Draft Environmental Assessment

High-Altitude Mountainous Environment Training

July 2011

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ENVIRONMENTAL ASSESSMENT FOR HIGH-ALTITUDE MOUNTAINOUS ENVIRONMENT TRAINING (HAMET)

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EXECUTIVE SUMMARY

The U. S. Army Garrison-Hawaiʻi (USAG-HI) prepared this environmental assessment (EA) to publicly disclose the results of an environmental impact analysis of High-Altitude Mountainous Environment Training (HAMET) for the 25th Combat Aviation Brigade (CAB), Hawaiʻi. If approved, HAMET would train 90 helicopter pilots and crew for high-altitude missions in preparation for deployment to Afghanistan and to satisfy mandated annual training requirements.

The need for well-prepared aviation brigades to conduct combat operations in Afghanistan led the U.S. Army Forces Command to prioritize the development of standardized training for high-altitude (up to 14,000 ft [4,267 m]) mountainous conditions. HAMET was developed to ready experienced helicopter pilots for success in combat operations as part of their train-up for deployment under Operation Enduring Freedom. HAMET adapts the National Guard's school for individual mountain helicopter training taught at the National Guard's High-Altitude Aviation Training Site in Gypsum, Colorado, with helicopter training that individual Army CABs have been conducting as part of their regular training operations for the past several years.

Six alternatives are evaluated in this EA:

1. The Preferred Alternative: HAMET flights conducted from Bradshaw Army Airfield at Pōhakuloa Training Area (PTA) to three existing Mauna Kea landing zones (LZs) and three existing Mauna Loa LZs. Under this alternative the training outside the Army training area is estimated to take 2 hours for each pilot to complete, requiring no more than 180 flight hours. This training would be conducted during October 2011.

   The existing LZs proposed for use lie on State of Hawaiʻi lands. To use these LZs, the USAG- HI will seek a right of entry (ROE) document from the DNLR Board for permission to land the helicopters on State land." The completed EA and its decision documents will accompany the Army's right of entry request to the Board.

   The Board reviews the information and may approve the request without comment or may approve the request with additional conditions to those already presented in the EA and decision document. A ROE document is the instrument by which the State of Hawaiʻi can regulate USAG-HI's use of Mauna Kea and Mauna Loa.

2. Mauna Kea Alternative: HAMET would be conducted from PTA and Bradshaw Army Airfield to three existing Mauna Kea LZs (i.e., the same LZs and processes identified under the Preferred Alternative).

3. Mauna Loa Alternative: HAMET flights would be conducted from PTA and Bradshaw Army Airfield to three existing Mauna Loa LZs (i.e., the same LZs and processes identified under the Preferred Alternative).

4. Other High-Altitude Locations in the State of Hawaiʻi Alternative.

5. Other High-Altitude Training Sites on the Continental United States (CONUS) Alternative.

6. No Action Alternative.

Under these alternatives, 90 experienced helicopter aviators of the 25th CAB would be trained for mountainous, high-altitude flights. Pilots would fly at high altitudes and land at designated high-altitude

LZs using varying angles of approach, headings, and air speeds to reach proficiency in tasks such as, but not limited to, visual-meteorological-conditions takeoff and approach, reconnaissance over high-altitude LZs, slope operations, and night-time operations. For Hawaiʻi Action Alternatives, pilots would be trained using the UH-60 Black Hawk and the CH-47 Chinook aircraft. All aircraft would be unarmed (i.e., no pyrotechnic devices, ordinance, etc.). Training conducted under non-Hawaiʻi alternatives could use additional aircraft types, as available at the specific training facility.

The No-Action Alternative would result in no HAMET being conducted and the aviators not being properly trained prior to deployment to Afghanistan. The No Action Alternative would be impracticable, undesirable and costly when trying to capture the training needs of new pilots assigned to the CAB during this time and those pilots who need to conduct additional training to meet the advanced requirement. Familiarity with this specialized high altitude environment is critical to save the lives of our 25th CAB aircrews and the Soldiers they transport when operating in support of Operation Enduring Freedom in Afghanistan.

Alternative 4, Other High-Altitude Locations (elevations above 8,000 ft [2,438 m]) in the State of Hawaiʻi, including other federal lands on Mauna Loa and lands on the island of Maui, was not considered further because of the following:

- Wilderness areas, including the federal lands on Mauna Loa and surrounding the summit in Haleakalā National Park, cannot be used for motorized vehicles

- Federal lands on Maui are designated National Park Service (NPS) wilderness areas and require aviators to avoid overflights below 2,000 ft (610 m)

- Other areas on the island of Maui best suited for HAMET flights would require sharing airspace with hang gliders, paragliders, and other types of unregulated sport flyers considered incompatible with military helicopters and extremely unsafe

- HAMET operations would require the use of Kahului Airport, a civilian facility requiring permissions and extensive coordination with airfield management, which would push the timeline for HAMET operations past the October 2011 target start date.

Alternative 5, Other High-Altitude Training Sites, was not considered further because of the following:

- The decrease in dwell time that would result from mainland training in light of upcoming overseas deployment

- Estimated to cost approximately $2M to send pilots and keep aircraft and maintenance crews on the mainland longer.

- The excess time the logistical challenges would require that could risk the CAB's ability to be trained prior to deployment

- The high cost and time associated with transporting soldiers, keeping aircraft, and support staff on the mainland and the disruption of other deployment-required training in Hawaiʻi that mainland HAMET could incur.

After conducting its evaluation, the USAG-HI determined that Alternatives 1, 2, and 3 satisfied the purpose and need, and those alternatives were further evaluated in this EA. As required by the National

Environmental Policy Act, the No Action Alternative, although considered unreasonable because it does not meet the purpose or need, is also evaluated further in this EA.

Impact of Action Alternatives

The Action Alternatives were evaluated with respect to their potential effects to the valued environmental components, which include climate, air quality, geology and soils, water resources, biological resources, cultural resources, socioeconomics and environmental justice, land use, recreation, noise, visual and aesthetic resources, human health and safety, traffic and circulation, and public services and utilities.

Climate

Impacts to local and regional climate conditions were evaluated, and it was determined that impacts to climate are not anticipated under the Action Alternatives. The climate at the proposed LZs, and the island of Hawaiʻi overall, would remain cool and tropical (upper montane to alpine), with no impacts on average temperatures, rainfall, or wind patterns.

Air Quality

Particulate Matter 10 (PM_{10}) emissions resulting from helicopter rotor wash on the LZs were evaluated along with pollutants emitted from the aircraft. Impacts to air quality under the Action Alternatives are anticipated to be less than significant. Based on modeling, the impact of fugitive dust from helicopter activity on either Mauna Loa or Mauna Kea LZ areas would be less than significant. The maximum concentration at 1,093 yd (1,000 m) away from the center of the LZ(s) is less than 17.98 $\mu g/m^3$, which is below the state and U.S. Environmental Protection Agency (EPA) emission standards.

The Army concludes that the cumulative air quality impacts on ozone or other secondary pollutants would be less than significant under the Action Alternatives, and that these Action Alternatives, when considered in combination with other past, present, and reasonably foreseeable future actions, would not be cumulatively significant.

Geology, Topography, and Soils

Adverse impacts to existing geologic conditions, including soil loss, sedimentation, and exposures to people or structures from geologic hazards, were evaluated. Impacts to geology and soils are not anticipated under the Action Alternatives. There would be no impact to geology or topography, because no construction to the LZs would be required. The soils present may be compacted or crushed by the weight of the helicopter. However, the soils are very resilient to wind forces, and fugitive dust has been modeled to be below state and EPA emission standards. The Army concludes that the Action Alternatives do not contribute to slope-stability or geology-disturbing direct or cumulative impacts and contribute only negligibly to cumulative soil disturbance, because existing LZs would be used.

Water Resources

Degradation of water quality, impacts on availability, and compliance with water quality standards were evaluated. Based on this evaluation, impacts to water resources are anticipated to be less than significant under the Action Alternatives. No impacts to surface water are expected as a result of the Alternative Actions, because there are no perennial streams or other surface water resources that could potentially be affected. The only potential, but unlikely, impact to groundwater would be contamination of an aquifer through an unlikely spill. Based on depth and geological formations the spill constituents are not anticipated to reach an aquifer. Additionally, Army helicopters have self-sealing primary and auxiliary fuel systems for rotary winged aircraft to reduce the possibility of leakage, fire and explosion during impact. When considered in combination with other past, present, and reasonably foreseeable future actions, would not result in significant cumulative impacts.

Biological Resources

Physical (pedestrian) surveys were conducted for each of the LZs to identify biological resources that could be potentially impacted by HAMET operations. The potential for impacts to endangered and threatened species, other species of concern, or habitat in general, are anticipated to be less than significant. No plant species of concern were identified within the operational areas of the LZs. Moreover, vegetation within the operational areas of LZs is extremely sparse to absent. Habitat use by faunal species of concern within the LZ operational areas was determined to be minimal, extremely limited, or transitory. Along the projected flight paths, no impact is anticipated to any species concern. Measures in place to reduce the impacts from invasive species and noise are expected to result in, as a whole; impacts to biological resources that are less than significant.

Cultural Resources

Through discussions with subject matter experts and after performing reconnaissance-level surveys at each LZ on Mauna Loa and Mauna Kea, it was determined that there are no historic properties within any of the LZs. Several features were identified near but outside the LZs. There was nothing associated with these features to indicate either date of construction or function. However, it was determined that these resources would not be impacted as a result of HAMET.

Mauna Kea is of cultural significance to Native Hawaiians as an ancestor and as a place to communicate with the gods. The Army has concluded that the cumulative impacts associated with the Action Alternatives would be less than significant on cultural resources, and that these alternatives, when considered in combination with other past, present, and reasonably foreseeable future actions, would not be significant, because access would not be restricted, flights would avoid known cultural resources, noise modeling showed insignificant impacts, the inherent cultural values associated with Mauna Kea would not be compromised, the presence of the helicopters would be temporary and of relatively short duration, and the proposed LZs have no historic properties to alter or destroy. The flight paths that were chosen under the alternatives were designed to minimize the area of over flight and avoid the vast majority of known cultural properties on both mountains.

Socioeconomics and Environmental Justice

The potential impacts to unemployment rate, changes in total income, business volume along with the impacts on local housing markets were evaluated. Disproportionate affects to any social, economic, physical, environmental, or low-income or minority groups or children were analyzed. Impacts to sociological resources, economic resources, environmental justice, and environmental health effects on children are not anticipated under the Action Alternatives. The alternatives would not alter the current state of the current conditions.

Land Use

Impacts to land use are not anticipated under the Action Alternatives. Basic land use would not change with the Action Alternatives. The Proposed Action does not involve acquiring land or rezoning land for use. As such, the Proposed Action and the use of the LZs would not result in any changes in current or planned land uses or zonings and thus would not cumulatively impact land use.

Recreation

Impacts to recreation are not anticipated under the Action Alternatives. Overflights may be perceived as a slight noise and visual distraction by people in the immediate area of any of the Action Alternatives, but HAMET would not significantly impact or result in the cessation of any recreational activities or access to them, including Mauna Loa Observatory Access Road, Saddle Road, and Mauna Kea Summit Access Road. The Action Alternatives also do not alter use of land for recreation and thus do not cumulatively impact recreation.

Noise

Impacts from noise on humans are not anticipated under the Action Alternatives. Noise modeling was performed to determine day-night averages associated with the proposed helicopter training. In addition, noise sampling was conducted for areas of potential concern to recreationists, cultural practitioners, and biological resources. The anticipated noise levels are acceptable for current land uses in these areas. The noise sampling results did not measure maximum decibel level discernable above background levels for areas of concern to cultural practitioners or recreationists. Levels measured within the flight plan did not show levels of concern for biological resources. The noise could impact sensitive species by causing the wildlife to flee the area and interrupting life-cycle events like breeding; however, it was determined that wildlife activities return to normal when the disturbance is over, and wildlife often adapt to frequent noise. Design features of the alternatives (e.g., flight-corridor and minimum-elevation requirements through the flight corridor) also result in less-than-significant impacts.

While noise sensitivity is species specific and varies among individuals within each species, average noise levels for the combination of any of the Action Alternatives with existing and future noise sources are unlikely to cause excessive disruption or annoyance in noise-sensitive locations. Thus, the Army concludes that the cumulative noise impacts associated with implementing any of the Action Alternatives would be negligible.

Visual and Aesthetic Resources

Sixteen representative view points were selected based on what were considered sensitive to cultural practitioners, sight seers, and residents. Spatial analysis was used to determine the potential that people at these locations could see a helicopter. Impacts to visual and aesthetic resources are anticipated to be less than significant under the Action Alternatives. The visual sensitivity associated with HAMET would have less-than-significant impacts, because the areas are not identified as areas of high scenic quality and are not readily accessible to, or used by, large numbers of people. HAMET flights would be unlikely to obstruct one’s view of natural beauty sites within the Hamakua and North Hilo planning districts. In addition, air-quality impacts to visibility are less than significant, intermittent, and of short duration and, in combination with other past, present, and reasonably foreseeable future actions, would not be cumulatively significant.

Human Health and Safety Hazards

Impacts to human health and safety are anticipated to be of no impact for hazardous materials under the Action Alternatives. A less-than-significant determination was made for the remote possibility of a crash that results in wildfire in vegetation that could sustain a wildfire. There is no such habitat at the LZs. A less-than-significant determination was made for LZ safety, because it is possible, but highly unlikely, for the public to be in the vicinity of operations. A less-than-significant determination was made for accident/incident investigation and recovery because of the CAB's safety record and the low potential for future accidents.

Traffic and Circulation

Impacts to traffic and circulation are anticipated to be less than significant under the Action Alternatives. Impacts to air traffic would be less than significant because of the small volume of commercial and recreational air traffic involved and the ability for recreational pilots to be redirected temporarily through air traffic control and use of the Common Traffic Advisory Frequency in response to HAMET missions. During periods of HAMET activity, the incremental increase in air traffic by HAMET is 3% over current levels. This increase is not considered cumulatively significant.

Public Services and Utilities

Impacts to public services and utilities are not anticipated under the Action Alternatives. Activities at the LZs would not require public services or utilities. While HAMET could marginally increase the demand for public services at PTA, current services are adequate.

Conservation Recommendations

Under the Action Alternatives, the following conservation recommendations would be implemented.

General

- Have firefighting resources on standby while training, and have transportation available for firefighting personnel.

- Notify Mauna Loa Observatory air-quality instrumentation personnel prior to conducting HAMET missions (requested by National Oceanic and Atmospheric Administration personnel).

- Notify the National park Service prior to conducting HAMET (as requested)

- Notify the public, through press releases, of training schedules.

Biological Resources

- Maintain a minimum altitude of 2,000 ft (610 m) in the flight path (e.g., when flying over palila critical habitat).

- Inspect the exterior of the aircraft for the presence of invasive ants and parts of invasive plants, and clean as required, prior to flight operations to reduce the potential for spread of invasive species.

- Apply pesticides and herbicides, as needed, to the helicopter landing pads located at Bradshaw Army Airfield to reduce the potential for spread of invasive species.

Cultural Resources

- Continue to participate in open communication with Native Hawaiians, other land use groups, and other interested parties to identify resources and reduce impacts.

- Conduct cultural awareness training for all HAMET personnel, with particular emphasis on intangible resources and their importance to Native Hawaiians.

- Avoid hovering directly over possible cultural features in the vicinity of LZ's 5 & 6 on Mauna Kea.

Monitoring

- Monitor for the presence of Hawaiian petrel and the band-rumped storm-petrel.

Outreach

After review of the public comments in response to previous environmental analyses the USAG-HI expanded its agency/organization outreach. Interdisciplinary teams presented to each agency/organization a HAMET briefing that explained the purpose, need, and details of the Preferred Alternative. Other alternatives were also presented and discussed. Dialogue ensued and concerns from the agencies/organization were solicited, discussed, and addressed at the meeting. The results of the outreach program are reflected in this EA.

Cultural Consultation

In compliance with Section 106 of the National Historic Preservation Act, the USAG-HI submitted a letter to the Hawai‘i State Historic Preservation Division (SHPD) and other consulting parties on the Proposed Action in October 2010. The letter determined that the project constitutes an undertaking, identified the area of potential effect, and made a no historic properties affected determination. The other consulting parties included the National Park Service, which concurred with the USAG-HI's determination of no effect to historic properties in the LZs. However, the NPS did express concern regarding traditional practitioner access and disturbance from HAMET activities. The SHPD formally responded to both the Section 106 consultation letter and the December 2010 NEPA EA on January 31, 2011. Concerns from both the NPS and SHPD consultation were addressed as part of the public comment analysis. The USAG-HI responded to the SHPD on April 15, 2011.

The Proposed Action was also presented to the PTA Cultural Advisory Committee during the November 2010 meeting, at which no serious concerns were raised. The PTA Cultural Advisory Committee has also been involved in subsequent consultation with Kahu Ku Mauna, a committee advisory to the Office of Mauna Kea Management.

Public Involvement

The formal opportunity to comment involves a 30-day period for public review of the draft EA and draft FNSI/Anticipated Negative Determination. A notice of availability of the draft EA and draft FNSI/ Anticipated Negative Determination was published in the State of Hawai‘i's Office of Environmental Quality Control Notice and website on July 23, 2011. Also, a public notice was published in the *Hawaii Tribune Herald* and *West Hawaii Today* newspapers to notify interested persons and organizations. Copies of the draft EA were provided to the Hilo Public Library, 300 Waianuenue Avenue, Hilo, Hawai‘i; the Kailua-Kona Public Library, 75-138 Hualalai Road, Kailua-Kona, Hawai‘i; and the Thelma Parker Memorial Public and School Library, 67-1209 Mamalahoa Highway, Kamuela, Hawai‘i. Copies also were mailed to interested individuals, organizations, Native Hawaiian organizations, and government agencies, if requested.

