378	hour	$83.46	$31,548		Assumes 27 7-hour days inside MRS for 2 Techs.
UXO Tech III 4%	184	hour	$83.46	$15,357		Assumes 23 8-hour days inside MRS performing construction support during road construction (2 days vegetation clearance+21 days road construction).
UXO Tech III 8%	378	hour	$86.67	$32,761		Assumes 27 7-hour days inside MRS for 2 Techs.
UXO Tech II Base	1212	hour	$66.96	$81,156		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 54 days for 6 Techs.
UXO Tech II 4%	1134	hour	$96.64	$109,590		Assumes 27 7-hour days inside MRS for 6 Techs.
UXO Tech II 4%	184	hour	$96.64	$17,782		Assumes 23 8-hour days inside MRS performing construction support during road construction (2 days vegetation clearance+21 days road construction).
UXO Tech II 8%	1134	hour	$72.32	$82,007		Assumes 27 7-hour days inside MRS for 6 Techs.
UXO Tech I Base	1212	hour	$55.35	$67,084		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 54 days for 6 Techs.
UXO Tech I 4%	1134	hour	$57.56	$65,273		Assumes 27 7-hour days inside MRS for 6 Techs.
UXO Tech I 8%	1134	hour	$59.78	$67,788		Assumes 27 7-hour days inside MRS for 6 Techs.
CADD Operator	210	hour	$68.44	$14,372		Real-time GIS support; Assume 3 hour per day and 5 days per week (based on past projects of similar size and scope)
Project Administrator	200	hour	$81.54	$16,308		Hiring and project support
Senior Project Accountant	46	hour	$95.19	$4,379		Assume project opening and closeout and 12 invoices
Work Plan/SHSP	1	LS	$65,000.00	$65,000		Prepare work plan and safety plan for the limited removal action. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
Site-Specific Final Report	1	LS	$50,000.00	$50,000		Prepare site-specific final report documenting the limited removal action. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
LUC Outreach	80	hours	$224.82	$17,986		Assumes 32 hours of preparation and two people attending 4 hour meeting (includes travel). Two outreach meetings in total. Average combined hourly rate for Senior Project Manager and Technical Sta
RAB Meetings	48	hours	$224.82	$10,791		Assumes 16 hours of preparation and two people attending a 2-hour meeting. Four RAB meetings in total. Average combined hourly rates for Senior Project Manager and Technical Sta
Trainer for Video	32	hours	$133.87	$4,284		Assumes 32 hours of preparation for video. Average hourly rate for Senior Project Manager and Technical Staff.
LUC WP	1	LS	$25,000.00	$25,000		Includes preparation of draft and final copies of land use control work plan detailing the specifics of the adopted institutional controls and their implementation. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
LUC Outreach	144	hours	$224.82	$32,374.08		Assumes 32 hours of preparation and two people attending 4 hour meeting (includes travel). Four outreach meetings in total. Average combined hourly rate for Senior Project Manager and Technical Staff.
RAB Meetings	48	hours	$224.82	$10,791.36		Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Two RAB meetings in total. Average combined hourly rates for Senior Project Manager and Technical Staff.
Trainer for Video	32	hours	$133.87	$4,283.84		Assumes 32 hours of preparation for video. Average hourly rate for Project Manager
LUC WP	1	LS	$25,000.00	$25,000.00		Includes preparation of draft and final copies of land use control work plan detailing the specifics of the adopted institutional controls and their implementation. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
Subcontractor Labor	**Subcontractor Labor Subtotal =**			**$1,951**		
Security	36	hours	$31.96	$1,151		Assumes 3 days security (12hr shift) between MEC ID and transport of demo explosives. Quote is from Aerotek.
Videographer (Training Video)	1	ea	$800.00	$800.00		Filming the training video for Kamehameha Schools Staff (recording in person training events to cover staff turnover
Equipment, Materials, and Other Direct Costs	**Equipment, Materials, and ODCs Subtotal =**			**$197,152**		
Crew Truck	17.5	month	$1,370.00	$23,975		Assumes 5 trucks for 3.5 months.
Fuel Crew Trucks	1,750	Gal	$6.61	$11,568		Assumes 5 trucks for 12 weeks, 28 gallons per week. Cost was used from a previous project with similar scope.
Office Trailer	3.5	Month	$1,120.41	$3,921		8 feet by 20 feet office trailer. Hawaii Modular Space
Trailer Delivery/Return	1	Each	$4,041.61	$4,042		8 feet by 20 feet office trailer. Hawaii Modular Space.
Porta Johns	28	Week	$243.03	$6,805		Assumes 2 porta johns for weekly servicing for 14 weeks.
Generator (20kw)	3.5	Month	$1,495.54	$5,234		FKS Rental 808-871-7171
Fuel Generator	700	Gal	$6.23	$4,361		Cost was used from a previous project with similar scope (i.e., 200 gallons per month).
55 gallon drum w/lid and ring	5	Each	$120.83	$604		http://www.grainger.com
Connex Delivery & Install (Equip Storage)	1	LS	$872.40	$872		Hawaii Modular Space
Connex Monthly Rental (Equip Storage)	3.5	Month	$311.57	$1,090		Hawaii Modular Space
Ice Chest	8	Each	$56.08	$449		Cost was used from a previous project with similar scope.
ice/water	84	day	$28.03	$2,355		Cost was used from a previous project with similar scope.
Safety Supplies (PPE + sunscreen, bug spray, etc)	200	LS	$1.25	$250		Cost was used from a previous project with similar scope
Replacement Boots (safety)	34	unit	$155.00	$5,270		Replacement boots (composite toe) for UXO personnel due to rugged terrain. Assumed two replacements due to length of project. Fukuda Seed store.
Chain Saw	4	unit	$500.00	$2,000		Assume 2 per team (2 teams). $500 each. Quote from Aloha Power Equipment. Unit price includes oil and replacement blades.
Weed Wacker	8	unit	$2,765.00	$22,120		Assume 4 per team (2 teams). Quote is from Aloha Power Equipment and includes necessary accessories.
Fuel for Saws and Weed Whackers	648	Gal	$7.75	$5,022		Assume 1 gallon of fuel per day per machine. Consumption rate is based on field experience with similar projects.
Two-Way Radios	154	Week	$7.48	$1,152		Assumes 11 radios. Cost was used from a previous project with similar scope.

Table C-10. Punaluu Valley, Alternative 3 - Limited Removal Action and LUCs - Capital Cost Detail (continued)

Description	Quantity	Unit	Unit Price	Cost	Project Years	Comments
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**			**$1,853,501**	**0-2**	Includes labor, equipment, materials, and other direct costs for suface and subsurface removal of MEC and MD over 23.43 acres with a contingency of 15% for a total of 26.94 acres and LUCs.
Minelab SE	140	Week	$26.17	$3,664		Assumes 10 minelabs. (4 per team (2 teams), one for UXOQC, and one spare). Cost was used from a previous project with similar scope.
Repeater Station	14	Week	$62.31	$872		Cost was used from a previous project with similar scope.
Office Supplies	2	Each	$373.88	$748		Cost was estimated from a previous project of smaller similar size and similar scope.
Misc supplies	2	Each	$623.14	$1,246		Cost was estimated from a previous project of smaller similar size and similar scope.
Scrapper Setup (Oxy/Propane) (delivery included)	3.5	Month	$2,075.86	$7,266		Cost was used from a previous project with similar scope
Demolition materials and	6	event	$6,231.41	$37,388		Cost was used from a previous project with similar scope.
FEDEX Freight (MD Shipping)	5	drums	$1,096.73	$5,484		FedEX
Aluminum Danger Signs (with posts)	50	unit	$150.80	$7,540		18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety Systems Signs Division. Assume 50 aluminum danger signs and posts installe
Delivery/Shipment of	50	unit	$124.63	$6,232		Replace all 50 signs every ten years. Assumed 10 signs per yeai
UXO ID Booklets	10	unit	$37.39	$374		10 books every 10 years (i.e. 40 books) with 3% annual inflation markup (quote is from Arc Pacific). Each book assumed to be 20 pages, half sheet (i.e., 8.5" by 5.5") double sided, fully laminated and bound.
Delivery of UXO ID	1	unit	$30.00	$30.00		Assumes shipment of 1 large FedEx box to Kamehameha Schools
Training DVDs	1	LS	$44.87	$44.87		Assumes 5 copies to be made each year. Includes cost of DVDs, cases, and shipping fees.
Community Outreach Materials	400	person	$49.85	$19,940		Includes RRR branded giveaways (e.g., bags, notepads, water bottles, etc) and costs for shipping and preparation of gift bags.
Community Meeting Posters	10	unit	$124.63	$1,246		Assume 10 posters for events (e.g., community meetings, farmers markets, etc.
Meeting Costs	8	unit	$498.51	$3,988		Includes meeting room rental, audio/visual equipment rental. Eight meetings total (4 outreach and 4 RAB).
Travel		**Travel Subtotal =**		**$504,504**		
Airfare Continental U.S. to Oahu	9	ea	$1,000.00	$9,000		Includes 1 round trip per UXO team member (1 SUXOS, 1 UXOQC, 1 UXOSO, 2 UXO Tech III), replacement Techs, and site visits.
Meals/Incidentals-Removal Action	1,752	ea	$111.00	$194,444		Assume 17 UXO staff working 58 days (2 travel, 2 onsite mobe/demobe, 54 clearance) and 3 site visits.
Lodging-Removal Action	1,752	ea	$177.00	$310,060		Assume 17 UXO staff working 58 days (2 travel, 2 onsite mobe/demobe, 54 clearance) and 3 site visits.