The USAG-HI will review comments received during the public comment period to determine whether the Proposed Action has potentially significant impacts that could not be reduced to less than significant with appropriate mitigation. If impacts are found to have the potential to be significant after the application of mitigation measures, the USAG-HI would be required to publish a notice of intent to prepare an EIS in the *Federal Register*. Otherwise, the USAG-HI will prepare a final EA and sign the final FNSI/Negative Determination, after which the Proposed Action could be implemented. The USAG-HI expects to receive written comments during the public comment period (July 23, 2011 to August 23, 2011) at:

NEPA PROGRAM USAG-HI,
Directorate of Public Works
Environmental Division (IMPC-HI-PWE)
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ACRONYMS

AAQS	ambient air quality standards
ADNL	A-weighted day-night average sound level
AGL	above ground level
amsl	above mean sea level
APE	area of potential effect
ARFORGEN	Army Force Generation
ARPA	Archaeological Resources Protection Act
bgs	below ground surface
CAB	combat aviation brigade
CAC	Cultural Advisory Committee
CARA	California Association for Research in Astronomy
CCC	Civilian Conservation Corps
CDNL	C-weighted day-night level
CDUP	Conservation District Use Permit
CEMML	Center for Environmental Management of Military Lands
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMP	comprehensive management plan
CONUS	Continental United States
CSO	Caltech Submillimeter Observatory
CTAF	Common Traffic Advisory Frequency
dBA	A-weighted decibel
dBC	C-weighted decibel
DLNR	Department of Land and Natural Resources
DNL	day-night average sound level

DoD	Department of Defense
DOFAW	Department of Fish and Wildlife
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FM	field manual
FNSI	finding of no significant impact
GMA	game management area
GPS	Global Positioning System
HAMET	High-Altitude Mountainous Environment Training
IWFMP	integrated wildland fire management plan
km/h	kilometers per hour
kWh	kilowatt hour
LUPZ	Land Use Planning Zone
LZ	landing zone
MBTA	Migratory Bird Treaty Act
MGD	million gallons per day
MLO	Mauna Loa Observatory
mph	miles per hour
NAR	natural area reserve
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NNL	National Natural Landmark

NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
NSF	National Science Foundation
NVG	night vision goggles
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OMKM	Office of Mauna Kea Management
OSHA	Occupational Safety and Health Administration
PCH	palila critical habitat
PM	particulate matter
ppb	parts per billion
ppm	parts per million
PTA	Pōhakuloa Training Area
ROE	right of entry
ROI	region of influence
RP	release point
SHPD	State Historic Preservation Division
SHPO	State Historic Preservation Officer
SONMP	statewide operational noise management plan
TacOps	Tactical Operations
TCP	traditional cultural property
TIGER	Topologically Integrated Geographic Encoding and Referencing (system)
TLV	threshold level value
TM	training and readiness manual
USAG-HI	United States Army Garrison-Hawaiʻi

USFWS	U. S. Fish and Wildlife Service
VEC	valued environmental component
VIS	visitor information station
VMC	visual meteorological conditions

Environmental Assessment for High-Altitude Mountainous Environment Training (HAMET) for the 25th Combat Aviation Brigade, Hawaiʻi

1. INTRODUCTION

The need for well-prepared aviation brigades to conduct combat operations in Afghanistan led the U.S. Army Forces Command to prioritize the development of standardized training for high-altitude (up to 14,000 ft [4,267 m]) mountainous conditions. High-Altitude Mountainous Environment Training (HAMET) was developed to ready pilots for success in combat operations as part of their train-up for deployment under Operation Enduring Freedom (OEF) (U.S. Army 2009). HAMET adapts the National Guard's school for individual mountain helicopter training taught in Gypsum, Colorado, with helicopter training that individual Army Combat Aviation Brigades (CABs) have been conducting as part of their regular training operations for the past several years (Gould 2010).

For operations in Afghanistan, Army helicopters have become a crucial means of transport for ground forces and supplies and for air assaults on remote Taliban-occupied villages and cave complexes located in the northern mountainous provinces along the Pakistan border and in the northern and western mountainous regions of Afghanistan (Gould 2010). Aviation brigades deploying to mountainous regions of Afghanistan must have confidence in their ability to conduct aviation operations at high altitude, where aircraft performance and power can be severely limited (U.S. Army 2009). Figure 1-1 shows ground forces being deployed by a single-wheel landing at high altitude.

Figure 1-1. High-altitude military operations.

By order of the commanding officer, the 25th Infantry Division – 25th CAB, based at Schofield Barracks on the central plateau of the island of O‘ahu in the State of Hawai‘i, will undergo HAMET prior to its upcoming deployment (date classified) for OEF (Lundy 2010).

1.1 25th Combat Aviation Brigade

The 25th Aviation Brigade was constituted on February 1, 1957, in the Regular Army as the 25th Aviation Company, assigned to the 25th Infantry Division, and activated at Schofield Barracks, Hawai‘i. In 2006, the 25th Aviation Brigade began a transition to the U.S. Army's new modular force structure as part of an overall transformation of the 25th Infantry Division. The unit was reorganized and renamed the 25th CAB.

The mission of the 25th CAB is to prepare for worldwide deployment and, when directed, conduct day and night combat or other military operations (Pike 2010). Over the past 10 years, the CAB has deployed five times in support of operations, including Operation Joint Forge, Operation Iraqi Freedom (OIF), and OEF. Most recently, the CAB returned from a 12-month deployment in September 2010 and only has a "dwell time" of approximately 14 months before it has to re-deploy in early 2012. ("Dwell time" is defined as the time needed to recover from 1 year of deployment.)

1.2 Proposed Action

In preparation for deployment in support of OEF in Afghanistan, and to satisfy mandated annual training requirements, the 25th CAB proposes to train helicopter air crews for high-altitude, mountainous-environment flights through the HAMET program.

1.3 Purpose of the Proposed Action

The *purpose* of the Proposed Action is to provide helicopter air crews mandatory high-altitude flight operations training, while recognizing Army environmental and social stewardship responsibilities within the affected region.

1.4 Need for the Proposed Action

The *need* for the Proposed Action is to ready helicopter air crews to be successful in the combat theater to support the operational and mission requirements of the 25th CAB, 25th Infantry Division, set forth by the Department of Army and Department of Defense (DoD). It is vitally important to conduct HAMET in order to prepare our aircrews. This training is critical to save the lives of our 25th CAB aircrews and the Soldiers they transport when operating in support of Operation Enduring Freedom in Afghanistan.

High altitudes and mountainous terrain pose several challenges to Army helicopter pilots. High altitudes are associated with high wind, high-density altitude (i.e., pressure altitude that is corrected for temperature and humidity), turbulence, and atmospheric instability. These factors greatly affect the performance of a helicopter engine and the handling characteristics of an aircraft. For example, an increased density altitude decreases the effectiveness of the rotor blades in providing both overall lift and thrust power to the tail rotor for directional control (i.e., increasing density altitude increases "drag"). Thus, an increased angle of attack and increased power are required to offset the increased drag. Simultaneously, the engine is less capable of producing power in the thinner air of higher altitudes, and the higher the altitude, the greater these effects have on the aircraft. As such, it is imperative that pilots master performance planning, power management, and high-altitude flight techniques to compensate for decreased aircraft performance in high-altitude, mountainous environments (Munger 2010a).

To conduct HAMET at a CONUS location, the 25th CAB aircrews will spend up to an additional 45 days away from Families prior to the upcoming deployment; and helicopters and maintenance crews will spend additional time on the mainland. When combined the impact are referred by the military as “perstempo". Perstempo is defined as the time an individual spends away from home station. Additionally, increased costs would accrue from the aircrews, helicopters, and equipment staying on the mainland longer. Furthermore, while the offsite HAMET would be occurring, the CAB’s ability to perform other mandatory pre-deployment training would be severely limited.

The Proposed Action satisfies Department of Army and DoD flight requirements. The intent of these flights is to conduct high-altitude helicopter training in accordance with the following:

- ARCENT/CFLCC 95-1, which contains flight regulations that provide flying procedures in Iraq and Afghanistan. All 25th CAB aircrews are required to complete high-altitude training prior to deploying to the theater.
- *OEF Aviation Planning Guide*, dated July 31, 2009, which lists the minimum tasks and documentation required prior to deploying to the theater. High-altitude training is required prior to deployment for all aircrews.
- “25th CAB Flight Standardization Standard Operating Procedures,” which contain academics, tasks, and documentation requirements for high-altitude training. Training on these procedures is required for all crews prior to conducting operations at the Pōhakuloa Training Area (PTA).
- Training and readiness manuals (TMs) for Black Hawk helicopters (UH60A/L/M, TM 55-1520-237-10) and Chinook helicopters (CH47D/F, TM 55-1520-240-10).
- Field Manual (FM) 3-04.126, *Air Calvary Squadron and Troop Operations*, dated February 16, 2007; FM 3-04.203, *Environmental Flight*, dated May 7, 2007; FM 3-18.12, *Air Assault Operations*, dated March 16, 1987; FM 3-18.12, *Air Assault Operations*, dated March 16, 1987; FM 25-100, *Training the Force*, dated October 22, 2002; and Training Circular 1-210, “Aircrew Training Program,” dated June 20, 2006.
- “25th CAB Aviation Standardization Message 10-001 High Altitude and Environmental Training Guidance” (Lundy 2010).

1.5 Document Scope

The U. S. Army Garrison, Hawai‘i (USAG-HI) prepared this environmental assessment (EA) in accordance with the National Environmental Policy Act (NEPA) of 1969 (42 USC § 4321 et seq.); the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR V §§ 1500–1508); “Environmental Analysis of Army Actions” (32 CFR V §§ 651.32–651.39 and 67 FR 61); Hawaii Revised Statutes (HRS) Chapter 343 Environmental Impact Statements and Hawaii Administrative Rules (HAR) Title 11 Department of Health Chapter 200, Environmental Impact Statement Rules (April 2008).

The intent of this EA is to ensure that there is comprehensive and systematic consideration given to potential impacts on the natural and human environment that may be caused by implementing the Proposed Action. This EA serves as an environmental decision document that identifies the purpose and need of the Proposed Action, reasonable alternatives, existing environmental conditions, potential environmental impacts, and measures to mitigate such impacts. The purpose of the EA is to provide USAG-HI and the State of Hawaii department of Land and Natural Resources (DLNR) decision-makers and the public with a complete, objective appraisal of the environmental impacts associated with implementing the various activities associated with the proposed action. The impact evaluations presented in this EA provide the basis for determining whether such impacts are significant enough to warrant the preparation of an environmental impact statement (EIS) or whether a finding of no significant impact (FNSI)/Negative Determination is appropriate.

1.6 Document Organization

The remainder of the EA is organized as follows:

- Section 2 of this EA, Description of the Proposed Action and Alternatives, considers five Action Alternatives and the No Action Alternative in meeting the purpose and need of the Proposed Action. Alternatives that were also considered, but not further analyzed because they did not meet the purpose and need and/or other screening criteria, are also presented in Section 2.
- Section 3, Affected Environment, describes existing conditions of valued environmental components (VECs) that constitute the baseline for analyzing potential effects of the Proposed Action. Section 3 further identifies, evaluates, and documents the environmental impacts of the Action Alternatives and the No Action Alternative with an analysis of the direct impacts (those directly caused by a specific action and occurring at the same time and place) and indirect impacts (those caused by an action but occurring late or physically disconnected from the action but within a reasonably foreseeable time or geographic area).
- Section 4, Environmental Consequences, presents a summary of the potential environmental impacts from the Action Alternatives and the No Action Alternative on the VECs.
- Section 5, Cumulative Impacts, presents the direct and indirect effects of the Proposed Action’s incremental impacts when considered in the context of other past, present, and reasonably foreseeable future actions regardless of who carries out the action.
- Section 6, Conclusions, presents the results of the consequences analysis.
- Section 7, Consultation and Coordination, lists the people and organizations contacted during the preparation of the EA.
- Section 8, Preparers, lists the personnel who conducted the analysis.
- Section 9, References, lists the literature used in the analysis.
- Appendix A, Section 7 Consultation
- Appendix B, Section 106 Consultation
- Appendix C, Aircraft for Use in High-Altitude Mountainous Environment Training
- Appendix D, Spatial Data References Used to Generate the EA Maps.

1.7 Agency and Public Involvement, Outreach, and Consultation

To present, HAMET EAs have been released for two full 30-day public comment periods. Each time the Army acknowledged and incorporated relevant input from the commenters.

On December 23, 2010, the USAG-HI released, for public comment, an EA and draft FNSI for the proposed action to conduct HAMET over the course of one year for 300-400 25th CAB aviators. The public comment period occurred from December 23, 2010, to January 23, 2011. After review of the comments, the USAG-HI revised its alternatives, expanded its agency and public outreach activities, collected additional information, and prepared a revised EA. The revised EA was published April 23, 2011 for a 30-day public comment period. The EA incorporated input received by the public and agencies of both the State of Hawaii and federal government. The proposed action was reduced to train 260 aviators for approximately 45 days over the course of three non-consecutive months.

Within this EA are the details related to the changes made by the USAG-HI in response to the public comments, the available time to conduct HAMET in the State of Hawaii, and the need to comply with HRS Chapter 343. In overview, the following changes were made to the Action Alternatives:

- Proposed HAMET on Hawaiian Island alternatives would be conducted with two aircraft types (i.e., Black Hawks and Chinooks) rather than three types; the OH58 Kiowa Warrior would not be flown for Hawaiian Island HAMET
- Fewer aviators will be trained (from 260 to 90), and the timeline for the Proposed Action has been refined from 3-three week periods in June, August, and October to only October 3 thru October 31, 2011.
- Flight paths for the Proposed Action were redesigned to reduce the size of the over flight area and avoid the Mauna Kea State Recreation Area and proximity to the Mauna Kea Ice Age Natural Area Reserve.
- All alternatives were re-examined.

In conjunction with changes to the Action Alternatives, the USAG-HI also performed the following:

- Additional research and surveys regarding biological resources
- Additional cultural resource research and surveys
- A noise level study
- A view plane analysis
- A re-analysis of valued environmental components.

1.7.1 Outreach

After review of the public comments, the USAG-HI expanded its agency/organization outreach. Interdisciplinary team members, including members of the CAB, PTA, and Department of Public Works, conducted meetings with representatives of the following agencies/organizations:

- The Office of Mauna Kea Management (OMKM)
- Waimea Rotary Club
- Hawai‘i Island Economic Development Board
- Hawai‘i Leeward Planning Conference
- Department of Land and Natural Resources
- U.S. Fish and Wildlife Service (USFWS)
- Department of Fish and Wildlife (DOFAW)
- State Historic Preservation Officer (SHPO)
- U.S. National Park Service (USNPS)
- Kahu Ku Mauna
- Mauna Kea Neighbors
- Office of Hawaiian Affairs (OHA)

Interdisciplinary teams presented to each agency/organization a HAMET briefing that explained the purpose, need, and details of the Preferred Alternative. Other alternatives were also presented and discussed. Dialogue ensued and concerns from the agencies/organization were solicited, discussed, and addressed at the meeting. The results of the outreach program are reflected in this EA.

1.7.2 Cultural Consultation

In compliance with the NHPA, the Department of the Army consulted the Hawai‘i SHPD on the Proposed Action. A letter initiating Section 106 consultation, dated October 20, 2010, was sent on October 25 to the SHPO at the Kapolei Office to request concurrence with a no-historic-properties-affected determination (Appendix B). This initiated the 30-day consult period. The Army also sent letters requesting review and comments to other consulting parties, including the NPS, Office of Hawaiian Affairs, Hawai‘i Island Council of Hawaiian Civic Clubs, Hui Malama I Na Kupuna O Hawa‘i Nei, and the Hawaii Island Burial Council. NPS responded by expressing concern regarding traditional practitioner access and disturbance from HAMET activities (Appendix B). These latter concerns are addressed in Subsection 4.7.6.

The Proposed Action was also presented to the PTA Cultural Advisory Committee at the November 2010 meeting. No serious concerns were raised at that time. In January 2011, SHPD provided a memo in response to the EA that also covered Section 106 concerns. The Army responded with a letter dated April 15, 2011.

The Office of Mauna Kea Management and its advisory council, Kahu Ku Mauna, expressed concerns about the Proposed Action and its impacts on cultural resources and cultural practices. On February 25, 2011, Kahu Ku Mauna joined the PTA Cultural Advisory Committee for a meeting. The meeting provided a good opportunity for discussion. Lieutenant Colonel Robinson of the CAB attended and provided an overview of the training. The entire group was then invited to view a static display of helicopters and talk with crew members and instructors. Members of the PTA CAC requested a special meeting on March 11, 2011, to discuss the concerns raised particularly by OMKM and Kahu Ku Mauna, to be followed by another meeting with Kahu Ku Mauna. Lieutenant Colonel Niles assured members of Kahu Ku Mauna that their concerns would be addressed in the revised EA. Lieutenant Colonel Niles provided a digital copy of the EA comments to members of the PTA CAC. The meeting was held on March 11, 2011, at which steps being taken to address the concerns that had been raised were discussed. A follow-up meeting was held with Kahu Ku Mauna on May 11, 2011. In addition, PTA representatives met with Kealoha Pisciotta, representing Mauna Kea Anaina Hou on May 25, 2011 to discuss the proposed project and concerns regarding Mauna Kea.

1.7.3 Biological Consultation

Endangered Species Act Section 7 consultation requirements were satisfied and are reported in the Biological Resources section of this EA, and described in Memoranda for Record, as referenced.

1.7.4 Public Involvement

The formal opportunity to comment involves a 30-day period for public review of the draft EA and draft FNSI/Anticipated Negative Determination. A notice of availability of the draft EA and draft FNSI/ Anticipated Negative Determination was published in the State of Hawaiʻi's Office of Environmental Quality Control Notice and website on July 23, 2011. Also, a public notice was published in the *Hawaii Tribune Herald* and *West Hawaii Today* newspapers to notify interested persons and organizations. Copies of the draft EA were provided to the Hilo Public Library, 300 Waianuenue Avenue, Hilo, Hawaiʻi; the Kailua-Kona Public Library, 75-138 Hualalai Road, Kailua-Kona, Hawaiʻi; and the Thelma Parker Memorial Public and School Library, 67-1209 Mamalahoa Highway, Kamuela, Hawaiʻi. Copies also were mailed to interested individuals, organizations, Native Hawaiian organizations, and government agencies, if requested.

The USAG-HI will review comments received during the public comment period to determine whether the Proposed Action has potentially significant impacts that could not be reduced to less than significant with appropriate mitigation. If impacts are found to have the potential to be significant after the application of mitigation measures, the USAG-HI would be required to publish a notice of intent to prepare an EIS in the *Federal Register*. Otherwise, the USAG-HI will prepare a final EA and sign the final FNSI/Negative Determination, after which the Proposed Action could be implemented. The USAG-HI expects to receive written comments during the public comment period (July 23, 2011 to August 23, 2011) at:

NEPA PROGRAM
USAG-HI, Directorate of Public Works
Environmental Division (IMPC-HI-PWE)
948 Santos Dumont Avenue, Bldg. 105, Wheeler Army Airfield
Schofield Barracks, HI 96857-5013

or

hamet_nepa@portageinc.com

or

Phone: (208) 419-4176
Fax: (208) 523-8860

1.8 Regulatory Framework

A decision on whether to proceed with the Proposed Action depends on numerous factors, such as mission requirements, permission from the State of Hawaii to utilize their LZs, schedule of proposed activities, availability of funds, and environmental considerations. In addressing environmental considerations, the USAG-HI is guided by the National Environmental Policy Act (NEPA) of 1969, the Army's NEPA implementing regulations 32 CFR 651, HRS Chapter 343 and its implementing regulation HAR 11-200, and all other applicable state and federal statutes and regulations.

Key provisions of these statutes and regulations are described in more detail in later sections of this EA if they are needed to better understand their application. Appendix A contains correspondence generated in conjunction with coordination activities under Section 7 of the ESA. Appendix B contains correspondence generated in conjunction with coordination activities under Section 106 of the NHPA.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

U.S. Army aviators have a need to better understand the aerodynamics and atmospheric effects on their aircraft at high altitudes (generally up to 14,000 ft [4,267 m]) to be capable and successful in theater (U.S. Army 2009). Much of the aviation force has experienced multiple deployments to the relatively flat desert terrain of Iraq. As the shift toward OEF and other operations in Afghanistan continues, HAMET will expose OIF veterans and newcomers to the challenges of high-altitude flight planning and aircraft operations in mountainous environments.

The Proposed Action is to train 90 experienced 25th CAB helicopter aviators for mountainous, high-altitude flights, satisfying the compulsory aviation training requirements defined in ARCENT/ CFLCC 95-1, which contains flight regulations that provide flying procedures in Iraq and Afghanistan. All 25th CAB aircrews are required to complete high-altitude training before deploying to the theater.

Specifically, the EA addresses the actual aircraft flight and maneuvers component of the HAMET program. The USAG-HI has developed five Action Alternatives discussed in Subsection 2.7, Action Alternatives, to accomplish its Proposed Action.

The following subsections present an overview of the HAMET program and its objectives, HAMET aircraft, PTA, annual training activities at PTA, previous HAMETs, the CAB's safety record, Action Alternatives, alternative screening, alternative evaluation, and alternatives not considered further.

2.1 HAMET Training Overview and Objectives

In overview, HAMET training includes academic classroom instruction, simulator training, individual flight technique training, and collective (group) training. The individual flight technique training component is a hands-on, incremental process in which experienced pilots proceed from lower to higher elevations, building on skills acquired at each altitude. The individual flight technique training component is required by the CAB Commander to be conducted in environments at or above 8,000 ft (2,438 m) (Lundy 2010) to replicate conditions in theater. Optimally, altitudes should range from 8,000 ft (2,438 m) to the highest altitude available, because pilots, upon deployment to theater, would routinely encounter altitudes in excess of 10,000 ft (3,048 m).

The individual flight technique training component of HAMET would be integrated with other scheduled flight training. Flight time is estimated to be approximately 2 hours for each pilot, depending on the ability of the pilot to reach proficiency in the required maneuvers.

During individual flight technique training, pilots must master performance planning, power management, and high-altitude flight techniques used to compensate for the decreased aircraft performance. Pilots would fly at high altitudes and land at designated high-altitude LZs using varying angles of approach, headings, and air speeds, under both day and night conditions, to reach proficiency for the following tasks:

- Visual-meteorological-conditions (VMC) takeoff.
- VMC approach (typically 10 degrees) to a landing or to a 3-ft hover.
- Abort and go-around procedures – climb-out maneuvers performed when conditions are no longer suitable for landing. A go-around procedure is a planned diversion around an LZ; for instance, it could be performed for weather-related reasons. An abort procedure is an unplanned diversion around an LZ.

- Elevated (100–500 ft [30–152 m]) reconnaissance over high-altitude LZs.

- Slope operations – landing operations performed on an angled, uneven surface (i.e., LZ).

- Pinnacle or ridgeline operations – landing operations performed on a pinnacle, or a formation similar to a pinnacle, that is a high point on a hill (or LZ).

2.2 HAMET Aircraft

The following aircraft would be used under all Action Alternatives for all HAMET missions. More detailed descriptions of these aircraft are provided in Appendix C. All aircraft used for HAMET would be unarmed (i.e., no pyrotechnic devices, ordinance, etc.).

2.2.1 Black Hawk

The UH-60 Black Hawk is a dual-engine, four-bladed utility tactical transport helicopter (Figure 2-1). The UH-60, with a crew of four (two pilots and two crew chiefs), can lift an entire 11-man, fully equipped infantry squad in most weather conditions. The aircraft's critical systems are armored or redundant, and its airframe is designed to progressively crush on impact to protect the crew and passengers. The Black Hawk is used to provide air assault, general support, aero-medical evacuation, command and control support, and special operations support for combat operations and stability-and-support operations (U.S. Army 2010a). Specifications for the UH-60 Black Hawk are as follows:

- Maximum gross weight: 23,500 lb (10,659 kg)

- Empty weight: 10,624 lb (4,819 kg)

- Height: 16 ft, 10 in. (5.1 m)

- Length: 64 ft, 10 in. (19.8 m)

- Rotor diameter: 53 ft, 8 in. (16.4 m)

- Maximum cruise speed: 159 knots (294.5 km/h).

Figure 2-1. UH-60 Black Hawk.

2.2.2 Chinook

The CH-47 Chinook is a twin-engine, tandem-rotor helicopter designed to transport cargo, troops, and weapons during day, night, visual, and instrument conditions (Figure 2-2). The minimum crew for tactical operations is four people: two pilots, one flight engineer, and one crew chief. The Chinook has served as the prime mover for the U.S. Army and other military forces for decades. Its principal mission is transporting troops, artillery, ammunition, fuel, water, barrier materials, supplies, and equipment on the battlefield (U.S. Army 2010b). Specifications for the CH-47 Chinook are as follows:

- Maximum gross weight: 50,000 lb (22,680 kg)
- Empty weight: 23,401 lb (10,615 kg)
- Height: 18 ft, 11 in. (5.8 m)
- Length: 98 ft, 10 in. (30.1 m)
- Rotor diameter: 60 ft, 0 in. (18.3 m)
- Maximum cruise speed: 170 knots (315 km/h).

2.3 Pōhakuloa Training Area

As shown in Figure 2-3, PTA is located in the north-central portion of the island of Hawaiʻi just to the west of Humuʻula Saddle, or plateau, formed by Mauna Loa and Mauna Kea. PTA is about a 1-hour drive (36 miles [58 kilometers]) from the eastern-shore city of Hilo and about a 1.5-hour drive (50 miles [80 kilometers]) from the western-shore city of Kailua-Kona. The town of Waimea is 25 miles (40 kilometers) from PTA. A third volcanic mountain range, Hualalai, lies to the west but does not affect the topography of PTA.

PTA was established as a multi-functional training facility in 1956 for the U.S. Army Western Command and other Pacific Command units. The installation encompasses approximately 132,000 acres (53,419 hectares), with a central impact area of approximately 51,000 acres (20,638 hectares). Total acreage includes the recently acquired Keʻāmuku Maneuver Area, or Keʻāmuku Parcel.

PTA supports training for a variety of services, including the Army, Army National Guard, Navy, Marine Corps, Air Force, Special Operations Forces, and allied armed forces from the Pacific region. Transportation of military personnel and cargo to PTA involves the use of several alternative land, sea, and air routes that employ commercial and military transportation systems. PTA includes Bradshaw Army Airfield, which is directly west of the cantonment area and includes a 90- by 3,696-ft (27.4- by 1,127-m) paved runway (USAEC and COE 2009).

The primary mission of PTA is to operate and maintain a safe, modern, major training area for the USAG-HI, Army, Pacific, and other U.S. Pacific Command military units. PTA is a primary tactical training area for conducting military Mission-Essential-Task-List training and contributes to the Army's training mission by providing resources and facilities for active and reserve component units that train on the installation each year. PTA assets are geared toward maneuver unit live fire, maneuver training, and artillery live fire. The largest live-fire range and training complex belonging to USAG-HI is located on PTA. Additionally, PTA is the base of operations for low-level helicopter training of the 25th CAB.

Figure 2-2. CH-47 Chinook.

2.4 25th CAB's Training at PTA

The 25th CAB's training plan is a modeled to be in accordance with the Army Force Generation (ARFORGEN) cycle. The ARFORGEN cycle is broken into three phases of reset/train, ready for deployment, and available for deployment. As part of the reset/train phase, the 25th CAB conducts individual and collective training on the island of O'ahu and at the National Training Center, California; the Joint Readiness Training Center, Louisiana; and/or PTA, Hawai'i. Aviators, in addition to their basic soldier skills, must undergo additional annual training to maintain flight proficiency. This training includes task and iteration requirements of certain flight maneuvers, annual proficiency and readiness testing, instrument evaluation, and collective flight training tasks. HAMET would be conducted in conjunction with an aviator's individual and collective training.

The CAB uses PTA for approximately 4,500 aviation training hours each year. The addition of HAMET would increase those hours by 180 (to qualify 260 UH-60 and CH-47 pilots).

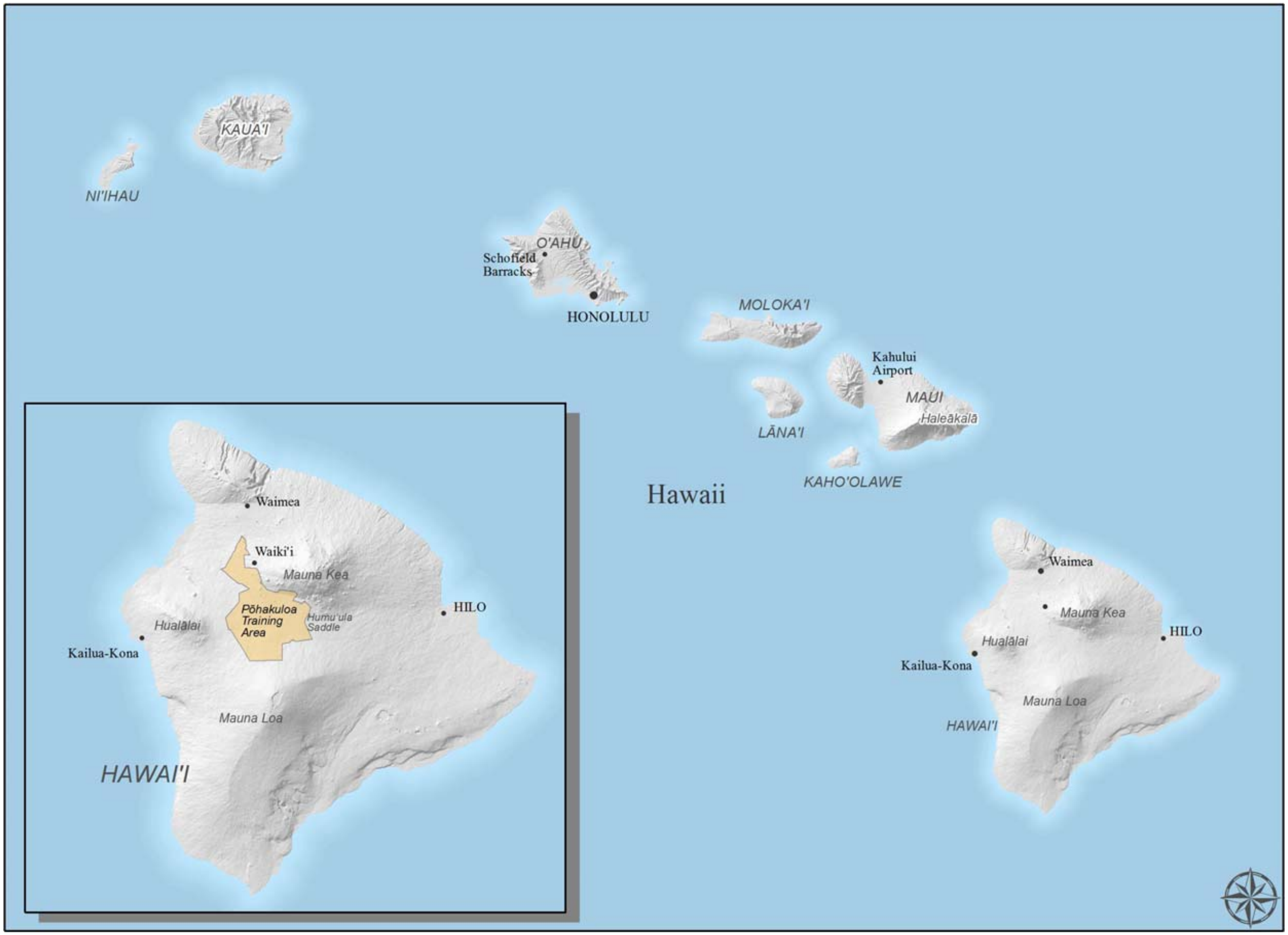

Figure 2-3. The State of Hawai‘i, including areas of interest on the island of Hawai‘i.

2.5 Previous HAMET and the 25th CAB

The 25th CAB has conducted the individual flight technique component of HAMET at PTA on the island of Hawaiʻi on four previous occasions as summarized below:

- October – December 2003: The 25th CAB requested the use of the State of Hawaiʻi land north of PTA to establish six LZs to conduct high-altitude training under a special use permit (DACA84-9-04-9) granted through the Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW), on October 2, 2003 (U.S. Army 2003a). Three of the six LZs established at this time are described in this document as LZ-4 through LZ-6 on Mauna Kea. The training within this area was considered critical to aviators deploying to Afghanistan from April 2004 to May 2005 as part of OEF. The 25th CAB conducted all landings above the tree line to avoid active hunting locations, and a sentry was posted at a nearby intersection to ensure hunters and unauthorized personnel did not access the sites when training was under way (U.S. Army 2003a). In November, while performing high-altitude training on the slopes of Mauna Kea, a U.S. Army Black Hawk helicopter landed about 3.5 miles (6 kilometers) east of the designated LZs within the Mauna Kea Ice Age Natural Area Reserve (NAR) within the boundaries of the Mauna Kea Adze Quarry. Subsequent to the incident, the USAG-HI was requested to implement additional mitigations to avoid future related impacts during the training period (Young 2003). The USAG-HI responded (Brown 2003) with the following requirements for the aircrews:

    - Participation in an environmental-awareness briefing conducted by the PTA environmental office prior to commencing training. A participant roster was kept, and the brief was valid for the duration of the training.

    - Participation in a cultural-awareness briefing conducted by the PTA cultural office prior to commencing training. A participant roster was kept, and the brief was valid for the duration of the training.

    - Installation of an operational Global Positioning System (GPS) device on each aircraft.

    - Participation in a detailed crew brief prior to each day's training, during which it was emphasized to land only at approved LZs.

    - PTA Cultural Resources staff also conducted mitigation in the form of providing copies of Mauna Kea adze quarry maps held at the Bishop Museum to the SHPO, and assisted in collecting submeter GPS coordinates for features in the adze quarry and assessing conditions of the features.

- August 2004: The 25th CAB requested the use of the State of Hawaiʻi land north of PTA to revisit the LZs to conduct high-altitude training under a special use permit (DACA84-9-04-86) granted through the DLNR, DOFAW, on August 3, 2004 (U.S. Army 2004a). The training within this area was to cycle through all of the aviators within the units who were unable to participate in previous training iterations. This training was considered critical to the aviators deploying to Afghanistan as part of OEF. The 25th CAB conducted all landings above the tree line in order to avoid active hunting locations, and a sentry was posted at a nearby intersection to ensure hunters and unauthorized personnel did not access the sites when training was under way (U.S. Army 2004a).

- January – February 2006: The 25th CAB requested the use of the State of Hawaiʻi land north of PTA to revisit all six LZs to conduct high-altitude training under a special use permit (DACA84-9-

06-16) granted through the DLNR, DOFAW, on December 16, 2005 (U.S. Army 2005a). The training within this area was considered critical to aviators deploying to Afghanistan. The 25th CAB conducted all landings above the tree line to avoid active hunting locations. Control measures were implemented to ensure no aircraft landed in unapproved locations. However, an incident did occur when an aircraft hovered too low over critical habitat. To avoid incidents concerning the critical habitats and mitigate environmental concerns, the use of three LZs was discontinued (Gordon 2006). Crews were also briefed to abort landings and reposition to another LZ if any civilians were seen in the area during training to ensure there were no incidents between civilians and Army aircraft (U.S. Army 2005a). The LZs that remained in use were LZ-4, LZ-5, and LZ-6 described in this document.

- March–April 2011: The 25th CAB requested the use of the State of Hawai‘i land (a portion of Mauna Kea Forest Reserve, North Kona) to conduct a 2-week data collection training period. This included noise monitoring, observing potential effects of and on rotor wash, wildlife, and cultural resources. These studies were conducted under a special use permit (DACA84-9-11-194; DOFAWHA-2011-02, Special Use Permit Forest Reserve System) granted through the DLNR, DOFAW, on March 15, 2011 (U.S. Army 2011a). The mission used three aircraft to and 11 pilots over 8 days. The operations executed during this exercise were conducted in accordance with the conditions specified in the special use permit. No incidents occurred during the exercises conducted under this permit.

2.6 25th CAB Safety Record

In the past 10 years, the 25th CAB has flown more than 480,000 hours in training and in support of contingency operations throughout the world. This figure includes more than 26,000 flight hours operating at high altitudes and mountainous terrain in support of OEF in Afghanistan. To date, the CAB has had zero accidents related to flight at high altitude, both in theater and in and around Hawaii (Lugo 2010). The 25th CAB has had two Class A accidents involving rotary-wing aircraft on the island of O‘ahu in February 2001 and May 2009. The 2001 incident was during an air-assault training operation in the Kahuku training area, and the 2009 incident was during a general maintenance test flight on Wheeler Army Airfield.