APITAL COSTS SUBTOTAL = $1,853,501.15
CAPITAL COSTS (4.71% $1,940,801.06

Note:
O&M = Operation and Maintenance
RAB = Restoration Advisory Board
Labor is based on WD 05-2154 (Rev.-14) located at www.wdol.gov viewed on 09/14/2010.

Table C-11. Punaluu Valley, Alternative 3 - Limited Removal Action and LUCs - O&M and Periodic Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Comments
O&M COSTS (ANNUAL)			**O&M COSTS (annual) Subtotal =**	**$ 20**	
Material and Other Direct Costs			**Material and Other Direct Costs Subtotal =**	**$ 20**	
Training DVDs	1	LS	$20.00	$ 20	Assumes 2 copies to be made each year. Includes cost of DVDs, cases, and shipping fees. Assumes one FedEx box sent from Honolulu, HI to Honolulu, HI. www.fedex.com
PERIODIC COSTS (EVERY 5 YEARS)			**PERIODIC COSTS (EVERY 5 YEARS) Subtotal =**	**$5,894**	
Labor			**Labor Subtotal =**	**$5,396**	
5-Year Review/Inspection of LUCs	48	hours	$87.77	$4,213	Assumes 48 hours of work including site inspection, desk top review of LUCs, and preparation of 5-year review report. Assumes six reviews over 30 years. Average hourly rate for mid-level technical staff.
RAB Meetings	24	hours	$224.82	$5,396	Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Average combined hourly rates for Senior Project Manager and
Material and Other Direct Costs			**Material and Other Direct Costs Subtotal =**	**$ 499**	
Meeting Costs (RAB)	1	unit	$498.51	$499	Includes meeting room rental, audio/visual equipment rental
PERIODIC COSTS (EVERY 10 YEARS)			**PERIODIC COSTS (EVERY 10 YEARS) Subtotal =**	**$14,175**	
Material and Other Direct Costs			**Material and Other Direct Costs Subtotal =**	**$14,175**	
Aluminum Danger Signs (with posts)	50	unit	$150.80	$7,540	18" by 24" aluminum and square sign, UV, fade, and weather resistant coating and channel post 10 feet long. Quote from Safety
Delivery/Shipment of Signs and Posts	50	unit	$124.63	$6,232	Replace all 50 signs every ten years.
UXO ID Booklets	10	unit	$37.39	$374	10 books every 10 years (i.e. 40 books) (quote is from Arc Pacific). Each book assumed to be 20 pages, half sheet (i.e., 8.5" by 5.5") double sided, fully laminated and bound.
Delivery of UXO ID Booklets	1	LS	$30.00	$30	Assumes shipment of 1 large FedEx box to Kamehameha Schools.
PERIODIC COSTS (EVERY 15 YEARS)			**PERIODIC COSTS (EVERY 15 YEARS) Subtotal =**	**$3,142**	
Labor			**Labor Subtotal =**	**$2,142**	
Trainer for Video	16	hours	$133.87	$2,142	Assumes 16 hours of preparation for video. Average hourly rate for Project Manager
Subcontractors			**Subcontractors Subtotal =**	**$1,000**	
Videographer (Training Video)	1	ea	$1,000.00	$1,000	Filming the updated version of the training video after 15 years (recording in person training events to cover staff turnover)

O&M COSTS SUBTOTAL = $20.00
O&M COSTS (4.71% Tax) = $20.94

PERIODIC COSTS (EVERY 5 YEARS) SUBTOTAL = $5,894.19
PERIODIC COSTS (EVERY 5 YEARS) (4.71% Tax) = $6,171.81

PERIODIC COSTS (EVERY 10 YEARS) SUBTOTAL = $14,175.40
PERIODIC COSTS (EVERY 10 YEARS) (4.71% Tax) = $14,843.06

PERIODIC COSTS (EVERY 15 YEARS) SUBTOTAL = $3,141.92
PERIODIC COSTS (EVERY 15 YEARS) (4.71% Tax) = $3,289.90

Note:
O&M = Operation and Maintenance
RAB = Restoration Advisory Board

Table C-12. Punaluu Valley, Alternative 4 - Removal Action - Capital Cost Detail

Description	Quantity	Unit	Unit Price	Cost	Project Years	Comments
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**			**$2,707,144**	**0-2**	Includes labor, equipment, materials, and other direct costs for suface and subsurface removal of MEC and MD over 35.34 acres with a contingency of 15% for a total of 40.64 acres.
Labor			**Labor Subtotal =**	**$1,739,634**		
Senior Project Geologist	256	hour	$131.51	$33,667		Offsite PM (financial mgmt, project support, client coordination). Assumed 16 hour per month for 16 months
Senior Projet Manager (MEC	150	hour	$163.54	$24,531		3 Site Visits
Project Manager (onsite)	420	hour	$157.60	$66,192		Assumes 84 days, 5 hours/day
SUXOS	286	hour	$96.41	$27,573		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 82 days.
SUXOS 4%	287	hour	$100.26	$28,775		Assumes 41 7-hour days inside MRS.
SUXOS 8%	287	hour	$104.12	$29,883		Assumes 41 7-hour days inside MRS.
UXOQC	286	hour	$91.54	$26,180		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 82 days.
UXOQC 4%	287	hour	$95.20	$27,322		Assumes 41 7-hour days inside MRS.
UXOQC 8%	287	hour	$98.86	$28,374		Assumes 41 7-hour days inside MRS.
UXOSO	286	hour	$91.54	$26,180		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 82 days.
UXOSO 4%	287	hour	$95.20	$27,322		Assumes 41 7-hour days inside MRS.
UXOSO 8%	2807	hour	$98.86	$277,509		Assumes 41 7-hour days inside MRS.
UXO Tech III Base	572	hour	$80.25	$45,903		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 82 days for 2 Techs.
UXO Tech III 4%	574	hour	$83.46	$47,906		Assumes 41 7-hour days inside MRS for 2 Techs.
UXO Tech III 4%	184	hour	$83.46	$15,357		Assumes 23 8-hour days inside MRS performing construction support during road construction (2 days vegetation clearance+21 days road construction).
UXO Tech III 8%	574	hour	$86.67	$49,749		Assumes 41 7-hour days inside MRS for 2 Techs
UXO Tech II Base	1716	hour	$66.96	$114,903		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 82 days for 6 Techs.
UXO Tech II 4%	1722	hour	$96.64	$166,414		Assumes 41 7-hour days inside MRS for 6 Techs.
UXO Tech II 4%	184	hour	$96.64	$17,782		Assumes 23 8-hour days inside MRS performing construction support during road construction (2 days vegetation clearance+21 days road construction).
UXO Tech II 8%	1722	hour	$72.32	$124,530		Assumes 41 7-hour days inside MRS for 6 Techs.
UXO Tech I Base	1716	hour	$55.35	$94,981		Assumes 2 days travel, 1 day training, 1 day mobe/demobe, and 3 hour/day to and from for 82 days for 6 Techs.
UXO Tech I 4%	1722	hour	$57.56	$99,118		Assumes 41 7-hour days inside MRS for 6 Techs.
UXO Tech I 8%	1722	hour	$59.78	$102,938		Assumes 41 7-hour days inside MRS for 6 Techs.
CADD Operator	1260	hour	$68.44	$86,234		Real-time GIS support; Assume 3 hour per day and 5 days per week (based on past projects of similar size and scope)
Project Administrator	240	hour	$81.54	$19,570		Hiring and project support
Senior Project Accountant	52	hour	$95.19	$4,950		Assume project opening and closeout and 16 invoices
Work Plan/SHSP	1	LS	$65,000.00	$65,000		Prepare work plan and safety plan for the limited removal action. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
Site-Specific Final Report	1	LS	$50,000.00	$50,000		Prepare site-specific final report documenting the limited removal action. Costs include draft, draft final, and final versions of report and two rounds of responses to comments.
RAB Meetings	48	hours	$224.82	$10,791		Assumes 16 hours of preparation and two people attending a 2-hour meeting plus 2 hr travel time. Two RAB meetings in total. Average combined hourly rates for Senior Project Manager and Technical Staff.
Subcontractor Labor	**Subcontractor Labor Subtotal =**			**$2,301**		
Security	72	hours	$31.96	$2,301	0-2	Assumes 3 days security (12hr shift) between MEC ID and transport of demo explosives. Quote is from Aerotek.
Equipment, Materials, and Other Direct Costs	**Equipment, Materials, and Other Direct Costs Subtotal =**			**$207,553**		
Crew Truck	26.3	month	$1,370.00	$35,963		Assumes 5 trucks for 5.25 months.
Fuel Crew Trucks	2940	Gal	$6.61	$19,433		Assumes 5 trucks for 21 weeks, 28 gallons per week. Cost was used from a previous project with similar size and scope.
Office Trailer	5.25	Month	$1,120.41	$5,882		8 feet by 20 feet office trailer. Hawaii Modular Space.
Trailer Delivery/Return	1	Each	$4,041.61	$4,042		8 feet by 20 feet office trailer. Hawaii Modular Space.
Porta Johns	42	Week	$243.03	$10,207		Assumes 2 porta johns for weekly servicing for 21 weeks.
Generator (20kw)	5.25	Month	$1,495.54	$7,852		FKS Rental 808-871-7171
Fuel Generator	1050	Gal	$6.23	$6,542		Cost was used from a previous project with similar scope (i.e., 200 gallons per month).
55 gallon drum w/lid and ring	10	Each	$120.83	$1,208		http://www.grainger.com
Connex Delivery & Install (Equip Storage)	1	LS	$872.40	$872		Hawaii Modular Space
Connex Monthly Rental (Equip Storage)	5.25	Month	$311.57	$1,636		Hawaii Modular Space

Table C-12. Punaluu Valley, Alternative 4 - Removal Action - Capital Cost Detail (continued)

Description	Quantity	Unit	Unit Price	Cost	Project Years	Comments
CAPITAL COSTS	**CAPITAL COSTS SUBTOTAL =**			**$2,707,144**	**0-2**	Includes labor, equipment, materials, and other direct costs for suface and subsurface removal of MEC and MD over 35.34 acres with a contingency of 15% for a total of 40.64 acres.
Ice Chest	6	Each	$56.08	$336		Cost was used from a previous project with similar scope. Assumed two replacement sets due to duration of projec
ice/water	82	day	$28.03	$2,298		Cost was used from a previous project with similar scope.
Safety Supplies (PPE + sunscreen, bug spray, etc)	300	LS	$1.25	$375		Cost was used from a previous project with similar scope
Replacement Boots (safety)	51	unit	$155.00	$7,905		Replacement boots (composite toe) for UXO personnel due to rugged terrain. Assumed three replacements due to length of project. Fukuda Seed store.
Chain Saw	4	unit	$500.00	$2,000		Assume 2 per team (2 teams). $500 each. Quote from Aloha Power Equipment. Unit price includes oil and replacement blades.
Weed Wacker	8	unit	$2,765.00	$22,120		Assume 4 per team (2 teams). Quote is from Aloha Power Equipment and includes necessary accessories.
Fuel for Saws and Weed	984	Gal	$7.75	$7,626		Assume 1 gallon of fuel per day per machine. Consumption rate is based on field experience with similar projects.
Two-Way Radios	231	Week	$7.48	$1,728		Assumes 11 radios. Cost was used from a previous project with similar scope.
Minelab SE	210	Week	$26.17	$5,496		Assumes 10 minelabs (4 per team(2 teams), one for the UXOQC, and one spare). Cost was used from a previous project with similar scope.
Repeater Station	21	Week	$62.31	$1,309		Cost was used from a previous project with similar scope.
Office Supplies	4	Each	$373.88	$1,496		Cost was estimated from a previous project of smaller size but similar scope.
Misc supplies	4	Each	$623.14	$2,493		Cost was estimated from a previous project of smaller size but similar scope.
Scrapper Setup (Oxy/Propane) (delivery included)	5	Month	$2,075.86	$10,379		Cost was estimated from a previous project of smaller size but similar scope
Demolition materials and delivery	6	event	$6,231.41	$37,388		Cost was estimated from a previous project of smaller size but similar scope.
FEDEX Freight (MD Shipping)	10	drums	$1,096.73	$10,967		FedEx
Road Construction	57,064	SF	$10.00	$570,640		Includes labor, heavy equipment, and material costs for vegetation clearance and installation of a gravel road covering approximately 57,064 square feet. Road follows Transects P006, P042, and P007 from western edge of 4.19 acre elevated density area to eastern edge of 12.88 acre target area. Cost was estimated from previous projects.
Travel			**Travel Subtotal =**	**$757,656**		
Airfare Continental U.S. to Oahu	9	ea	$1,000.00	$9,000		Includes 1 round trip per UXO team member (1 SUXOS, 1 UXOQC, 1 UXOSO, 2 UXO Tech III), replacement Techs, and site visits.
Meals/Incidentals-Removal Action	2,585	ea	$111.00	$286,907	0-2	Assume 17 UXO staff working 86 days (2 travel, 2 onsite mobe/demobe, 82 clearance) and 3 site visits.
Lodging-Removal Action	2,585	ea	$177.00	$457,501	0-2	Assume 17 UXO staff working 86 days (2 travel, 2 onsite mobe/demobe, 82 clearance) and 3 site visits.
Meals/Incidentals-Road Construction	46	ea	$111.00	$ 5,106		Assume 2 UXO staff working 23 days of construction support (2 days vegetation clearance+21 days road construction
Lodging-Road Construction	46	ea	$177.00	$ 8,142		Assume 2 UXO staff working 23 days of construction support (2 days vegetation clearance+21 days road construction

APITAL COSTS SUBTOTAL =	**$2,707,143.71**
CAPITAL COSTS (4.71%	**$2,834,650.18**

Note:
O&M = Operation and Maintenance
RAB = Restoration Advisory Board
Labor is based on WD 05-2154 (Rev.-14) located at www.wdol.gov viewed on 09/14/2010.

Appendix D Institutional Analysis

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DRAFT-FINAL

INSTITUTIONAL ANALYSIS REPORT

PACIFIC JUNGLE COMBAT TRAINING CENTER

OAHU, HAWAII

FUDS Project Number H09HI027401
Contract: W912DY-10-D-0053
Task Order: 0002

Prepared for:

U.S. Army Corps of Engineering, Honolulu District

and

U.S. Army Engineering and Support Center, Huntsville

November 2015
Revision 1

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DRAFT-FINAL

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Acronyms and Abbreviations

DEM	City and County of Honolulu, Department of Emergency Management
DLNR	State of Hawaii Department of Land and Natural Resources
EOD	Explosive Ordnance Disposal
HAR	Hawaii Administrative Rules
HFD	City and County of Honolulu, Honolulu Fire Department
HPD	City and County of Honolulu, Honolulu Police Department
HRS	Hawaii Revised Statues
HE	high explosive
IA	institutional analysis
LUC	land use control
MC	munitions constituents
MEC	munitions and explosives of concern
mm	millimeter
MRS	munitions response site
OE	Ordnance and Explosives
PD	point detonating
PJCTC	Pacific Jungle Combat Training Center
RI	Remedial Investigation
TMK	Tax Map Key
TNT	2,4,6-trinitrotoluene
USACE	U.S. Army Corps of Engineers
§	Section

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1.0 Introduction and Purpose

1.0.1 This report documents and presents the results of the institutional analysis (IA) performed for the Formerly Used Defense Sites Property Number H09HI027401, known as the former Pacific Jungle Combat Training Center (PJCTC) (also referred to herein as "the site"). This report was prepared in accordance with U.S. Army Corps of Engineers (USACE) guidance (Engineer Pamphlet 1110-1-24) for "Establishing and Maintaining Institutional Controls for Ordnance and Explosives (OE) Projects" dated December 15, 2000.

1.0.2 The purpose of this IA is to collect basic data to support the development of a land use control (LUC) program at the former PJCTC to protect property owners and the public from explosive hazards potentially present within the boundaries of the site. The objectives of this IA include (1) illustrating opportunities that exist to implement an LUC program at the site, (2) identifying government stakeholders and landowners with jurisdiction or ownership responsibility over the former PJCTC, and (3) gathering information and assessing the capability and willingness of identified entities to support implementation of LUCs at the site. In addition, this IA identifies and recommends preliminary LUCs for the site, as discussed in Section 10.

1.0.3 LUCs are mechanisms that protect property owners and the public from hazards on a site by limiting the access or use of a property, or by warning of the potential present hazard. They are implemented to manage residual risk remaining at a site. LUCs may take the form of legal mechanisms, engineering controls, and educational programs. Legal mechanisms are associated with restrictions on the land such as restrictive covenants, zoning, and permitting. Engineering controls either limit the public's access to a site or limit the public's exposure to residual munitions and explosives of concern (MEC) to an acceptable level. Examples of engineering controls include fences, signs, and soil caps. Educational programs focus on educating the public on the hazards associated with a site and appropriate response actions should they encounter a MEC item. Examples of educational programs include formal education seminars and public notices. The overall effectiveness of LUCs at a site depends on the type of controls implemented and the support, involvement, and willingness of local agencies and landowners to enforce and maintain their strict implementation to limit public interaction with MEC.

2.0 Site Background and History

2.0.1 The former PJCTC is located on the northeast end of the island of Oahu, Hawaii. It consists of several non-contiguous parcels within the adjacent Kahana and Punaluu Valleys that total approximately 2,545 acres[1]. The parcels are collectively considered a munitions response site

[1] *Site acreage calculated with Geographical Information System (GIS) is 2,387 acres. The acreages reported in this document and on maps are based on previous reports, unless otherwise noted.*

(MRS). Figure 1 presents the general location of the site within the island of Oahu and the property boundaries within the MRS.