2.7 Action Alternatives

The following alternatives were identified and considered (67 FR 61) in meeting the Proposed Action:

- Alternative 1 – Mauna Kea/Mauna Loa (Subsection 2.7.3, Preferred Alternative)
- Alternative 2 – Mauna Kea (Subsection 2.7.4)
- Alternative 3 – Mauna Loa (Subsection 2.7.5)
- Alternative 4 – Other High-Altitude Locations in the State of Hawai‘i (Subsection 2.7.6)
- Alternative 5 – Other High-Altitude Training Sites CONUS (Subsection 2.7.7).

A sixth alternative, conducting HAMET entirely through simulation, was considered briefly but dismissed. Such an alternative would not address purpose and need, because it does not meet the mandatory in air training requirements.

2.7.1 Features Common to All Action Alternatives

Features that are common to all Action Alternatives are as follows:

- The 25th CAB aviators/crews would train on aircraft internal to the aviation brigade
- These proposed 90 25th CAB pilots would be trained under all Action Alternatives
- The anticipated start date for HAMET would be October 2011
- The Proposed Action/Alternatives involve leaving no assets post-activity.

2.7.2 Features Common to Alternatives 1, 2, and 3

The features common to Alternatives 1, 2, and 3 are the training requirements, HAMET flight details, HAMET conduct, the LZs selected, and the use of LZs. HAMET is a temporary aerial exercise. HAMET is not an expansion of PTA or any of its facilities. The USAG-HI is requesting use of the LZs from the State of Hawai‘i under permit; the USAG-HI is not acquiring LZs under the Proposed Action. Under Alternatives 1, 2, and 3, HAMET would be executed as described in the following subsections.

2.7.2.1 Training Requirements. The following training requirements would be common to Alternatives 1, 2, and 3:

- HAMET would be taught in three phases. Phase I would consist of academic classroom instruction and simulator training conducted at Wheeler Army Air Field and Schofield Barracks, O‘ahu.
- Phase II would be an element of annual and pre-deployment individual flight technique training conducted on high-altitude LZs in mountainous environments with aviators in their assigned aircraft.
- Phase III would be collective (group) training based at Bradshaw Army Air Field, PTA, and Schofield Barracks, where tactical and mission flight training would be conducted inside military training areas.

2.7.2.2 HAMET Flight Details. Aircrews would pilot helicopters in the following manner under Alternatives 1, 2, and 3:

- Aircrews would ascend from PTA to a minimum of 2,000 ft (610 m) above ground level (AGL) prior to exiting the PTA boundary.
- Minimum altitude for all HAMET helicopters would be 2,000 ft (610 m) AGL while departing PTA and enroute to an inbound release point (RP). The designated flight path is 1,640 ft (500 m) left and right of the centerline of the route. Figure 2-4 shows a flight maintaining 2,000 ft (610 m) AGL to the inbound RP.

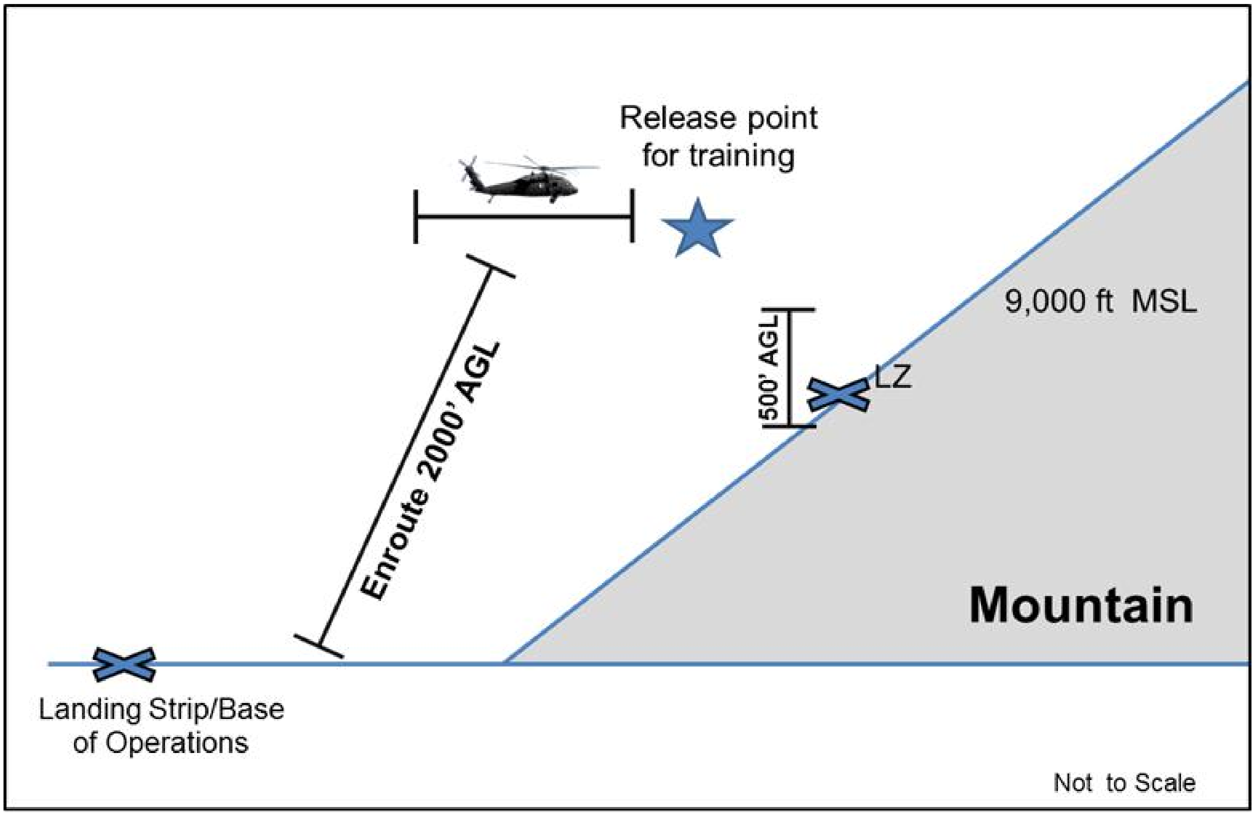

Figure 2-4. Vertical simulated view of HAMET flight to an LZ on a mountain.

- After passing the inbound RP, the aircrew would begin their descent directly to an LZ. Flight around the LZs would be conducted at 500 ft (152 m) and above until a final approach path has been established. Once established on final approach, the pilot would make a controlled descent to the selected LZ. Figure 2-5 shows a helicopter flying from an RP to an LZ.

- The area 3,280 ft (1,000 m) from the center of each LZ would be the training area where helicopters would be expected to be at terrain flight altitudes of 200 ft (61 m) AGL.

- On departure from the LZs, and because of descending terrain, the maximum elevation the aircraft could attain is 500 ft (152 m) AGL above the LZ as the aircraft proceeds along a horizontal course to meet 2,000 ft (610 m) AGL at the outbound RP.

- Aircraft would remain above 2,000 ft (610 m) AGL from the outbound RP until back inside the PTA property line.

- Aircraft may only deviate from the protocol stated in the HAMET Flight Details section during actual aircraft emergencies.

- The maximum number of helicopters training on any mountain at one time would be three.

- Army aircraft are flown in accordance with the Federal Aviation Administration (FAA) regulations and within recommended altitudes established by the FAA, the State of Hawai‘i, and restricted airspace (R-3103) over PTA.

- Army helicopters would be using the Island Traffic Advisory Frequency when outside of PTA and while conducting HAMET. This Island Traffic Advisory Frequency is the same radio frequency that all the civilian airplanes, tour helicopter companies, and military helicopters use to de-conflict air traffic and communicate (DOT 2010a, p. 14).

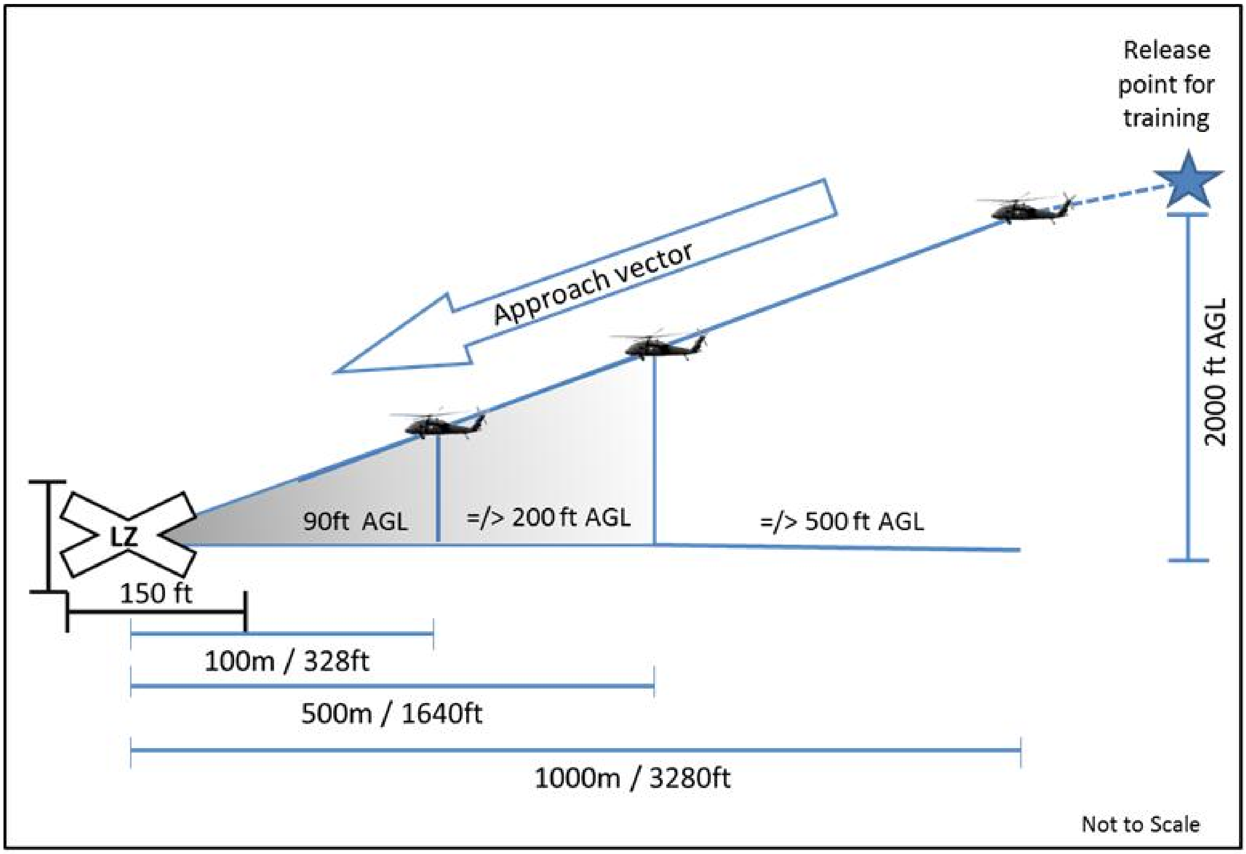

Figure 2-5. Simulated vertical view of HAMET flight from an RP to an LZ.

2.7.2.3 HAMET Conduct. HAMET conduct would be as follows for Alternatives 1, 2, and 3:

- Phase II would be an element of annual and pre-deployment individual flight technique training conducted on high-altitude LZs in mountainous environments with aviators in their assigned aircraft. This is the only phase that needs to be conducted outside the Army training area, and it is estimated that it will take 2 hours of training per pilot to complete. HAMET Phase II would require approximately 180 flight hours and will be conducted during October 2011.

- No HAMET flights would be conducted on weekends or during any known scheduled ceremonies. Flights will not be conducted on: October 10, Columbus Day.

- Training will be scheduled for 20 days and will not exceed 10 hours per day. October HAMET is required for approximately 90 Army aviators. On average, each aircrew will spend 2 hours of flight training around the LZs, with ground time in the LZ not to exceed 10 minutes. Aircrews will fly defined routes and land at designated LZs using varying angles of approach, headings, and airspeeds to achieve proficiency in tasks such as, but not limited to, visual / meteorological-conditions takeoff and approach, reconnaissance over high altitude LZs, slope operations, and night-time operations.

- USAG-HI aircrews are trained, proficient, and equipped with modern technology using night vision goggles (NVG). As shown in Figures 2-6 and 2-7, NVG are light intensifiers that allow the wearer to "see in the dark." Night flights would involve crews equipped with and using NVG during HAMET.

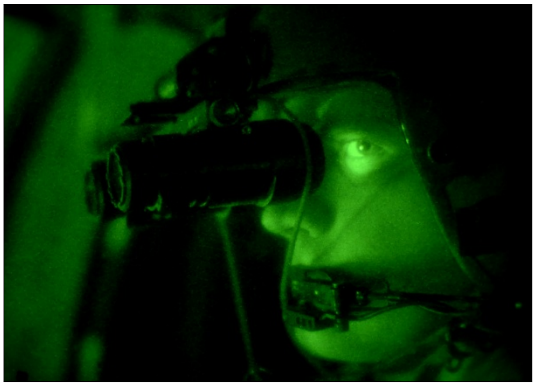

Figure 2-6. Pilot using night vision goggles.

Figure 2-7. Pilot's view through night vision goggles.

- HAMET entails aviation aircrews only. HAMET would not be used in conjunction with ground-maneuver training activities or for picking up/dropping off troops or supplies.

- No sling-loading would be conducted.

- At no time would any aircraft involved carry ammunition.

- All flight paths are designed to avoid designated wilderness areas and to increase the distance from recreation and cultural areas.

- All aircraft would be staged at PTA when used for training exercises.

2.7.2.4 LZ Selection. Under Alternatives 1, 2, and 3, LZs were chosen for their training-appropriate characteristics (i.e., high-altitude mountainous terrain, uneven surfaces, and pinnacle/pinnacle-like and ridge/ridge-like features) but also with safety as a consideration so as to not harm pilots or damage aircraft. Generally, an LZ is an area that can contain one or more helicopter landing sites. The terrain condition, slope, and overall topography of the LZ are taken into consideration when selecting an LZ. For example, sandy soil and other loose impediments might become airborne when disturbed by rotor wash. Sites chosen for LZs must have soil conditions that are capable of supporting the weight of the aircraft to prevent aircraft from being mired, creating excessive dust, or blowing snow. Loose material can cause obscuring visual conditions.

The proposed LZs for Alternatives 1, 2, and 3 are pre-existing landing areas that are approximately 150 by 150 ft (46 by 46 m). The nature and extent of previous use for LZs 1–3 (located on Mauna Loa) are not fully known, but their disturbed surface areas indicate evidence of previous use. LZs 4–6 (located on Mauna Kea) were established by the 25th CAB and used for previous HAMETs under special-use permits, as described in Subsection 2.5. No modifications to the LZs are needed for the Proposed Action. LZs chosen for consideration under these alternatives met the following criteria:

- They would require aircraft to operate at HAMET elevations (>8,000 ft [2,438 m]) (Lundy 2010)

- Their locations do not interfere with observatory operations
- They do not contain historic properties or threatened and endangered species
- They are pre-existing, used areas that need no modification to make them suitable for HAMET use.

The six LZs proposed to be used under Alternatives 1, 2, and 3 that met the criteria above are shown in Figures 2-8 through 2-13.

The LZs proposed for use lie on State of Hawai‘i lands. To use these LZs, the USAG-HI is required to submit for, and receive, a right-of-entry (ROE) document. The USAG-HI does this by formal request to the Department of Army, Real Estate Branch, of the Hawai‘i DLNR Board (i.e., Board). For HAMET, the military requests use/access of State of Hawai‘i land, in which the LZs lie, that is managed by the DOFAW. The EA and its decision document accompany the request. The request and environmental documents are forwarded to the Board for consideration. The Board reviews the information and may approve the request without comment, or the Board may approve the request with additional conditions to the conditions already presented in the EA and decision document. Conditions the Board adds could involve the Army (e.g., curtailing flight on certain days) and/or the public (e.g., implementing temporary access restrictions or closure of areas). When the request is approved, the DOFAW provides a ROE document for the specified use and time described in the Army’s formal request.

Figure 2-8. LZ-1 – Mauna Loa at latitude 19°36'5.64"N, longitude 155°28'14.64"W, and 7,889-ft (2,405-m) elevation.

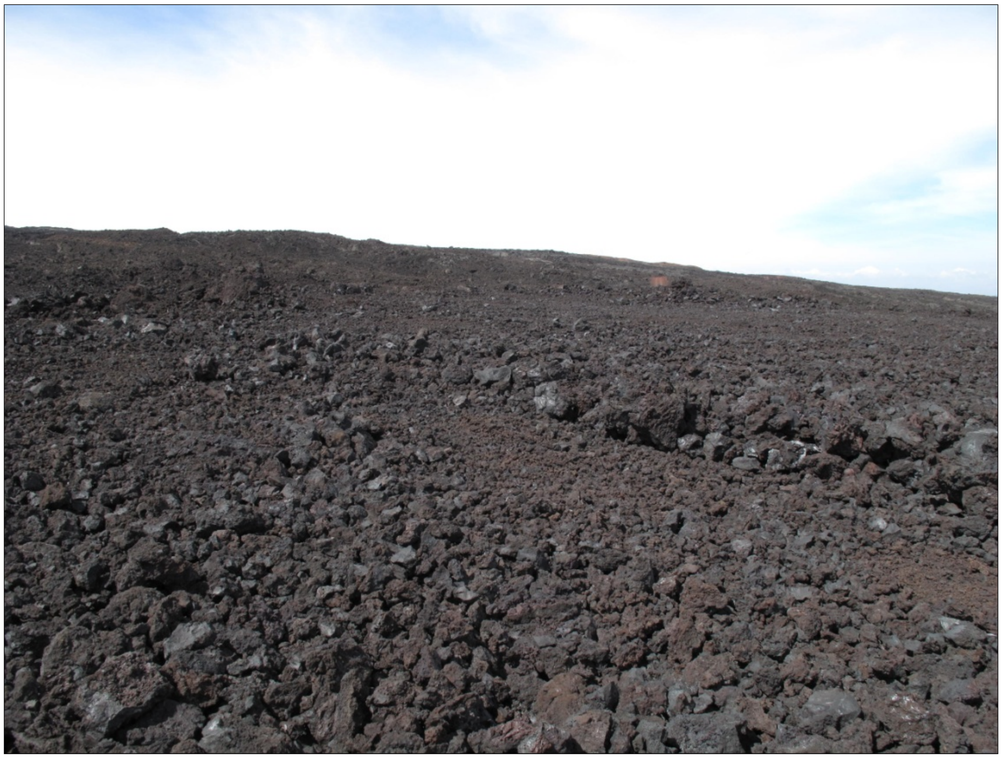

Figure 2-9. LZ-2 – Mauna Loa at latitude 19°36'0.48"N, longitude 155°28'37.74"W, and 8,049-ft (2,453-m) elevation.