2.0.2 The Kahana Valley parcels are owned by the State of Hawaii and managed by the Department of Land and Natural Resources (DLNR), Division of State Parks. The Kahana Valley parcels are located in the Ahupua‘a ‘O Kahana State Park. The park was established as a “living park” with the primary purpose to nurture and foster native Hawaiian cultural traditions and the cultural landscape of rural windward Oahu. Thirty-one families live within the ahupua’a of Kahana. They assist with interpretive programs that share the Hawaiian values and lifestyle. Additionally, there are public hiking trails, campsites, and hunting areas within the park that intersect with the project site. Permits are required to access the campsites and hunting areas. There are no known plans for future development that deviate from the current usage.

2.0.3 The Punaluu Valley parcels are primarily owned by Kamehameha Schools Bishop Estate (Kamehameha Schools). Kamehameha Schools leases land for agricultural purposes. Several of the smaller parcels are owned by private landowners.

2.0.4 Interior portions of the Punaluu Valley parcels are located in the Hauula Forest Reserve. Residential dwellings are located at the mouth of the valley; however the majority of the accessible land is being used for agricultural purposes. Hunting is allowed in the valley though access is generally restricted to valley residents, guests, and landowner and lease personnel. Kamehameha Schools has developed the Punalu’u Ahupua‘a Plan that identifies 29 projects and programs currently in progress or to be developed in the future. Several have target dates within the next three to five years. Future projects and programs focus on economic and agricultural development, educational programs, cultural support, and environmental management.

2.0.5 The Army established a unit jungle combat training center beginning in September 1943. The Army initially leased 485.25 acres in Kahana Valley in November 1944, retroactive to May 1943. Between 1943 and 1947, the Army acquired an additional 1,781.52 acres in the neighboring Punaluu Valley. The training center was used to teach basic and advanced jungle warfare as well as instructor training. Live ammunition was reportedly utilized during jungle warfare training scenarios. The Army reportedly constructed Japanese villages and pillboxes for training purposes. Temporary barracks, a mess hall, a bakery, and shower facilities were also erected, though no longer exist.

2.0.6 Postwar plans called for closing the majority of the center except for portions within Punaluu Valley to be retained to fulfill the Army’s postwar training requirements. The Army re-opened Punaluu Valley on April 1, 1946 to provide emergency shelter for area residents displaced by a tsunami. Tents were erected for sleeping quarters, to render medical treatment, and to feed approximate 1,700 individuals. De-dudding efforts were conducted in Punaluu Valley in 1949 as a result of live ammunition used during training. Parcels in Kahana Valley were returned to previous landowners in August 1946. The leases, licenses, and permits for parcels in Punaluu

Valley terminated between April 1945 and November 1950 and were reverted back to previous owners.

2.0.7 Previous investigations conducted at the site included the 1993 Inventory Project Report, 2004 Inventory Project Report Supplement, and the 2008 Site Inspection Report. Additionally, in August 2012, munitions items were reported to the Honolulu Police Department (HPD). The HPD responded with the U.S. Army Explosive Ordnance Disposal (EOD) team and disposed of the items through in-place detonation. These investigations as well as the 2012 incident identified the presence of, or the potential presence of, MEC and munitions debris at the PJCTC.

2.0.8 A Remedial Investigation (RI) was conducted at the site between October 2013 and March 2014 and in September 2014. The purpose of the RI was to evaluate the nature and extent of contamination and the associated explosive hazards and risk to humans from MEC and munitions constituents (MC). RI field activities included (1) surface and subsurface investigations to identify the type and quantity of MEC; (2) collection of soil samples to evaluate the concentrations of MCs at the site; and (3) investigation of potential underwater munitions located within the Kahana Stream in two locations. A total of thirty-two MEC items were found in the MRS during the RI:

- Two MEC items, a slap flare and a point detonating (PD) Fuze M46, were found within Kahana Valley during the RI. The fuze was found in lower Kahana Stream and appeared to be unfired and discarded with other unfired small arms.

- Thirty MEC items were found in Punaluu Valley during the RI, and consisted of:

    - a ½-pound 2,4,6-trinitrotoluene (TNT) demolition block
    - 60-millimeter (mm) high explosive (HE) mortars, M49A2
    - 81-mm mortars, M56
    - a Type-88 fuze
    - a MK II hand grenade
    - 2.36-inch rockets, M6A1
    - rifle grenades, M9A1
    - slap flare

2.0.9 The potential exposure pathway to human receptors is through direct contact with MEC present at the ground surface and subsurface. MC were not detected at concentrations exceeding the State of Hawaii Department of Health's Tier 1 environmental action levels in any samples, thus MC are not considered to pose a risk to human health or the environment.

3.0 Methodology

3.0.1 The methodology used to perform this IA included a review of publicly available information on the mission, authority, and jurisdiction of primary government agencies. Information was gathered from each agency's website. Information on agencies was also gathered on the website for Hawaii Administrative Rules (HAR) and Hawaii Revised Statues (HRS). Additionally, the IA included a review of major landowners with property greater than 150 acres within the areas investigated in the RI. The majority of Kahana Valley is owned by the State of Hawaii; the majority of Punaluu Valley is owned by Kamehameha Schools. Based on the review and the selection criteria, as discussed in Section 5, the following primary government stakeholders and one private landowner were identified for PJCTC:

- State of Hawaii Department of Land and Natural Resources (DLNR)
- State of Hawaii Land Use Commission
- City and County of Honolulu, Department of Emergency Management (DEM)
- City and County of Honolulu, Honolulu Fire Department (HFD)
- City and County of Honolulu, Honolulu Police Department (HPD)
- Kamehameha Schools

3.0.2 Telephone interviews were then conducted and questionnaires were sent to the primary government stakeholders and landowners to collect further information on their mission, authority, and jurisdiction and to identify their capabilities to assist with and desire to participate in a LUC program at PJCTC. Section 11 summarizes the telephone and questionnaire interviews.

4.0 Scope of Effort

This IA supports the development of strategies that require the cooperation of state and local agencies. The effort required to complete the IA Report included internet research of, and communication with, government agencies with jurisdiction over PJCTC. Representatives of the agencies with jurisdiction over PJCTC were sent questionnaires to document their concern, capability, and willingness to exercise LUCs over the property. This study documents the results of that research, includes outlines of the agency interviews, and preliminarily identifies recommended LUCs for the site.

5.0 Selection Criteria

5.0.1 State and local agencies were selected for analysis based on their relevance to the LUC process. The following criteria were used in the selection of agencies:

- Have jurisdiction as a public agency
- Have primary concern for ordnance hazards because of ownership or use
- Have a technical capability for access control or behavior modification strategies
- Have authority and capability to assist in implementation and maintenance of LUCs
- Have responsibility for LUC or public safety
- Have capability to conduct public information and education activities
- Expressed an ability and willingness to assist in implementation and maintenance of LUCs

5.0.2 Landowners were selected based on ownership of property greater than 150 acres within the areas investigated in the RI.

6.0 Acceptance of Joint Responsibility

Generally, the stakeholders have agreed to participate in carrying out land use controls to maintain public safety, depending on the level of effort required. The responses are summarized below:

- Kamehameha Schools has expressed willingness to participate in the LUC planning process and potentially with maintenance of LUCs, to the extent that their ownership of the land allows.
- DLNR, managing the land on behalf of the State of Hawaii, has expressed a willingness to participate in the LUC planning process and potentially with maintenance of LUCs, depending on their scope and frequency.
- The State of Hawaii Land Use Commission has declined to participate in land use controls or in an advisory capacity.
- DEM has expressed a willingness to participate in educating the public on MEC recognition and safety.
- HFD and HPD have expressed a willingness to appropriately respond to any potential incidents or calls concerning the site. However, HFD and HPD have explicitly stated that they will not perform MEC recognition and safety training to occupants.

7.0 Technical Capability

Kamehameha Schools are technically capable of implementation and maintenance of LUCs to the extent that their ownership of land allows and in accordance with Kamehameha Schools' policies and procedures. DLNR may be able to assist with the provision of personnel to monitor, repair, and replace LUCs such as signs and informational pamphlets. DEM can provide personnel to educate the public on MEC recognition and safety.

8.0 Intergovernmental Relationships

Interagency cooperation may be required between Kamehameha Schools and DLNR when conducting educational programs as a component of the LUCs at PJCTC. The identified technical capabilities of the remaining primary government stakeholders do not overlap.

9.0 Stability and Funding

9.0.1 The identified primary government stakeholders have a history of continuing performance in their current capacity and are believed to be sufficiently stable for inclusion in the LUC Plan. The primary funding source for maintaining these governmental agencies is through state and county taxes, as well as potential federal grants. The long-term funding to support these institutions is stable.

9.0.2 Kamehameha Schools is also financially stable and has a continuing commitment to steward the lands and natural resources through their endowment. The Punaluu Valley is part of the Kamehameha Schools' Land Assets Division portfolio and sufficient resources are provided by Kamehameha Schools to properly manage its resources.