Figure 2-10. LZ-3 – Mauna Loa at latitude 19°34'32.10"N, longitude 155°29'21.78"W, and 8,955-ft (2,729-m) elevation.

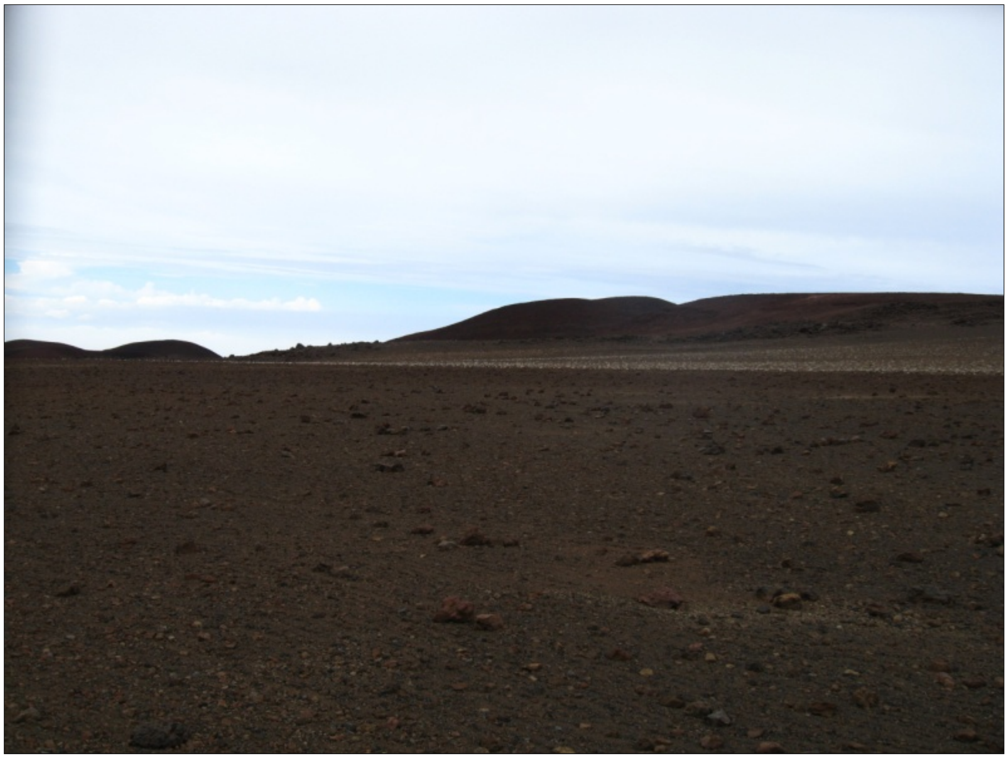

Figure 2-11. LZ-4 – Mauna Kea at latitude 19°49'26.243"N, longitude 155°31'23.509"W, and 11,208-ft (3,416-m) elevation.

Figure 2-12. LZ-5 – Mauna Kea at latitude 19°49'28.315"N, longitude 155°31'47.004"W, and 11,324-ft (3,452-m) elevation.

Figure 2-13. LZ-6 – Mauna Kea at latitude 19°49'12.106"N, longitude 155°31'16.313"W, and 11,539-ft (3,517-m) elevation.

2.7.2.5 Use of LZs. HAMET use of LZs would be as follows under Alternatives 1, 2, and 3:

- Maneuvers conducted at LZs would include VMC takeoff; VMC approach to a landing or a 3-ft (1-m) hover; go-around, slope operations; and pinnacle or ridgeline operations. Pilots would execute multiple touch-and-go, hover, short-stop approach, full-stop landing, and elevated (100–500 ft [30–152 m]) reconnaissance over the high-altitude LZs.

- All hovering, take-offs, and landings would occur inside the LZ(s).

- Avoid flying directly over identified mounds in the vicinity of LZ’s 5 and 6 located on Mauna Kea.

- Aircraft would spend a minimal amount of time (not to exceed 10 minutes) in the LZs.

- At any given time, no more than two aircraft would be in an individual LZ.

- Pilots may receive a short in-cockpit instruction after a full-stop landing before take-off from an LZ.

- LZs would not be used to transport or off-load personnel for ground-based training.

- No personnel would exit the helicopter on the LZ, except that a crew member may exit the helicopter to perform an aircraft inspection on an as-needed basis.

- No drop zone operations would need to be executed.

- No physical modifications of the existing LZs would be made.

2.7.3 Alternative 1 (Preferred Alternative) – Mauna Kea/Mauna Loa

Alternative 1 for the Proposed Action is to conduct HAMET flights from Bradshaw Army Airfield at PTA to three established Mauna Kea LZs and three established Mauna Loa LZs that would provide critical realistic training in a high-altitude, mountainous environment. Within the State of Hawaiʻi, Mauna Kea and Mauna Loa on the island of Hawaiʻi (see Figure 2-3) provide suitable terrain and altitude to accomplish this training task.

Alternative 1 is the Army's preferred alternative for several reasons. The availability of six LZs at various high elevations on two mountains:

- Allows pilots to realistically experience, and complete training for, a full spectrum of high-altitude helicopter operational effects

- Affords the CAB more flexibility by as it increases the probability that the Army can continue flights to non-affected LZs when local weather patterns, particularly diurnal cloud ceiling fluctuations, make some LZs inaccessible

- Decreases use of an individual LZ by spreading total use across a larger number of LZs

- Increases pilot and public safety by increasing the temporal and spatial distancing among flights

- Decreases potential conflicts with hunters/hikers, and other users can be avoided in that the pilot would move to another LZ or another mountain until the potential conflict is gone.

This alternative uses all six LZs presented in Subsection 2.7.2.4, LZ Selection, allowing for completion of HAMET Phase II for 90 aircrew in approximately 20 flying days. The estimated flight time from Bradshaw Army Airfield to the Mauna Kea LZs (approach time) is approximately 7 minutes, and estimated flight time from Bradshaw Army Airfield to the Mauna Loa LZs is approximately 13 minutes. Flight paths of this alternative avoid designated wilderness areas and are designed to avoid close proximity to Kipuka ʻAinahou Nene Sanctuary, Mauna Kea State Recreation Area, the Natural Area Reserve and fly high enough over palila critical habitat as not to disturb palila, if present. The proposed LZs and the aerial extent of the conduct of HAMET are shown in Figure 2-14. Figures 2-15, 2-16, and 2-17 show vertical and horizontal simulated views of HAMET flights on Mauna Kea, and Figures 2-18, 2-19, and 2-20 show vertical and horizontal simulated HAMET flights on Mauna Loa.

2.7.4 Alternative 2 – Mauna Kea

Alternative 2 for the Proposed Action is to conduct HAMET missions from PTA and Bradshaw Army Airfield to three established Mauna Kea LZs that would provide critical realistic training in a high-altitude, mountainous environment. Within the State of Hawaiʻi, Mauna Kea on the island of Hawaiʻi (see Figure 2-3) provides suitable terrain and altitude to accomplish this training task.

HAMET training requirements, flight details, conduct, LZ selection, and use of LZs are the same as detailed in Section 2.7.2, Features Common to Alternatives 1, 2, and 3. This alternative uses only LZ-4, LZ-5, and LZ-6 (i.e., Mauna Kea LZs) presented in Subsection 2.7.2.4, LZ Selection. The estimated flight time from Bradshaw Army Airfield to the Mauna Kea LZs (approach time) is approximately 7 minutes. All flight paths in this alternative are designed to avoid close proximity to Mauna Kea State Recreation Area, the Natural Area Reserve and fly high enough over palila critical habitat as not to disturb palila, if present. The proposed LZs and the aerial extent of the conduct of HAMET under Alternative 2 are shown in Figure 2-21. Figures 2-15, 2-16, and 2-17 show vertical and horizontal simulated views of HAMET flight on Mauna Kea.

2.7.5 Alternative 3 – Mauna Loa

Alternative 3 for the Proposed Action is to conduct HAMET missions from PTA and Bradshaw Army Airfield to three established Mauna Loa LZs that would provide critical realistic training in a high-altitude, mountainous environment. Within the State of Hawaiʻi, Mauna Loa on the island of Hawaiʻi (see Figure 2-3) provides suitable terrain and altitude to accomplish this training task.

HAMET training requirements, flight details, conduct, LZ selection, and use of LZs are the same as detailed in Section 2.7.2, Features Common to Alternatives 1, 2, and 3. This alternative uses LZ-1, LZ-2, and LZ-3 (i.e., Mauna Loa LZs) presented in Subsection 2.7.2.4, LZ Selection. The estimated flight time from Bradshaw Army Airfield to the Mauna Loa LZs is approximately 13 minutes. All flight paths in this alternative are designed to remain clear of all designated federal wilderness areas and the Kipuka ʻAinahou Nene Sanctuary. The proposed LZs and the aerial extent of the conduct of HAMET under Alternative 3 are shown in Figure 2-22. Figures 2-18, 2-19, and 2-20 show vertical and horizontal simulated views of HAMET flight on Mauna Loa.

2.7.6 Alternative 4 – Other High-Altitude Locations in the State of Hawaiʻi

Other high-altitude locations in the State of Hawaiʻi include federal lands on Mauna Loa. Hawaiʻi Volcanoes Wilderness is a federally designated wilderness area within Hawaiʻi Volcanoes National Park. Wilderness designation was established as part of the 1964 Wilderness Act and prohibits development and motorized and mechanized travel, including bicycles. The U.S. Congress designated the Hawaiʻi Volcanoes Wilderness in 1978 with 123,100 acres (49,817 hectares), and it was later expanded to 130,790 acres (52,928 hectares). The area is managed by the National Park Service (NPS). Wilderness designation covers the northwestern extension of the national park (where high-altitude conditions exists), including Mokuʻaweoweo, the summit of the volcano Mauna Loa.

Other than on the island of Hawaiʻi, the only land in the State of Hawaiʻi above 8,000 ft (2,438 m) in elevation is located on the island of Maui (see Figure 2-23). Haleakalā, or the East Maui Volcano, is a massive shield volcano that comprises more than 75% of the island of Maui. The tallest peak of Haleakalā, at 10,023 ft (3,055 m), is Puʻu ʻUlaʻula (Red Hill). Surrounding the summit is Haleakalā National Park, a 30,183-acre (12,215 hectare) area, of which 24,719 acres (100,003 hectares) is wilderness.

State lands on Maui above 8,000 ft (2,438 m) include parcels west and south of Haleakalā National Park. The State Department of Hawaiian Homelands manages lands southwest of Haleakalā National Park as well. Three privately owned areas are also located above 8,000 ft (2,438 m). These areas include Haleakalā Ranch, located northwest of Haleakalā National Park; KJZ, located west of Haleakalā National Park, and Kaonoulu Ranch, located west of Haleakalā National Park. There are eight forest reserve areas (Koʻolau, Makawao, Waihou, Hana, Kula, Kahikinui, Kipahulu, and West Maui) (Hawaiʻi Forestry 2007). The seven forest reserve areas around the Haleakalā summit as can be seen in Figure 2-23. There is one commercial airport (Kahului Airport) on the island. The Army has no aviation support facilities on the island of Maui.

Public Law 100-9 prohibits flight of visual-flight-rules helicopters or fixed-wing aircraft below 9,500 ft mean sea level over the following areas in Haleakalā National Park: Haleakalā Crater, Crater Cabins, Scientific Research Reserve, Halemauʻu Trail, Kaupa Gap Trail, or any designated tourist viewpoint. In addition to Public Law 100-9, noise abatement areas exist on the island of Maui (DOT 2010b). Specifically, noise abatement areas cover most of the accessible points above 8,000 ft (2,438 m) in the Haleakalā National Park. Figure 2-24 shows the noise abatement areas on the island of Maui.

A potential landing area for HAMET is located near the 10,000-ft (3,048-m) elevation on the southwest ridge of Haleakalā. This area is located on state land outside of the forest reserves and the Halelakalā National Park. This area is roughly 5 by 0.25 miles (8 by 0.4 kilometers). Figure 2-23 also shows four glider activity areas. “Guided” paragliders launch from Polipoli Flight Park located in Polipoli Spring State Recreation Area, the main paragliding site on Maui. It is flyable an average of 330 days a year. Located on the lee side of Mount Haleakalā, this area is protected from the trade winds. The geography allows an area of calm air to set up each morning, which heats up by the sun and allows launches as early as 2 hours after sunrise. The highest launch site is Ferns Launch at 6,500 ft (1,981 m) mean sea level and provides for a 3,000-ft (914-m) decent to the nearest LZ (Proflyght Paragliding 2011**)**. On the other side of Halelakalā, where winds are stronger, powered hang gliders are operated. It is unknown how many “unguided” aerialists use vendor launches and other launch sites for sport-flying activities throughout this vicinity of the islands.

2.7.7 Alternative 5 – Other High-Altitude Training Sites on the CONUS Alternative

Offsite HAMET could be conducted at the Army National Guard training site in Gypsum, Colorado, with provided mountainous operations for rotor-wing military pilots. Training at the Gypsum site is approximately 1 week, which includes 1 day of classroom instruction to learn power management in high-altitude, mountainous terrain and 4 days of tactical high-altitude (6,500–14,000 ft [1,981–4,267 m]) terrain training. Aircraft located at the Gypsum facility that may be “borrowable” include the OH-58C Kiowa and UH-60A Black Hawks (Colorado National Guard 2010). However there are no training slots available to schedule.

Another possible offsite location for HAMET that the 25th CAB considered is at Fort Carson in Colorado Springs, Colorado. Although most of the 25th CAB is going to conduct a majority of the HAMET requirement at Fort Carson, it is undesirable and exorbitantly expensive to capture the training needs of new pilots assigned to the CAB during this time and those pilots who need to conduct additional training to meet the advanced requirement. Aircrews will spend up to an additional 45 days away from Families prior to the upcoming deployment; and helicopters and maintenance crews will spend additional time on the mainland, which when combined, impacts what is referred by the military as “perstempo". Perstempo is defined as the time an individual spends away from home station.

Additionally, HAMET was considered outside Fort Bliss in El Paso, Texas. The Fort Bliss location has desert-like mountains, which are quite different than the terrain found at Gypsum, Colorado, but the Texas site does allow pilots to become partially familiar with terrain similar to that found in Afghanistan (Futrell 2010). Most importantly to consider is that there are no borrowable aircraft at Fort Bliss and no training slots available to schedule.

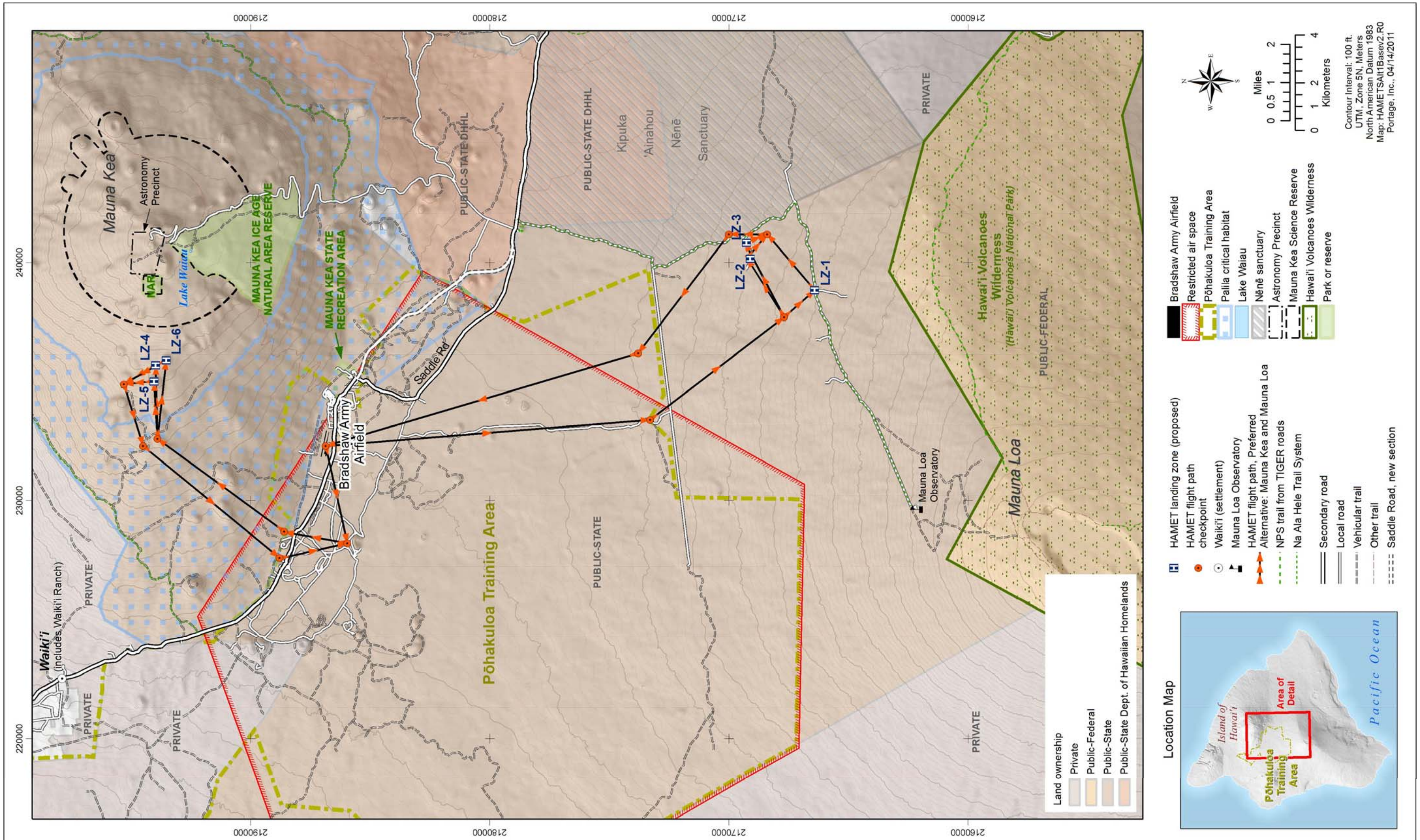

Figure 2-14. HAMET Alternative 1: Mauna Kea and Mauna Loa (Preferred Alternative).