10.0 Recommendations

10.0.1 Based on this IA, the preliminary LUCs identified below are recommended for PJCTC.

Engineering Controls

- Installing signs along the public hiking trails warning of the presence of MEC and their explosive hazard.
- Installing information stands at the start of hiking trails containing information on the history of the site, the presence and dangers of MEC, safety considerations when using recreational areas at PJCTC, and response actions that should be taken if MEC are identified.

Educational Programs

- Conducting educational awareness training (i.e., participation in public meetings, community events, school outreach events, and homeowner association meetings) for community residents regarding the history of the site, the presence and dangers of MEC, safety considerations when using recreational areas within the PJCTC, and response actions that should be taken if MEC are identified.
- Attaching educational information to hunting permits issued by Kamehameha Schools regarding the potential hazards associated with MEC found in the area and the appropriate response (3Rs – recognize, retreat, and report).

10.0.2 Once the selection of LUCs and agency participation are finalized, a formal LUC Program and a LUC Plan will be developed to document the details of the selected LUCs and each agency's

responsibilities for their administration. The LUC Program and Plan will be made available for public comment on the proposed program and plan.

11.0 Interview Summaries

Agency responses to the IA questionnaires are present below.

11.1 State of Hawaii Department of Land and Natural Resources

The purpose of the DLNR is to "enhance, protect, conserve and manage Hawaii's unique and limited natural, cultural and historic resources held in public trust for current and future generations of visitors and the people of Hawaii nei in partnership with others from the public and private sectors." DLNR manages state-owned lands in ways that will promote the social, environmental, and economic well-being of people in the state of Hawaii and will ensure that these lands are used in accordance with the goals, policies, and plans of the state. DLNR owns and manages most of the land within the Kahana Valley and operates and maintains hiking trails available to the public. The Nakoa Trail is 2.5 miles long and loops through Kahana Valley within the MRS boundaries.

Institutional Analysis 1: Department of Land and Natural Resources

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center State of Hawaii Department of Land and Natural Resources	
Required Field	**Agency Response**
Name of Agency	DLNR
Origin of Institution	State Government
Basis of Authority	Statutory, State Law
• What are the limits of the agency's authority?	Manage and administer the public lands of the State and minerals thereon and all water and coastal areas of the State except the commercial harbor areas of the State, including the soil conservation function, the forests and forest reserves, aquatic life, wildlife resources, state parks, including historic sites, and all activities thereon and therein including, but not limited to, boating, ocean recreation, and coastal areas programs. [§26-15, HRS].

Institutional Analysis 1: Department of Land and Natural Resources (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center State of Hawaii Department of Land and Natural Resources	
Required Field	**Agency Response**
• How much control is exercised by the agency?	Enforcement of applicable sections of the HRS and HAR. A DLNR State Parks representative monitors the park on a daily basis and actively reinforces guidelines through interaction with park users and residents.
• Does the agency have enforcement authority?	Yes. DLNR has the power to issue a civil citation to any person who is charged with having committed a civil resource violation. DLNR is authorized to set, charge, or collect administrative fines or bring legal action to recover administrative fees and cost or payment for damages, or for the cost to correct damages resulting from a violation, per HRS §195-8.
Sunset Provisions	None
Geographic Jurisdiction	All the islands of the Hawaiian Archipelago, except Midway Atoll, together with their appurtenant reefs and territorial waters (The Admission Act, HRS §2). Territorial waters extend 3 miles from each island.
Mission of the Agency	"Enhance, protect, conserve and manage Hawaii's unique and limited natural, cultural and historic resources held in public trust for current and future generations of the people of Hawaii nei, and its visitors, in partnership with others from the public and private sectors."
• Public Safety Function	DLNR participates in aspects of public safety as directed by HAR and HRS, e.g., design and placement of warning signs on public lands. [HAR, Title 13, Subtitle 1, Chapter 8] DLNR's board may establish a reasonable schedule of visiting hours for all or portions of the premises and close or restrict the public use of all or any portion thereof, when necessary for the protection of the area or for the safety and welfare of persons or property, by the posting or appropriate signs indicating the extent and scope of closure.
• LUC Function	DLNR has authority to grant Right of Entry to public land, and is responsible for the management of forests, natural areas, public hunting areas, and plant and wildlife sanctuaries on public lands. DLNR's Division of Conservation and Resources Enforcement has full police powers to enforce all State laws and rules involving State land and its State Parks, historical sites, forest reserves, aquatic life and wildlife areas, coastal zones, Conservation districts, and State shores, as well as county ordinances involving county parks.

Institutional Analysis 1: Department of Land and Natural Resources (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center State of Hawaii Department of Land and Natural Resources	
Required Field	**Agency Response**
• Financial Capability	Funded by the Hawaii State Legislature and through collection of fees, rents, and other income derived from its inventory of lands. Capability to financially support institutional controls is limited to providing staff to assist with occasional maintenance of institutional controls, such as inspection of LUC signs, notifying USACE if signs need to be replaced, and restocking of informational brochures.
Constraints to Institutional Effectiveness	Limited to working within the existing regulatory framework and with available funding.
Known Land Use Restrictions	None
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items • Informational and safety fact sheets and notices attached to construction or land use permits and leases • Issuance and enforcement of zoning laws for land use permits • Issuance and enforcement of land use permits • MEC recognition and safety training involving educating lessees and workers conducting intrusive activities on the site	DLNR is willing to participate in the IA to arrive at solutions that support protection of natural resources and public safety. DLNR may also be willing to assist with occasional maintenance of LUCs, depending on their scope and frequency.

11.2 State of Hawaii Land Use Commission

In 1961, the State of Hawaii Legislature established the Land Use Law, which establishes an overall framework of land use management whereby all lands in the state of Hawaii are classified into one of four Districts: urban, rural, agricultural, and conservation. The State of Hawaii Land Use Commission administers the statewide zoning Land Use Law and is responsible for preserving and protecting Hawaii's lands and encouraging those uses to which lands are best suited.

Institutional Analysis 2: State of Hawaii Land Use Commission

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center State of Hawaii Land Use Commission	
Required Field	**Agency Response**
Name of Agency	State of Hawaii Land Use Commission
Origin of Institution	State Government
Basis of Authority	State Law
• What are the limits of the agency's authority?	The State of Hawaii Land Use Commission has jurisdiction over the four state land use district designations. The State of Hawaii Land Use Commission has the authority to designate and revise land use district boundaries.
• How much control is exercised by the agency?	The State of Hawaii Land Use Commission assigns land use district designations and may revise their boundaries in accordance with HRS §205.
• Does the agency have enforcement authority?	Limited to reclassification of a land use district in response to a violation.
Sunset Provisions	None
Geographic Jurisdiction	State of Hawaii
Mission of the Agency:	Preserving and protecting lands and encouraging those uses to which lands are best suited.
• Public Safety Function	None
• Land Use Control Function	Sets and controls statewide land use district boundaries.
• Financial Capability	None
Constraints to Institutional Effectiveness	Based on agency authority, can only assist as indicated below. Unable to participate in any other LUCs.
Known Land Use Restrictions	None

Institutional Analysis 2: State of Hawaii Land Use Commission (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center State of Hawaii Land Use Commission	
Required Field	**Agency Response**
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items • Informational and safety fact sheets and notices attached to construction or land use permits and leases • Issuance and enforcement of zoning laws for land use permits	No.
• Issuance and enforcement of land use permits • MEC recognition and safety training involving educating lessees and workers conducting intrusive activities on the site	

11.3 City and County of Honolulu, Department of Emergency Management

The DEM coordinates city and county emergency management plans, programs, and initiatives with that of the state, federal, private, and corporate entities. The mission of the DEM is to develop, prepare for, and assist in the implementation of emergency management plans and programs to protect and promote the public health, safety, and welfare of the city during times of disaster or emergency. Disasters, emergencies, threats, or hazards against which DEM direct their efforts include enemy attack; natural disasters such as hurricanes, earthquakes, tsunamis, flooding, high surf, and high winds; man-caused disasters such as aircraft crashes, radiological incidents, marine and inland oil spills, and hazardous material releases; and acts or threats of terrorism, to include terrorist use of weapons of mass destruction. DEM conforms to the standards for local preparedness set forth by the Federal Emergency Management Agency by performing awareness, prevention, mitigation, preparedness, coordinated response and recovery activities, and planning.