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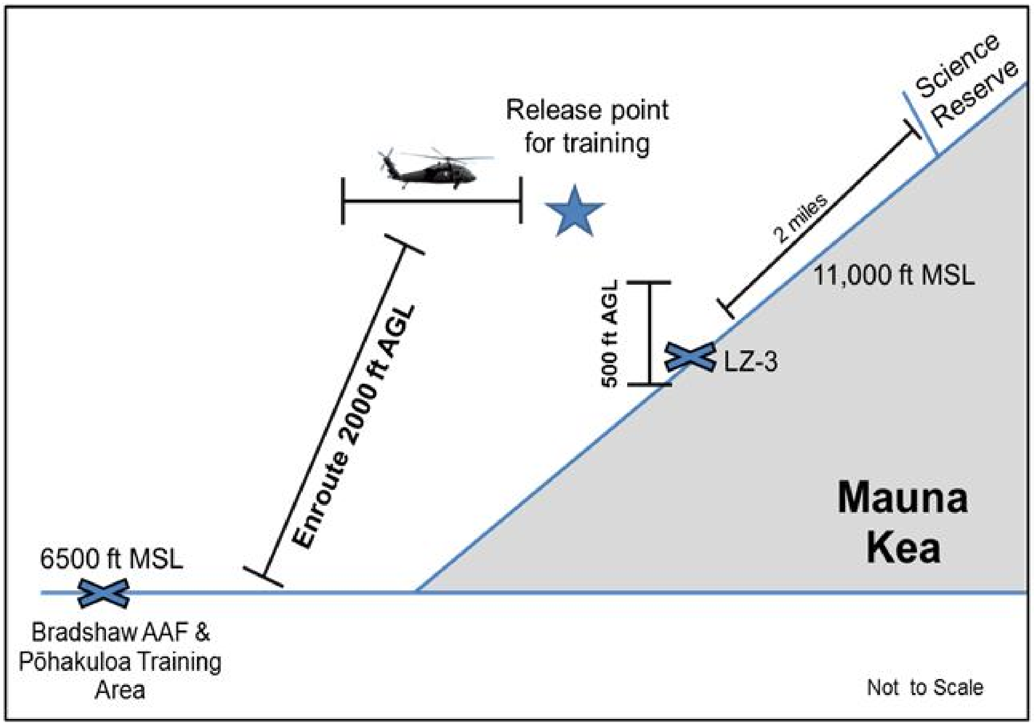

Figure 2-15. Vertical simulated view of HAMET flight on Mauna Kea.

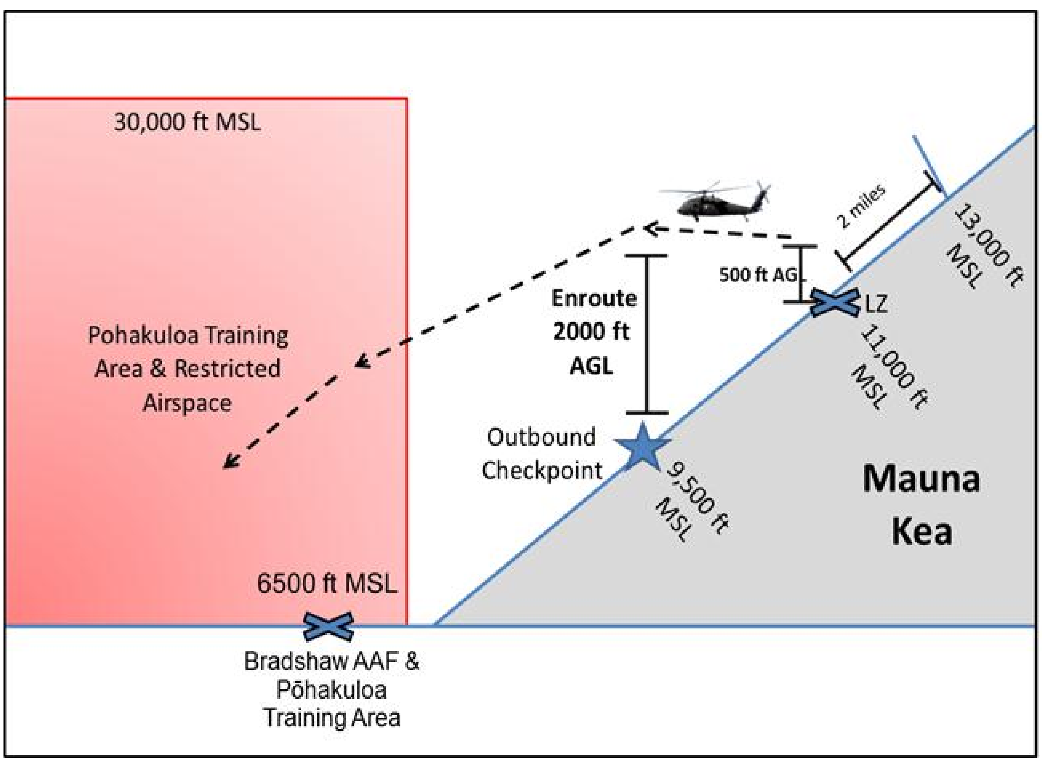

Figure 2-16. Vertical simulated view of HAMET return flight on Mauna Kea.

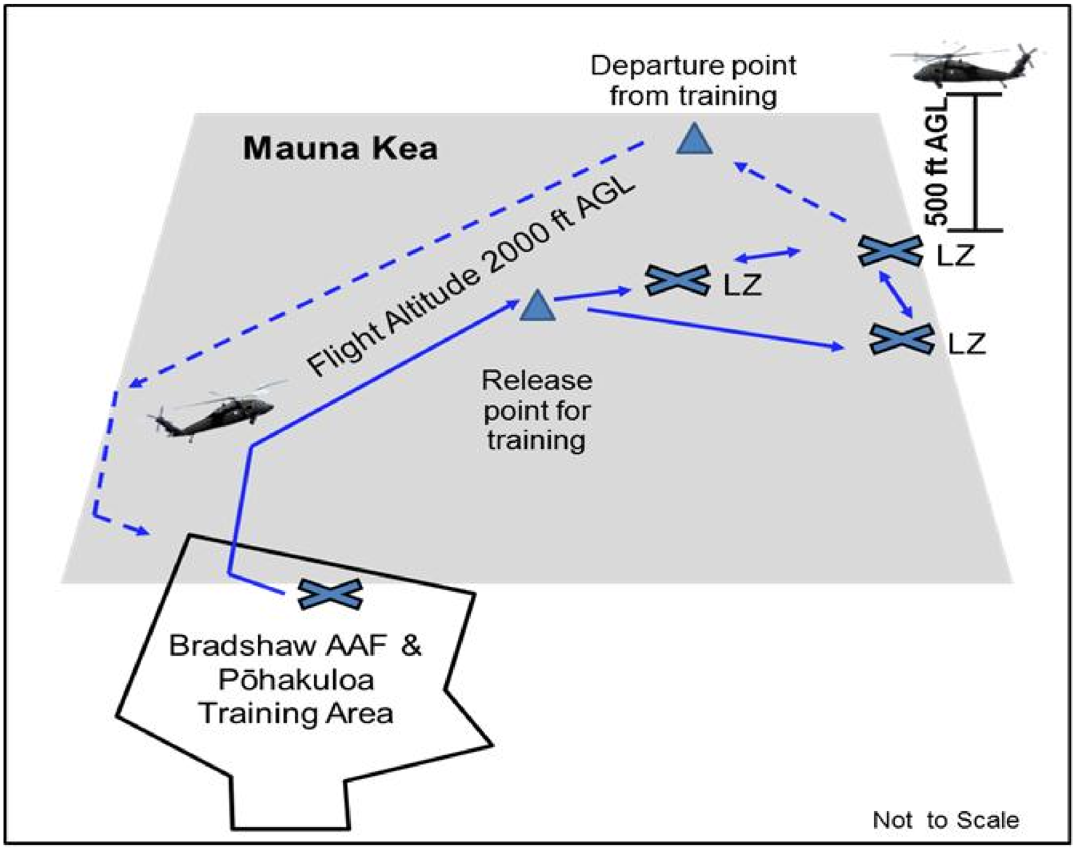

Figure 2-17. Horizontal simulated view of HAMET flight on Mauna Kea.

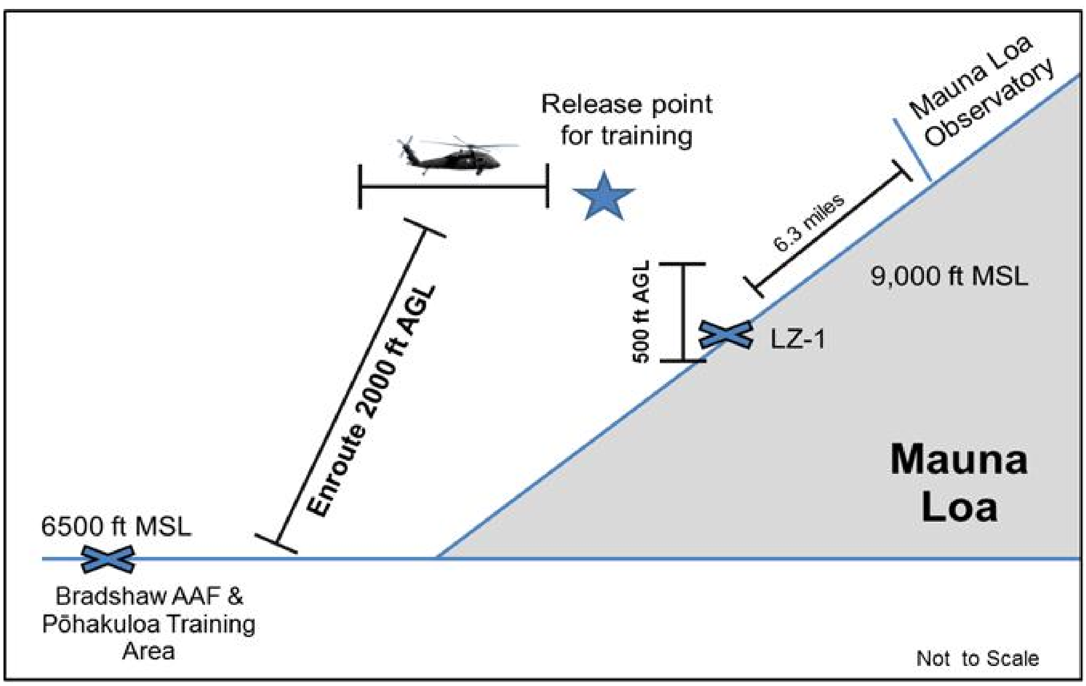

Figure 2-18. Vertical simulated view of HAMET flight on Mauna Loa.

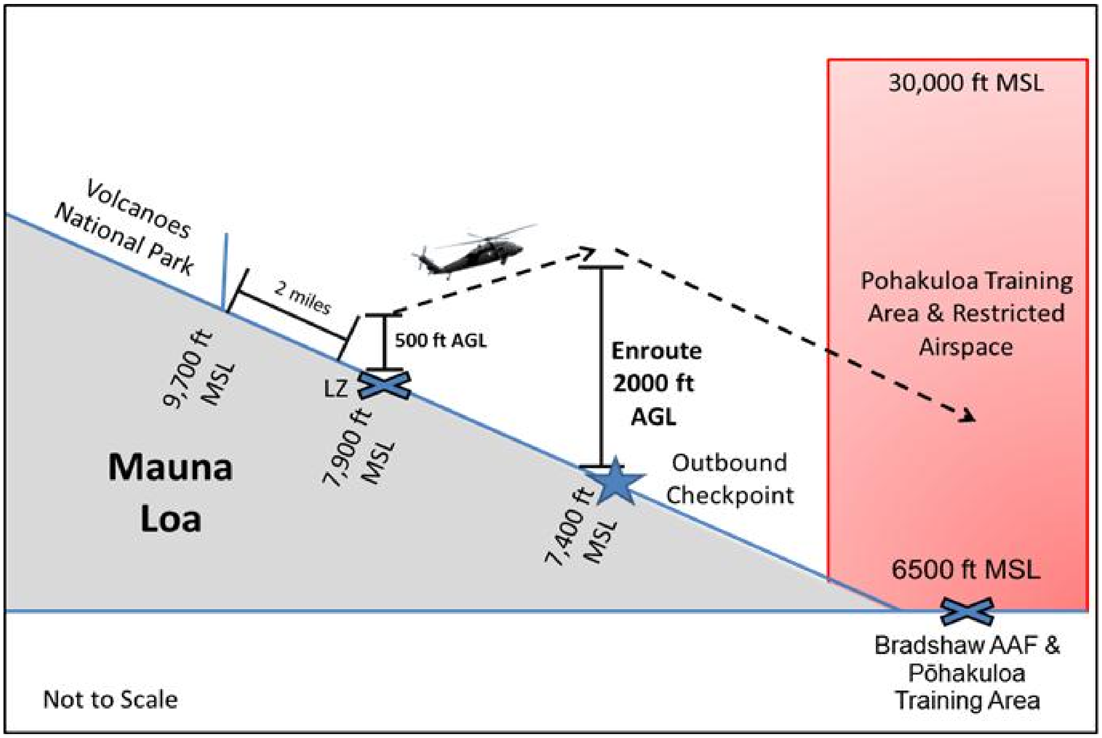

Figure 2-19. Vertical simulated view of HAMET return flight on Mauna Loa.

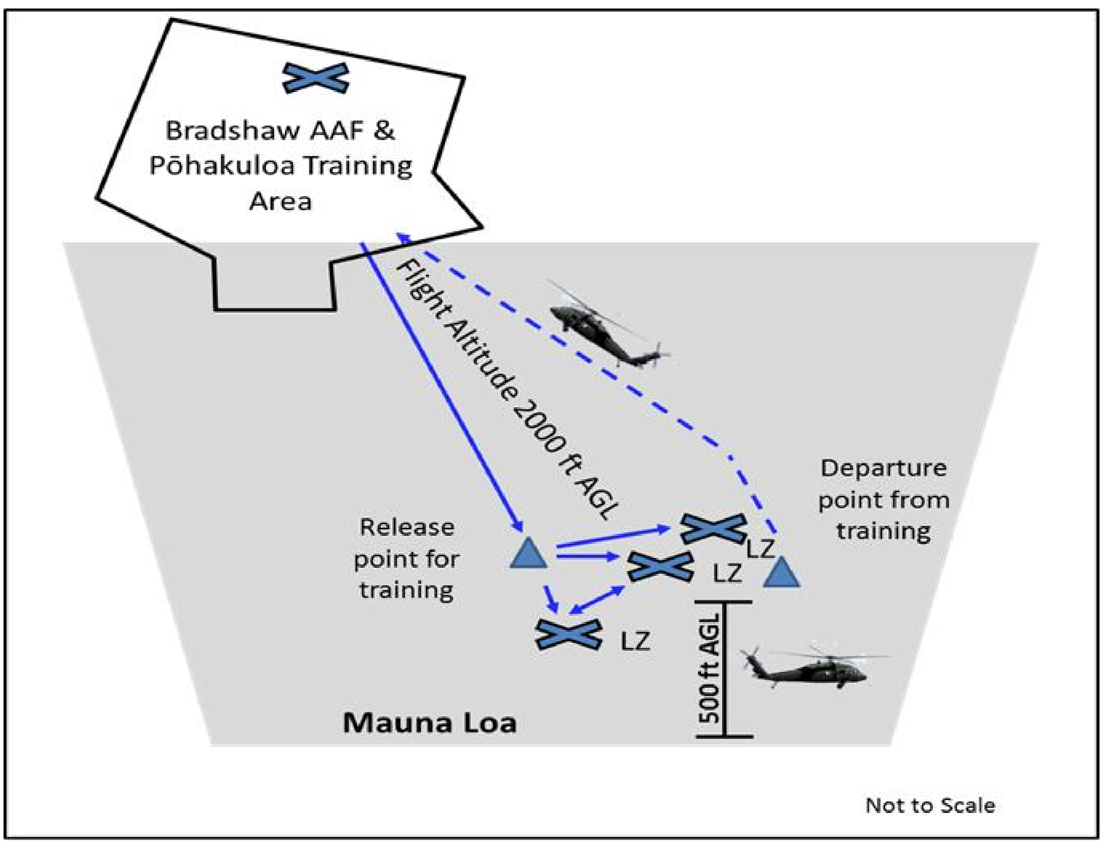

Figure 2-20. Horizontal simulated view of HAMET flight on Mauna Loa.