Institutional Analysis 3: City and County of Honolulu, Department of Emergency Management

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center City and County of Honolulu, Department of Emergency Management	
Required Field	**Agency Response**
Name of Agency	DEM
Origin of Institution	City and County of Honolulu
Basis of Authority	Statutory
• What are the limits of the agency's authority?	The DEM is established by HRS § 128-13 and § 6-103 of the Revised Charter of the City and County of Honolulu.
• How much control is exercised by the agency?	Limited; no regulatory enforcement authority.
• Does the agency have enforcement authority?	None
Sunset Provisions	Not applicable
Geographic Jurisdiction	City and County of Honolulu, comprising the Island of Oahu and the small islands northwest of Kauai and Niihau extending from Nihoe to Kure (except Midway).
Mission of the Agency:	The department's mission is to plan and prepare for, respond to, and recover from disasters to protect the public's health, safety, and welfare. DEM responds to natural disasters (e.g., hurricanes, earthquakes, tsunamis, flooding, high surf, wild fires, and high winds) and technological disasters (e.g., aircraft crashes, radiological

Institutional Analysis 3: City and County of Honolulu, Department of Emergency Management (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center City and County of Honolulu, Department of Emergency Management	
Required Field	**Agency Response**
Mission of the Agency (continued)	and hazardous material releases, and marine and inland oil spills). DEM oversees the City's Emergency Operations Center, where disaster response and recovery are coordinated. The Emergency Operations Center brings together state and federal government agencies and the private sector.
• Public Safety Function	Plan and prepare for, respond to, and recover from disasters (e.g., natural and technological) to protect the public's health, safety, and welfare.
• Land Use Control Function	Limited (recommendation) unless there is a Governor Declaration of Emergency, in which case land can be used and/or controlled for emergency.
Financial Capability	Limited (no budget for LUC program).
Constraints to Institutional Effectiveness	Smallest department within the City and County of Honolulu (14 member full-time staff) with limited budget.
Known Land Use Restrictions	None
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items • Informational and safety fact sheets and notices attached to construction or land use permits and leases • Issuance and enforcement of zoning laws for land use permits • Issuance and enforcement of land use permits • MEC recognition and safety training involving educating lessees and workers conducting intrusive activities on the site	• DEM is willing to partner and participate in public safety outreach activities such as public awareness and educating the community of the hazards of MEC. • Continued participation in Restoration Advisory Boards to maintain situational awareness and provide input from a city and county and community health, safety, and welfare perspective. • Encourage USACE – Honolulu District to actively participate in the Honolulu Local Emergency Planning Committee as a forum to communicate and collaborate with other hazardous materials safety and security stakeholders. • Facilitate greater situational awareness among City and County of Honolulu departments of the LUC program. Particular focus among public safety processionals of HFD, HPD, and Emergency Services Department.

11.4 City and County of Honolulu, Honolulu Fire Department

The HFD is a firefighting agency with a jurisdiction encompassing the entire island of Oahu. HFD was established in 1851. The mission of HFD is to save lives, protect property, and provide for a safer community through preparation, prevention, and effective emergency response.

Institutional Analysis 4: City and County of Honolulu, Honolulu Fire Department

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center City and County of Honolulu, Honolulu Fire Department	
Required Field	**Agency Response**
Name of Agency	HFD
Origin of Institution	City and County of Honolulu; department was established in 1851.
Basis of Authority	Revised Charter of the City and County of Honolulu, Chapter 10 HRS §132, Revised Ordinances of Honolulu Chapter 20.
• What are the limits of the agency's authority?	Investigation of fires, prevention, inspection, and education.
• How much control is exercised by the agency?	Authority to respond to fires, medical and hazardous materials incidents, and rescues in the City and County of Honolulu.
• Does the agency have enforcement authority?	No
Sunset Provisions	None known
Geographic Jurisdiction	City and County of Honolulu
Mission of the Agency:	Promoting fire prevention and other public safety education program; respond to fires, medical incidents, and hazardous materials incidents and rescues
• Public Safety Function	Promote safety and fire prevention.
• Land Use Control Function	None
Financial Capability	None known
Constraints to Institutional Effectiveness	None known
Known Land Use Restrictions	None known

Institutional Analysis 4: City and County of Honolulu, Honolulu Fire Department (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center City and County of Honolulu, Honolulu Fire Department	
Required Field	**Agency Response**
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items	No
• Informational and safety fact sheets and notices attached to construction or land use permits and leases	No
• Issuance and enforcement of zoning laws for land use permits	No
• Issuance and enforcement of land use permits	No
• MEC recognition and safety training involving educating lessees and workers conducting intrusive activities on the site	No

11.5 City and County of Honolulu, Honolulu Police Department

The HPD is a law enforcement agency with a jurisdiction encompassing the entire island of Oahu. HPD was established in 1932. The mission of HPD is to provide excellent service through partnerships that build trust, reduce crime, create a safe environment, and enhance the quality of life in the community.

Institutional Analysis 5: City and County of Honolulu, Honolulu Police Department

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center City and County of Honolulu, Honolulu Police Department	
Required Field	**Agency Response**
Name of Agency	HPD
Origin of Institution	The HPD was established in 1932 as a county police department for the City and County of Honolulu.
Basis of Authority	Law enforcement agency for the City and County of Honolulu.
• What are the limits of the agency's authority?	The department's jurisdiction encompasses the entire island of Oahu, which has a circumference of about 137 miles and an area of approximately 596 square miles.
• How much control is exercised by the agency?	HPD enforces the laws and ordinances established by the Hawaii Revised Statues and Revised Ordinances of the City and County of Honolulu.
• Does the agency have enforcement authority?	Yes. HPD enforces the laws and ordinances established by the Hawaii Revised Statues and Revised Ordinances of the City and County of Honolulu.
Sunset Provisions	None.
Geographic Jurisdiction	The department's jurisdiction encompasses the entire island of Oahu, which has a circumference of about 137 miles and an area of approximately 596 square miles.
Mission of the Agency	Public Safety. Mission statement: "We the men and women of the Honolulu Police Department are dedicated to providing excellent service through partnerships that build trust, reduce crime, create a safe environment, and enhance the quality of life in our community." We are committed to the principles of integrity, respect, and fairness.

Institutional Analysis 5: City and County of Honolulu, Honolulu Police Department (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center City and County of Honolulu, Honolulu Police Department	
Required Field	**Agency Response**
• Public Safety Function	• Preservation of public peace • Protection of the rights of persons and property • Prevention of crime • Detection and arrest of offenders • Enforcement of all state laws and city ordinances • Service of processes and notices in civil and criminal proceedings
• Land Use Control Function	HPD enforces the laws and ordinances established by the Hawaii Revised Statues and Revised Ordinances of the City and County of Honolulu.
Financial Capability	Financed by the City and County of Honolulu
Constraints to Institutional Effectiveness	No federal jurisdiction unless deputized by federal agency.
Known Land Use Restrictions	None
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items • Informational and safety fact sheets and notices attached to construction or land use permits and leases • Issuance and enforcement of zoning laws for land use permits • Issuance and enforcement of land use permits • MEC recognition and safety training involving educating lessees and workers conducting intrusive activities on the site	HPD will respond to calls for assistance if an MEC is discovered, military EOD will be notified for recovery if it is identified as military ordnance. Contractors should adhere to their contracts if it states they are responsible for having EOD specialists on site during any site inspection or remediation.

11.6 Kamehameha Schools – Major Land Owner

Kamehameha Schools is a privately-held real estate Trust operating in Honolulu, Hawaii. It was founded in 1883.

Institutional Analysis 6: Kamehameha Schools, Major Land Owner

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center Kamehameha Schools – Major Land Owner	
Required Field	**Agency Response**
Name of Agency	Kamehameha Schools
Origin of Institution	Privately held Trust
Basis of Authority	Land Owner
• What are the limits of the agency's authority?	Owner of approximately 3,600 acres of agricultural, residential, and conservation land in Punaluu Valley
• How much control is exercised by the agency?	All controls allowed in accordance with fee simple land ownership, the Land Use Ordinance, State and County Zoning and Codes.
• Does the agency have enforcement authority?	Yes.
Sunset Provisions	None.
Geographic Jurisdiction	Tax Map Keys (TMKs) 153011001, 153003001, 153007023, 153004007, and 153004018.
Mission of the Agency	Mission statement: "To fulfill Bernice Pauahi Bishop's desire to create educational opportunities in perpetuity to improve the capability and well-being of people of Hawaiian ancestry."
• Public Safety Function	None.
• Land Use Control Function	Respondent was unsure of Kamehameha Schools' responsibility to institute/enforce land use controls. Their participation is limited to the extent that their ownership of land allows and in accordance with Kamehameha Schools' policies and procedures
Financial Capability	Privately held Trust.
Constraints to Institutional Effectiveness	Respondent was unsure of Kamehameha Schools' involvement and therefore unclear on what their constraints to institutional effectiveness would be. As stated above, Kamehameha Schools' participation is limited to the extent that their ownership of land allows and in accordance with Kamehameha Schools' policies and procedures

Institutional Analysis 6: Kamehameha Schools, Major Land Owner (continued)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center Kamehameha Schools – Major Land Owner	
Required Field	**Agency Response**
Known Land Use Restrictions	Agricultural and Conservation
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items • Informational and safety fact sheets and notices attached to construction or land use permits and leases • Issuance and enforcement of zoning laws for land use permits • Issuance and enforcement of land use permits • MEC recognition and safety training involving educating lessees and workers conducting intrusive activities on the site	Yes, to the extent that our ownership of land allows, and in accordance with Kamehameha Schools' policies and procedures.

12.0 References

Huikala, 2015, *Draft Remedial Investigation Report, Pacific Jungle Combat Training Center, Oahu, Hawaii*. April.

USACE, 2000. *EP 1110-1-24, Engineering and Design - Establishing and Maintaining Institutional Controls for Ordnance and Explosives (OE) Projects*. December.

Appendix A Figures

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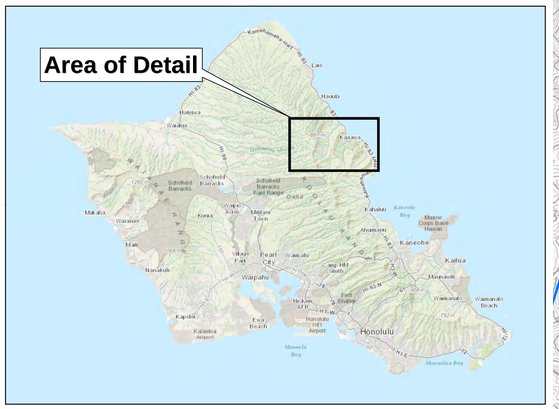

Bishop Trust Estate (Kamehameha Schools) 53004018

Bishop Trust Estate (Kamehameha Schools) 53007023

Bishop Trust Estate (Kamehameha Schools) 53011001

Bishop Trust Estate (Kamehameha Schools) 53003001

Bishop Trust Estate (Kamehameha Schools) 53003001

Bishop Trust Estate (Kamehameha Schools) 53011008

Bishop Trust Estate (Kamehameha Schools) 53011001

Ahupua'a 'O Kahana State Park Orientation Center

State of Hawaii (DLNR) 52002001

Road

Nakoa Trail

LEGEND:

- Approximate Location of 22" - 24" Water Line
- Agriculture Production Area / Land Conservation Plan
- Agriculture Expansion Area
- Approximate FUDS Property and Maneuver Area Boundary
- Tax Map Key (TMK) Parcel Boundary
- Bishop Trust Estate (Kamehameha Schools) 53003001 — Parcel Owner/Lessee, Parcel ID Number

Notes

DLNR = Department of Land and Natural Resources

Coordinate System: Universal Transverse Mercator NAD83, Zone 4 North

Sources: U.S. Geological Survey; U.S. Army Corps of Engineers; City and County of Honolulu, Department of Planning and Permitting (gis.hicentral.com); State of Hawaii Department of Land and Natural Resources (www.hawaiistateparks.org)

References:

1. "Final Site Inspection Report, Pacific Jungle Combat Training Center," December 2008, prepared by Parsons.
2. "DERP-FUDS Inventory Project Report Pacific Jungle Combat Training Center, Kahana and Punaluu Valleys, Island of Oahu, Hawaii, Site No. H09HI027400," prepared by Wil Chee Planning, December 1993.

N

0 4,000

SCALE: 1" = 1,200'

PROJECT: Pacific Jungle Combat Training Center FUDS Project No. H09HI027401	**PROPERTY BOUNDARY MAP**			
LOCATION: City and County of Honolulu, Hawaii	DRAWN BY: LCV 11/12/2014	CHECKED BY: CAL 11/12/2014	PROJECT NO. 2012-128	FIG NO. **1**

Appendix B Institutional Analysis Questionnaire Responses

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Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center	
Required Field	**Agency Response**
Name of Agency	Department of Emergency Management
Origin of Institution	City and County of Honolulu
Basis of Authority	
▪ What are the limits of the agency's authority?	The Department of Emergency Management (DEM) is established by Section 128-13, Hawaii Revised Statutes, and Section 6-103, Revised Charter of the City and County of Honolulu.
▪ How much control is exercised by the agency?	Limited, no regulatory enforcement authority
▪ Does the agency have enforcement authority?	None
Sunset Provisions	N/A
Geographic Jurisdiction	City and County of Honolulu – comprised of the Island of Oahu and the small islands northwest of Kauai and Niihau extending from Nihoe to Kure except Midway.
Mission of the Agency:	The department's mission is to plan and prepare for, respond to, and recover from disasters to protect the public's health, safety and welfare. DEM responds to natural disasters (e.g. hurricanes, earthquakes, tsunamis, flooding, high surf, wild fires and high winds) and man-caused disasters (e.g. aircraft crashes, radiological and hazardous material releases, and marine and inland oil spills). DEM oversees the City's Emergency Operations Center (EOC) where disaster response and recovery are coordinated. The EOC brings together state and federal government agencies and the private sector.
▪ Public Safety Function	Plan and prepare for, respond to, and recover from disasters (e.g. natural and man-caused) to protect the public's health, safety and welfare.
▪ Land Use Control Function	Limited (recommendation) unless there is a Governor Declaration of Emergency, in which case land can be used/controlled for emergency
Financial Capability	Limited (no budget for LUC program)
Constraints to Institutional Effectiveness	Smallest department within the City and County of Honolulu (14 member full-time staff) with limited budget.
Known Land Use Restrictions	Limited (recommendation)

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center (continued)	
Required Field	**Agency Response**
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items; • Informational and safety fact sheets/ notices attached to construction or land-use permits, leases; • Issuance and enforcement of zoning laws for land use permits; • Issuance and enforcement of land use permits; and, • MEC recognition and safety training involving educating occupants conducting intrusive activities on the site.	• DEM is willing to partner and participate in public safety outreach activities such as public awareness and educating the community of the hazards of MEC. • Continued participation in Restoration Advisory Boards (RAB) to maintain situational awareness and provide input from a city and county, community health, safety, and welfare perspective. • Encourage USACE – Honolulu District to actively participate in the Honolulu Local Emergency Planning Committee (LEPC) as a forum to communicate and collaborate with other "hazardous materials" safety and security stakeholders. • Facilitate greater situational awareness among City and County of Honolulu departments of the LUC program. Particular focus among public safety professionals of the Honolulu Fire Department (HFD), Honolulu Police Department (HPD), and Emergency Services Department (ESD).

If you have any questions or concerns please contact Cindy Liu at cliu@huikala.com or at (808) 533-6000.

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center

Name of Agency – Honolulu Police Department

Origin of Institution - The Honolulu Police Department (HPD) was established in 1932. The city of Honolulu is located on the island of Oahu and is also the capitol city of the State of Hawaii.

Basis of Authority: Law enforcement agency for the City and County of Honolulu.

What are the limits of the agency's authority?
The department's jurisdiction encompasses the entire island of Oahu, which has a circumference of about 137 miles and an area of approximately 596 square miles.

How much control is exercised by the agency?
HPD enforces the laws and ordinances established by the Hawaii Revised Statues and Revised Ordinances of the City and County of Honolulu.

Does the agency have enforcement authority?
Yes. HPD enforces the laws and ordinances established by the Hawaii Revised Statues and Revised Ordinances of the City and County of Honolulu.

Sunset Provisions? None.

Geographic Jurisdiction. The department's jurisdiction encompasses the entire island of Oahu, which has a circumference of about 137 miles and an area of approximately 596 square miles.

Mission of the Agency: Public Safety.

Public Safety Function – Primary law enforcement agency for the City and County of Honolulu.

Land Use Control Function – HPD enforces the laws and ordinances established by the Hawaii Revised Statues and Revised Ordinances of the City and County of Honolulu.

Financial Capability – Financed by the City and County of Honolulu

Constraints to Institutional Effectiveness – No federal jurisdiction unless deputized by federal agency.

Known Land Use Restrictions – None

Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs:

- Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items.
    - HPD will respond to calls for assistance if an MEC is discovered, military EOD will be notified for recovery if it is identified as military ordnance. Contractors should adhere to their contracts if it states they are responsible for having EOD specialists on site during any site inspection or remediation.

- Informational and safety fact sheets/notices attached to construction or land use permits, leases;
    - HPD does not perform these duties.
- Issuance and enforcement of zoning laws for land use permits;
    - HPD does not perform these duties.
- Issuance and enforcement of land use permits;
    - HPD will only enforce trespassing and property crime laws as stated within the Hawaii Revised Statutes
- MEC recognition and safety training involving educating occupants conducting intrusive activities on the site.
    - HPD does not perform these duties.
    - HPD will only enforce trespassing and property crime laws as stated within the Hawaii Revised Statutes

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

June 16, 2014

Environmental Programs Branch
Programs and Project Management Division

Mr. Joey Char
Land Asset Manager
Kamehameha Schools
567 South King Street, Suite 200
Honolulu, Hawaii 96813
(*via electronic mail: jochar@ksbe.edu*)

Subject: Institutional Analysis
Remedial Investigation/Feasibility Study at the former Pacific Jungle Combat Training Center
Oahu, Hawaii

Dear Mr. Char:

The U.S. Army Corps of Engineers (USACE) – Honolulu District (CEPOH) and U.S. Army Engineering and Support Center, Huntsville (USAESCH) is soliciting your response to an institutional analysis questionnaire that will be used during the evaluation of remedial alternatives at the former Pacific Jungle Combat Training Center (PJCTC) Formerly Used Defense Site (FUDS) located in Oahu.

Huikala was contracted by the USAESCH to perform a Remedial Investigation and Feasibility Study (RI/FS) at the PJCTC. As part of the RI/FS process, an institutional analysis is performed. The institutional analysis is conducted to (1) identify the opportunities that exist to implement a land use control (LUC) program at the PJCTC; (2) identify government agencies and landowners with jurisdiction or ownership responsibility over lands containing munitions and explosives of concern (MEC); and (3) assess the appropriateness, capability, and willingness of government agencies and landowners to assert their control over lands with MEC hazards.