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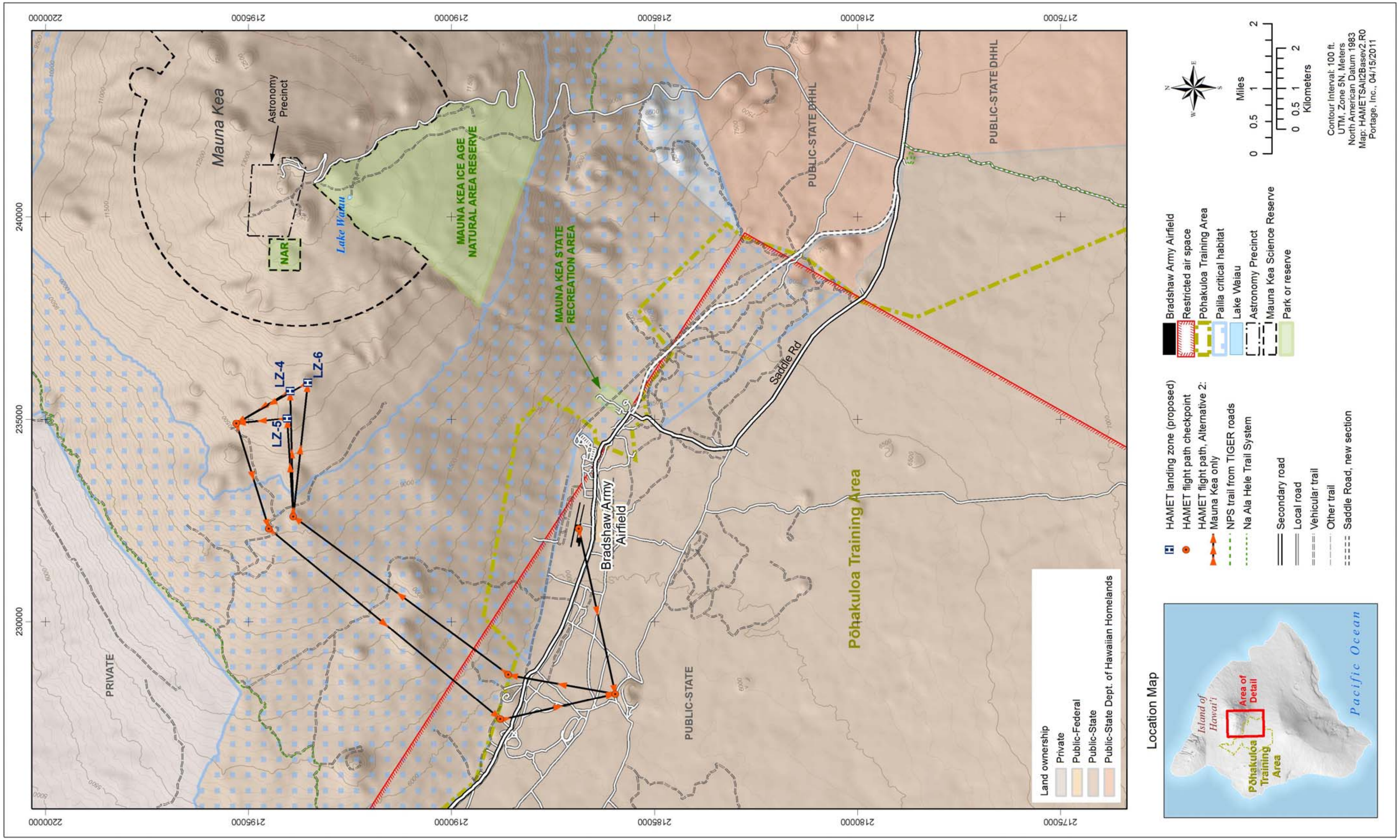

Figure 2-21. HAMET Alternative 2: Mauna Kea.

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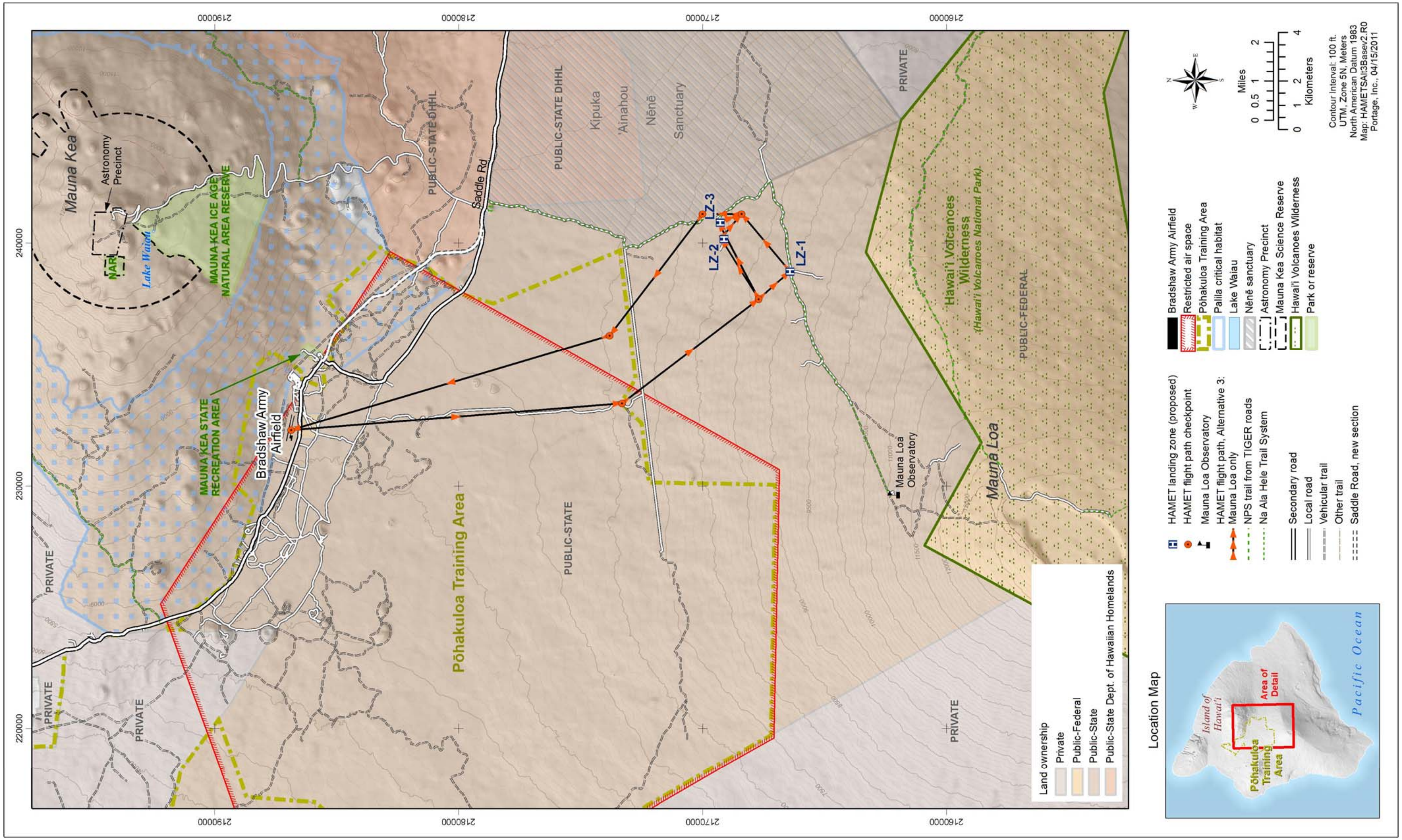

Figure 2-22. HAMET Alternative 3: Mauna Loa.

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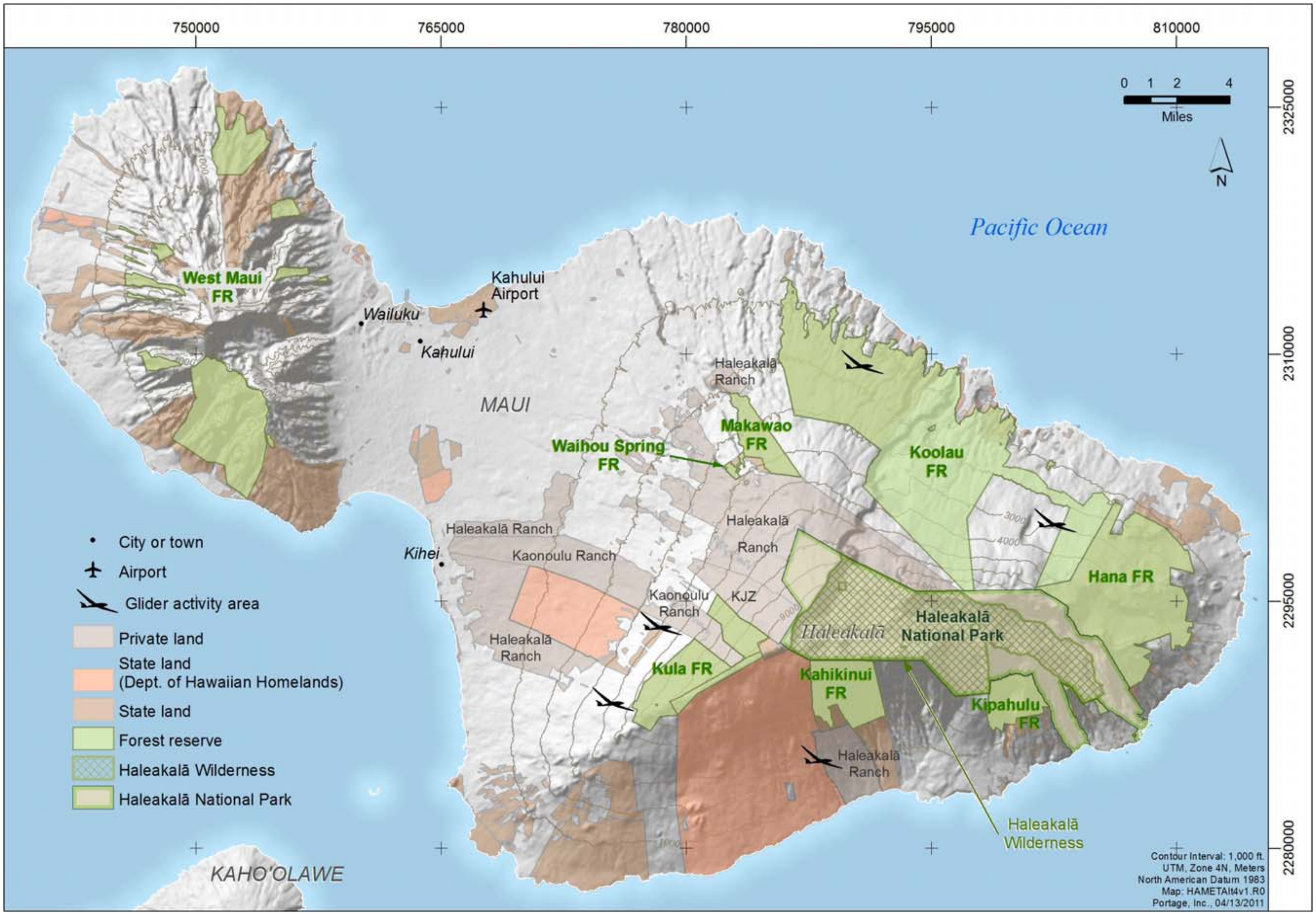

Figure 2-23. Forest Reserve System on Maui.

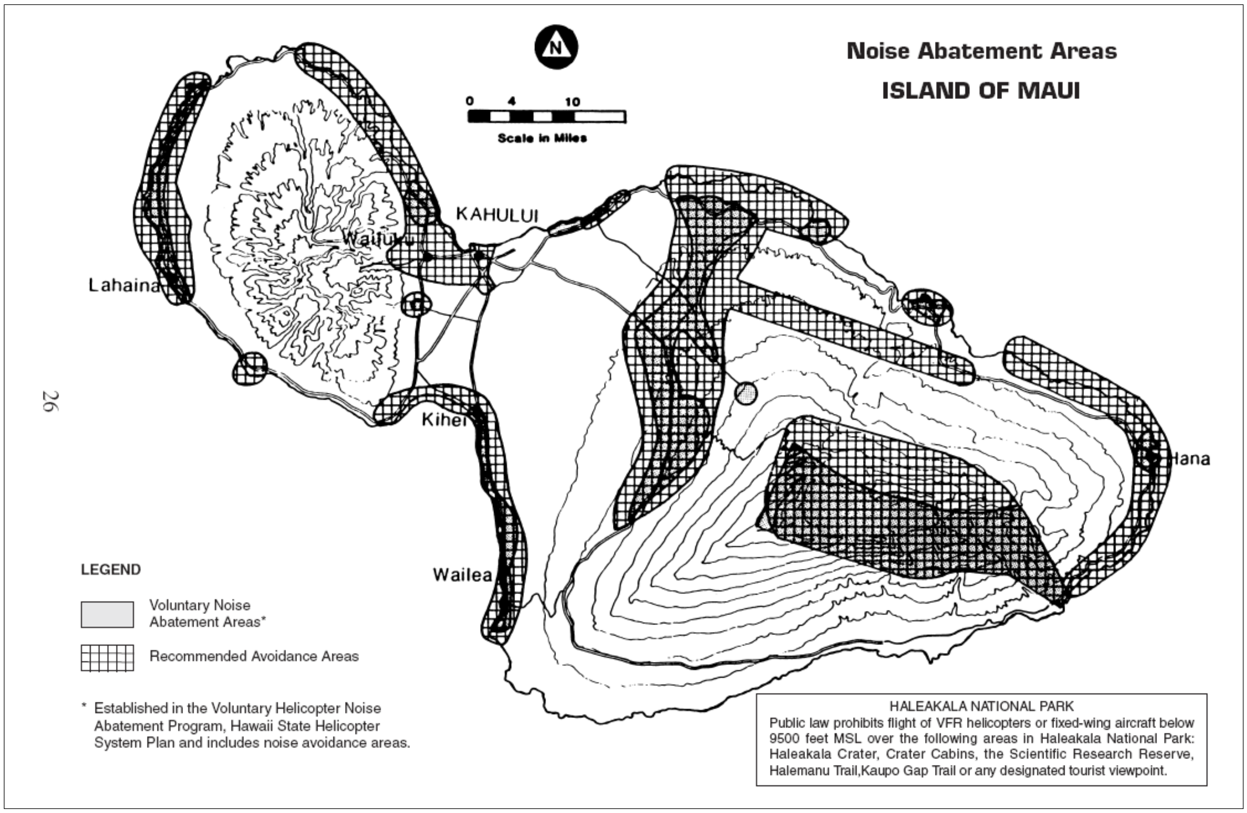

Figure 2-24. Noise abatement areas on the island of Maui from DOT (2010b).

2.7.7.1 Features of the Alternative. This alternative would require the physical relocation to the mainland of the proposed 90 trainees and many additional aircraft. Two methods of physical transport of aircraft from Wheeler Army Airfield in Hawai‘i to the mainland and then to Gypsum, Colorado, or Fort Bliss in Texas, could be used: sealift and/or airlift. Sealift would require between 28 and 50 days (round trip) for aircraft to leave Hawai‘i, arrive in Colorado (or to arrive at Fort Bliss) and be returned to Hawai‘i through the following steps:

- Two days are required for aircraft to be prepared for shipping and loaded for transport from O‘ahu via the Honolulu Harbor commercial port.
- Aircraft would then be set to sail for 6 days to reach Long Beach California or the San Diego, California, commercial port or for 21 days to reach the Beaumont, Texas, commercial port.
- At any of the three ports, 3–4 days would be required to unload and reassemble aircraft prior to flight. Flight time to Gypsum, Colorado, is 2 days from Texas and 4 days from the California ports. Flight time to Fort Bliss is between 6 and 8 hours from the Beaumont, Texas, commercial port.

Airlift would require between 14 and 16 days (round trip) for aircraft to leave Hawai‘i, arrive in Gypsum, Colorado, (or at Fort Bliss, Texas) and be returned to Hawai‘i through the following steps:

- Two days are required to load helicopters for airlift onto military transports at Hickam Air Force Base, O‘ahu.

- Aircraft and pilots would be transported via an 8-hour flight to either Fort Carson, Colorado, or to the Colorado Springs Airport. Aircraft and pilots would be transported via a 10-hour flight to Fort Bliss, Texas.

- At any of the three airports, 3–4 days are required to unload and reassemble aircraft prior to flight.

- While offsite, helicopter maintenance could require shipment of parts from Wheeler, which could result in training downtime (Mansoor 2010). Additionally, specialized aircraft mechanics, inspectors, and maintenance test pilots would need to be deployed, impacting the home station mission.

- Pre-deployment helicopter training for non-HAMET pilots is occurring at present and would continue at Wheeler Army Airfield and PTA. Offsite HAMET pilots would require the availability of the same bench-stock and maintenance personnel who would be supporting the current pre-deployment training (Mansoor 2010).

- To remain current in mountain operations for deployment when an offsite training location is used, training would have to be conducted close to the actual date of a unit's deployment. Offsite locations would have to accommodate this need (Mansoor 2010).

2.7.7.2 Training Requirements. Training requirements are the same those as detailed in Subsection 2.7.2, Features Common to Alternatives 1, 2, and 3, and in Subsection 2.7.2.1, Training Requirements, except:

- HAMET Phase II would be a stand-alone exercise based out of Gypsum, Colorado, or Beaumont, Texas, based on facility availability

- UH-60 Black Hawks and CH-47 Chinooks would be transported to Gypsum, Colorado, or Beaumont, Texas, based on facility availability.

2.7.7.3 HAMET Flight Details, HAMET Conduct, LZ Selection, and Use of LZs. HAMET flight details, conduct, LZ selection, and use of the LZs would be in accordance with the requirements of the Gypsum, Colorado, (or the Fort Bliss) facility(ies).

2.7.8 The No Action Alternative

As required by the CEQ, the No Action Alternative serves as a benchmark against which the Action Alternatives can be evaluated. Because the Proposed Action analyzed in this EA is for the USAG-HI to conduct high-altitude, mountainous-environment training in preparation for deployment in support of OEF and future related theater actions (as well as to satisfy compulsory aviation training doctrine), HAMET Phase II would not be conducted if no action were taken.

2.8 Alternative Screening

This EA carries forward for evaluation a range of alternatives considered to be reasonable. In determining whether an alternative was reasonable, each identified alternative was evaluated against the stated purpose and need in Subsections 1.3 and 1.4. Summarized, the need of the Proposed Action is to ready helicopter crews to be successful in the combat theater to support the operational and mission requirements for deployment in support of operations in Afghanistan and future related theater actions.