FS alternatives that include LUCs must be coordinated with the current landowners, regulatory agencies, and appropriate local authorities. A list of potentially appropriate LUCs for this site is listed below under "Remedial Investigation Results and Feasibility Study." In order to best assess those alternatives, CEPOH is performing an institutional analysis to determine landowner/agency acceptance, willingness, and capability to implement any of these (or other) proposed LUC options. The Corps is respectfully requesting your input for this institutional analysis.

LUCs are physical, legal, or administrative mechanisms that restrict the use of, or limit access to, contaminated property to reduce risk to human health and the environment. Physical mechanisms encompass a variety of engineered remedies to contain or reduce contamination and physical barriers to limit access to a property, such as fencing or signs. Legal mechanisms include restrictive covenants, negative easements, equitable servitudes, and deed notices. Administrative mechanisms include notices, adopted local land use plans and ordinances, construction permitting, or other existing land use management systems that may be used to ensure compliance with use restrictions.

As a landowner, Kamehameha Schools has been identified as a primary stakeholder with which CEPOH should coordinate to implement LUCs at the PJCTC. The purpose of this letter is to collect agency-specific data needed as part of the institutional analysis to support the development of a LUC program as an effective response action alternative for the PJCTC.

Background

The PJCTC FUDS consists of several non-contiguous parcels within the adjacent Kahana and Punaluu Valleys that total approximately 2,545 acres and includes a single Munitions Response Area (MRA) and Munitions Response Site (MRS) designated with the same name and boundaries. An MRA is an area on a defense site that is known or suspected to contain MEC, including unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC). An MRA may be composed of a single MRS or subdivided into multiple MRSs each representing discrete locations that require a munitions response.

The PJCTC was established in September 1943 and was used for basic and advanced jungle warfare and instructor training. During previous investigations, small arms and munitions debris (MD) (e.g., 0.30-caliber bullets and casings and expended M1 and M2 cartridges) and MEC items (e.g., 75-mm high explosive projectile, and 81-mm mortar) were observed at the MRS.

Kahana and Punaluu Valleys are mostly undeveloped, rugged, and densely-forested land with mixed residential, agricultural, and recreational uses. Recreational uses include hiking, camping, and hunting. The Kahana Valley parcels are owned by the State of Hawaii and managed by the DNLR, Division of State Parks. The Kahana Valley parcels are located in the Ahupuaʻa ʻo Kahana State Park and are used as a "living park" for families with the primary purpose to nurture and foster native Hawaiian cultural traditions and the cultural landscape of rural windward Oahu. No changes to land use are anticipated for Kahana Valley. The Punaluu Valley parcels are primarily owned by Kamehameha Schools Bishop Estate. The Punaluu Valley parcels are located in the Hauula Forest Reserve and are mainly used for agricultural purposes. Future land uses for Punaluu Valley include projects and programs that focus on economic and agricultural development, educational programs, cultural support, and environmental management.

Project Objectives

The final objective of the project is to reduce the explosive hazard posed by MEC and the chemical hazards posed by MCs to humans and the environment. This objective will be met through a combination of LUCs, removal/remediation (if necessary), and public education to render the MRA as safe as reasonably possible for humans and the environment. All objective activities will be based on the current and anticipated future land uses.

Remedial Investigation Results and Feasibility Study

The USACE, as the Department of Defense Executive Agent for the Defense Environmental Restoration Program – Formerly Used Defense Sites (DERP-FUDS), conducted a Remedial Investigation (RI) in Winter 2013. The purpose of the RI was to determine the nature and extent, and associated risk, from MEC and MCs. RI field activities included (1) surface and subsurface investigations to determine the type and quantity of MEC and (2) environmental sampling to determine the concentration of MCs in soil at the site.

The RI was conducted between October 2013 and March 2014. In total, 32 miles of transects (equal to 12.3 acres) and 51 grid areas (equal to 7.83 acres) were surveyed. In addition, 54 soil samples were collected from 22 locations and evaluated for the presence of MC. Thirty MEC items were found during the RI surveys (i.e., ten M6A1 2.36-inch rockets, six 60-mm mortars, six 81-mm mortars, four M9A1 rifle grenades, two M12A1 slap flares, one Type 88 fuze, and one MK II hand grenade). The potential exposure pathway to human receptors is through direct contact with MEC present at the ground surface and subsurface. MC concentrations were not

detected above the Hawaii Department of Health Tier 1 Environmental Action Levels in any sample and therefore MC are not considered to pose a risk to human health or the environment.

The RI Report is currently in draft and will be followed by a Feasibility Study (FS) Report that uses the findings of the RI to evaluate alternatives for remedial response to mitigate potential residual risk. Potential alternatives that are anticipated to be evaluated in the FS include LUCs. LUCs considered potentially appropriate for this site include:

- Installation and maintenance of signs warning individuals of potential risks and response actions if they were to encounter suspected MEC items;
- Informational and safety fact sheets/notices attached to construction permits;
- Issuance and enforcement of zoning laws for land use permits;
- Issuance and enforcement of land use permits; and,
- MEC recognition and safety training involving educating landowners and workers conducting intrusive activities on the site.

Requested Agency Information

Huikala is conducting the institutional analysis on behalf of CEPOH. Enclosed with this letter is a brief questionnaire that will be used to determine your willingness to participate in institutional control alternatives at this site, should they be selected in the FS. Your participation is important to the successful evaluation of instructional control alternatives as an appropriate response to mitigate any potential risks at this site.

Please review all fields and provide your responses to Cindy Liu via electronic mail to cliu@huikala.com or directly at (808) 533-6000. We are also available to meet with you in person to review the questions and record your responses.

We respectfully request your response and completed questionnaire no later than July 16, 2014.

We appreciate your cooperation with this analysis and look forward to receiving your responses. Please contact Mr. Kevin Pien, USACE Project Manager at (808) 835-4091 if you have any questions or would like further information.

Thank you for your participation in this matter.

Sincerely,

Kevin Pien
CEPOH Project Manager
Environmental Programs Branch

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File

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center	
Required Field	**Agency Response**
Name of Agency	Kamehameha Schools
Origin of Institution	Privately held Trust
Basis of Authority	Land owner
▪ What are the limits of the agency's authority?	Owner of approximately 3,600 acres of agricultural, residential and conservation land in Punalu`u Valley
▪ How much control is exercised by the agency?	All controls allowed in accordance with fee simple land ownership, the Land Use Ordinance, State & County Zoning and Codes.
▪ Does the agency have enforcement authority?	Yes.
Sunset Provisions	None
Geographic Jurisdiction	TMKs:153011001;153003001;153007023;153004007;153004018
Mission of the Agency:	To fulfill Bernice Pauahi Bishop's desire to create educational opportunities in perpetuity to improve the capability and well-being of people of Hawaiian ancestry.
▪ Public Safety Function	N/A
▪ Land Use Control Function	Not sure what this means
Financial Capability	Privately held Trust
Constraints to Institutional Effectiveness	Not sure what this means
Known Land Use Restrictions	Agriculture and Conservation

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center (continued)	
Required Field	**Agency Response**
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items; • Informational and safety fact sheets/ notices attached to construction or land-use permits, leases; • Issuance and enforcement of zoning laws for land use permits; • Issuance and enforcement of land use permits; and, • MEC recognition and safety training involving educating occupants conducting intrusive activities on the site.	Yes, to the extent that our ownership of land allows, and in accordance with Kamehameha Schools' policies and procedures.

If you have any questions or concerns please contact Cindy Liu at cliu@huikala.com or at (808) 533-6000.

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center	
Required Field	**Agency Response**
Name of Agency	State of Hawaii Land Use Commission
Origin of Institution	Chapter 205 HRS promulgated by state legislature
Basis of Authority	Chapter 205 HRS
▪ What are the limits of the agency's authority?	Land use Boundary amendments
▪ How much control is exercised by the agency?	n/a
▪ Does the agency have enforcement authority?	NO
Sunset Provisions	none
Geographic Jurisdiction	State of Hawaii
Mission of the Agency:	See Chapter 205 HRS
▪ Public Safety Function	none
▪ Land Use Control Function	Large Scale Classification
Financial Capability	None
Constraints to Institutional Effectiveness	n/a
Known Land Use Restrictions	n/a

Institutional Analysis Questionnaire – Former Pacific Jungle Combat Training Center (continued)	
Required Field	**Agency Response**
Is your agency able or willing to participate in the implementation and/or maintenance of the following LUCs: • Installation and maintenance of signs warning individuals of potential risks and response actions if they encounter suspected MEC items; • Informational and safety fact sheets/ notices attached to construction or land-use permits, leases; • Issuance and enforcement of zoning laws for land use permits; • Issuance and enforcement of land use permits; and, • MEC recognition and safety training involving educating occupants conducting intrusive activities on the site.	NO

If you have any questions or concerns please contact Cindy Liu at cliu@huikala.com or at (808) 533-6000.