To evaluate all proposed alternatives and determine which of those could meet this need, and thus be carried forward for full evaluation, the following screening criteria were developed:

- Availability: A reasonable alternative should have the availability (both time and space) to begin training 25th CAB pilots in October 2011 to allow the CAB to meet available-for-deployment status. A reasonable alternative should also possess the facilities to meet HAMET requirements specified in Section 1, including the requirement to train at an elevation of 8,000 ft (2,438 m) or higher.

- Throughput: Throughput is the number of pilots that can be put through a process. A reasonable alternative from a throughput standpoint for the Proposed Action would be the number of soldiers that can be trained to proficiency prior to December 31, 2011.

- Time and Cost: These pilots must be trained beginning in October 2011 and have completed training by December 31, 2011, for the CAB to meet available-for-deployment status. This means that training facilities must be available within a geographic distance that allows pilots to deploy logistically, and with aircraft, to and from training locations to complete essential training tasks within established timeframes. Each unit has a limited amount of time and money to achieve training requirements. The time and cost of transport cannot be so excessive that they compromise the CAB's ability to meet all mission-essential tasks and readiness requirements.

- Quality of Life: A reasonable alternative should ensure that soldiers are not separated from their families for unreasonable periods. Quality of life for soldiers and their families is critical to retaining experienced soldiers. This is especially so when world events require many soldiers to deploy overseas for more than 1 year at a time. One of the Army's priorities is to increase dwell time from the current 12–18 months to 2 years by the end of 2011 (Daniel 2010).

2.9 Alternative Evaluation

After the five alternatives were detailed, the USAG-HI reevaluated them against the purpose, need, and screening criteria presented previously, and the results are shown in Table 2-1. To be considered a reasonable alternative and carried forward for full analysis, an alternative had to meet the purpose and need and had to satisfy all four screening criteria. All screening criteria were considered independently.

After conducting its evaluation, the USAG-HI determined that Alternatives 1, 2, and 3 satisfied the need criteria; these alternatives are evaluated further in this EA. As required by NEPA, the No Action Alternative, although considered unreasonable because it does not meet the purpose or need, is also evaluated further in this EA.

The USAG-HI concluded that Alternative 4, Other High-Altitude Locations in the State of Hawai‘i, is not feasible as a result of the following:

- Wilderness areas, including the federal lands on Mauna Loa and surrounding the summit in Haleakalā National Park, cannot be used for motorized vehicles.

- Federal lands on Maui are designated NPS areas and require aviators to avoid overflights below 2,000 ft (610 m).

- The area best suited for HAMET flight would require sharing airspace with hang gliders, paragliders, and other types of unregulated sport flyers. According to FAA regulations, gliders have the right-of-way over rotorcraft (i.e., helicopters) (14 CFR I § 91.113). Military helicopters and personal-powered and unpowered aircraft are incompatible uses of the airspace and extremely unsafe.

- HAMET operations would require the USAG-HI to conduct operations from Kahului Airport, a civilian facility. Permissions and extensive coordination with airfield management would be required for co-use of civilian facilities. This coordination would push the timeline for start of HAMET operations past the June 2011 target date**.**

Table 2-1. HAMET alternatives evaluation**.**

Screening Criteria[a]	1 Mauna Kea and Mauna Loa	2 Mauna Kea	3 Mauna Loa	4 Another Hawai‘i Site	5 Continental U.S. site
Availability	X	X	X	–	X
Throughput	X	X[b]	X[b]	X[b]	X
Time/Cost	X	X	X	–	–
Quality of Life	X	X	X	X	–

a. Each criterion is considered independently.

b. Throughput can be achieved but will require additional training days.

X = Meets criteria.

— = Does not meet criteria.

Alternative 5, Other High-Altitude Training Sites, The USAG-HI concluded that Alternative 5, Other High-Altitude Training Sites, was considered unreasonable, because of the following:

- The decrease in dwell time that would result from mainland training in light of upcoming overseas deployment
- Estimated to cost approximately $2M to send pilots and keep aircraft and maintenance crews on the mainland longer.
- The excess time the logistical challenges would require that could risk the CAB’s ability to be trained prior to deployment
- The high cost and time associated with transporting soldiers, keeping aircraft, and support staff on the mainland and the disruption of other deployment-required training in Hawai‘i that mainland HAMET could incur.

Thus, as shown in Table 2-1, the Army determined that Alternatives 4 and 5 did not satisfy the needed criteria, were unreasonable, and/or did not meet the screening criteria. Therefore, these alternatives were eliminated from further review.

2.10 Alternatives Not Considered Further

As a result of their evaluation, Alternative 4, Other High-Altitude Locations in the State of Hawai‘i, and Alternative 5, Other High-Altitude Training Sites, were not further considered in the analysis.

3. AFFECTED ENVIRONMENT

This section provides an overview of the existing VECs that occur within the vicinity of the Proposed Action and the Action Alternatives. The region of influence (ROI) overall is the area that potentially can be directly or indirectly affected by the Action Alternatives. The ROI may vary depending on the specific VEC. However, only resource areas relevant to the Proposed Action are presented in this EA. These resources include climate; air quality; land use; recreation; geology and topography; soils and hydraulic properties; water resources; biological resources, vegetation, and wildlife; cultural resources; socioeconomics and environmental justice; noise; visual and aesthetic resources; human health and safety; traffic and circulation; and utilities and public services.

The ROI, unless stated otherwise in a specific VEC discussion, is the designated flight path and the area 3,280 ft (1,000 m) from the center of the LZs, as defined by each specific Action Alternative.

3.1 Climate

The most prominent feature of the circulation of air across the tropical Pacific Ocean is the persistent trade-wind flow in a general east-to-west direction. The trade winds blow across Hawaiʻi primarily from the northeast quadrant throughout the year, with the windiest months being from May through September. The trade winds blow approximately 80% of the time in the summer and 50% of the time in the winter. In addition to the trade winds, wind patterns are influenced by major storm systems and by topographic features that alter or channel prevailing wind directions. Topographic features have additional influences on local wind patterns in coastal areas, with upslope/downslope flow patterns often reinforcing sea-breeze/land-breeze patterns. Local winds tend to move inland from the coast during midmorning to early evening periods, then reverse direction and flow offshore during night and early morning hours. The onshore sea breeze component tends to be stronger than the offshore land breeze component. Sea/land breeze patterns are most common on the south and west coasts of the Hawaiian Islands.

The combination of a dominant trade-wind pattern and limited seasonal changes in the length of day and night combine to limit seasonal variations in weather conditions in Hawaiʻi. Weather conditions in Hawaiʻi show a two-season pattern, with a winter season of 7 months (October through April) and a summer season of 5 months (May through September). The summer months generally are warmer and drier than the winter months. Most major storms occur during the winter season. Seasonal variations in temperature conditions are mild at lower elevations, with daytime temperatures commonly between 75 and 85°F (24 to 29°C) and nighttime temperatures between 65 and 75°F (18 to 24°C).

In the summit regions, winter temperatures range from 10 to 40°F (−12 to 4°C), but wind chill can bring the temperature to below 0°F (−18°C); summertime temperatures recorded at the summit range from less than 30 up to 60°F (–1 to 15°C). Annual precipitation ranges from approximately 20 in. (51 cm) at an altitude of 12,600 ft (3,840 m) to approximately 15.5 in. (39 cm) (including snowfall) at an altitude of 13,375 ft (4,077 m). Storms, including wintertime cold fronts, upper-level and surface low-pressure systems, tropical depressions, and hurricanes, provide most of the annual precipitation over a very short period. Varying amounts of snow and ice regularly fall near the summit, concentrated during January through March and rarely from June to September.

Wind velocities usually range from 10 to 30 miles per hour (mph) (16 to 48 kilometers per hour [km/h]) in the summit region. During severe winter storms, though, winds can exceed 100 mph (161 km/h) on exposed summit areas, such as the tops of cinder cones. High winds are also common due to atmospheric anomalies, such as the jet stream dipping down or low- and high-pressure systems that create vortexes. Other unique characteristics found in the summit regions include minimal cloud cover, with about 325 days per year being cloud free, and low water vapor level, which means the atmosphere is more transparent. The dry and breezy conditions facilitate high rates of evaporation at the summit and maintain the cool, dry atmosphere.

The typical climate around the proposed LZ elevations would be similar to that at Hale Pōhaku, at 9,200 ft (2,804 m), with a temperature range between 30 and 70°F (−1 and 21°C) throughout the year. At Hale Pōhaku, it is not uncommon for winds to reach upwards of 20 mph (32 km/h). Annual precipitation ranges from 12 to 20 in. (30 to 50.8 cm), with most rain occurring between November and March. Fog is common, and snow is rare.

The climate at elevations below the LZs at PTA is classified as cool and tropical (upper montane to alpine). The average annual temperature is 55°F (12.8°C), with small fluctuations. Diurnal temperature fluctuations are greater than seasonal variations.

Meteorological conditions that may impact the island and the LZs on a daily basis are the effects of the diurnal wind patterns and temperature inversions. Diurnal wind patterns consist of localized winds that tend to move inland from the coast during the day and then reverse direction and flow offshore at night and in the early morning. Temperature inversions occur when hot air, which normally rises without restriction, is trapped by cooler air above. This situation happens at the 5,000- to 7,000-ft (1,524- to 2,133-m) elevations and above land masses. Both Mauna Kea and Mauna Loa are high enough for temperature inversions to develop.

Temperature inversions develop most frequently in the summer when the air above the island becomes warmer. Moisture is forced from the rising trade winds at the inversion layer, where it is trapped below the inversion zone. Orographic rainfall may be a result. If the mountain is above the inversion zone, dryer air released from below may rise to the mountaintop, creating desert-like conditions above the inversion zone.

The formation of the inversion layer may result in moist air in the form of clouds or fog being trapped at the inversion layer, causing restricted visibility. As shown in Figure 3-1, clouds or fog trapped at the inversion layer will generally rise as daytime ambient temperatures rise and the daytime diurnal wind pattern flow is up the mountain. Conversely, clouds or fog trapped at the inversion layer will drop in elevation as nighttime temperatures fall and the diurnal wind pattern is down the mountain. The result is that during inversion conditions, cloud cover or fog may lift or fall to cover the LZs, potentially impacting training operations. Also, because the LZs on Mauna Kea and Mauna Loa differ in elevation by more than 1,000 vertical ft (305 m), the visibility at the LZs could be impacted only on Mauna Kea, only on Mauna Loa, or at both locations (Millen 2010).

3.2 Air Quality

Air pollution levels in Hawai‘i generally are low due to the small size and isolated location of the state. The state’s isolated location means that upwind areas do not contribute significant background pollution levels. The state’s small size limits opportunities for locally generated air pollutants to accumulate or recirculate before being transported offshore and away from land areas. Locally generated contributors to air pollution in the area of the LZs include vehicle exhaust and fugitive dust. However, dust and other emissions quickly dissipate, while smoke from wildland fires can last longer (Gene Stout & Associates and DPW 2002).

Figure 3-1. Clouds trapped in the inversion layer in the valley between Mauna Kea and Mauna Loa (seen in the distance). Photograph courtesy of M. Lasky (taken March 21, 2010).

Localized fugitive dust can be generated by wind effects on exposed soils and unpaved roads, and this dust would be expected from the high-altitude aviation training operations. High concentrations of suspended particulate matter can occur in some lower-elevation areas, mostly due to agricultural burning or fireworks (U.S. Army 2004b). The entire state is classified as being in compliance with federal ambient air quality standards, or "in attainment" (USAEC 2008).

The Mauna Kea LZs are located approximately 2 to 3 miles (3.5 to 4.5 kilometers) away from the summit of Mauna Kea and its observatories. The Mauna Loa LZs are located approximately 6 to 8 miles (10 to 12 kilometers) away from the summit of Mauna Loa and its observatory. The LZs are also located approximately 2,000 to 3,000 ft (610 to 914 m) below the summits and, for the most part, downwind of the summits.

The Mauna Loa Observatory (MLO) is located on the north flank of Mauna Loa Volcano at an elevation of 11,135 ft (3,394 m). MLO is best known for its measurements of rising anthropogenic carbon dioxide concentrations in the atmosphere. MLO also measures ozone, solar radiation, and both troposspheric and stratospheric aerosols. Data from MLO are also used to calibrate and verify data from satellites and stations around the world.

3.2.1 Ambient Air Quality Standards for Criteria Pollutants

Ambient air quality is the atmospheric concentration of a specific compound experienced at a particular geographic location that may be some distance from the source of the relevant pollutant emissions. The U.S. Environmental Protection Agency (EPA) has established ambient air quality standards for several different pollutants that often are referred to as criteria pollutants (ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, suspended particulate matter, and lead). The term "criteria pollutants" is derived from the requirement that the EPA must describe the characteristics and potential health and welfare effects of these pollutants. Suspended particulate matter is any solid or liquid that can remain suspended in the atmosphere for more than a few minutes. Standards for suspended particulate matter have been set for two size fractions—inhalable particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$). Federal ambient air quality standards are based primarily on evidence of acute and chronic (or short- and long-term) health effects. Federal ambient air quality standards apply to outdoor locations to which the general public has access.

Hawai‘i, along with other states, has adopted ambient air quality standards that are in some areas more stringent than the comparable federal standards and address pollutants that are not covered by federal ambient air quality standards. The state ambient air quality standards are based primarily on health effects data but can reflect other considerations, such as protection of crops, protection of materials, or avoidance of nuisance conditions (such as objectionable odors). Table 3-1 summarizes federal and state ambient air quality standards applicable in Hawai‘i.

3.2.2 Hazardous Air Pollutants

Federal air quality management programs for hazardous air pollutants focus on setting emission limits for particular industrial processes rather than setting ambient exposure standards. Some states have established ambient exposure guidelines for various hazardous air pollutants and use those guidelines as part of the permit review process for industrial emission sources.

Hawai‘i has adopted ambient concentration guidelines for hazardous air pollutants. Those guidelines are used as part of the permit review process for emission sources that require state or federal air quality permits. The Hawai‘i ambient exposure guidelines for hazardous air pollutants include the following (State of Hawai‘i 2003):

- For noncarcinogenic compounds, an 8-hour average concentration equal to 1% of the corresponding 8-hour threshold level value (TLV) adopted by the Occupational Safety and Health Administration (OSHA)

- For noncarcinogenic compounds, an annual average concentration equal to 1/420 (0.238%) of the 8-hour TLV adopted by OSHA

- For noncarcinogenic compounds for which there is no OSHA-adopted TLV, ambient air concentration standards set by the Director of Health on a case-by-case basis so as to avoid unreasonable endangerment of public health with an adequate margin of safety

- For carcinogenic compounds, any ambient air concentration that produces an individual lifetime excess cancer risk of more than 10 in 1 million assuming continuous exposure for 70 years.

While these guidelines exist, they apply only to point sources and do not apply to mobile sources, such as aircraft (e.g., HAMET aircraft), automobiles, and trucks (State of Hawai‘i 2003).

Table 3-1. State and national ambient air quality standards (AAQS) applicable in Hawai‘i.

Air Pollutant	Measure	Hawai‘i AAQS	Federal Primary Standard	Federal Secondary Standard
Carbon monoxide	1-hr average	9 ppm	35 ppm	None
	8-hr average	4.4 ppm	9 ppm	None
Nitrogen dioxide	1-hour average	None	100 ppb	None
	Annual average	0.04 ppm	0.053 ppm	Same as primary
PM_{10}	24-hr block average	150 µg/m^3	150 µg/m^3	Same as primary
	Annual average	50 µg/m^3	None	None
$PM_{2.5}$	24-hr block average	None	35 µg/m^3	Same as primary
	Annual average	None	15 µg/m^3	Same as primary
Ozone	8-hr rolling average	0.08 ppm	0.075 ppm	Same as primary
Sulfur dioxide	1-hr average	None	75 ppb	None
	3-hr block average	0.5 ppm	—	0.5 ppm
	24-hr block average	0.14 ppm	0.14 ppm	—
	Annual average	0.03 ppm	0.03 ppm	—

Notes:

ppb = parts per billion

ppm = parts per million

All standards except the national PM_{10} and $PM_{2.5}$ standards are based on measurements corrected to 77°F (25°C) and 1 atmosphere pressure.

The national PM_{10} and $PM_{2.5}$ standards are based on direct flow volume data without correction to standard temperature and pressure.

The “10” in PM_{10} and the “2.5” in $PM_{2.5}$ are not particle size limits; these numbers identify the particle size class (aerodynamic diameter in microns) collected with 50% mass efficiency by certified sampling equipment. The maximum particle size collected by PM_{10} samplers is about 50 microns. The maximum particle size collected by $PM_{2.5}$ samplers is about 6 microns.

Data Sources:

40 CFR § 50, 2010, “National Primary and Secondary Ambient Air Quality Standards.”

State of Hawai‘i, 2001, “Ambient Air Quality Standards,” Hawai‘i Administrative Rules, Title 11, Chapter 59, State of Hawai‘i, Clean Air Branch, September 15, 2001.

State of Hawai‘i, 2010, *Federal and State Ambient Air Quality Standards*, Clean Air Branch, Hawai‘i Department of Health, Honolulu, Hawai‘i, online via: http://hawaii.gov/health/environmental/air/cab/cab_misc_pdf/naaqs_sep_2010.pdf.

3.2.3 Air Quality Planning Programs

The federal Clean Air Act (42 USC 85 § 7401 et seq.) requires each state to identify areas that have ambient air quality in violation of federal standards. States are required to develop, adopt, and implement a state implementation plan to achieve, maintain, and enforce federal ambient air quality standards.

The status of areas with respect to federal ambient air quality standards is categorized as nonattainment, attainment (better than national standards), unclassifiable, or attainment/cannot be classified. Unclassifiable areas are treated as attainment areas for most regulatory purposes. All of Hawaiʻi is categorized as attainment or unclassifiable for each of the federal ambient air quality standards.

3.2.4 Clean Air Act Conformity

The Clean Air Act requires federal agencies to ensure that actions they undertake in nonattainment and maintenance areas are consistent with federally enforceable air quality management plans for those areas. No portions of Hawaiʻi are classified as nonattainment or maintenance areas. Consequently, Clean Air Act conformity analysis procedures do not apply to Army actions in Hawaiʻi.

3.2.5 Existing Air Quality Conditions

Hawaiʻi currently operates five monitoring stations on the island of Hawaiʻi. All of the monitoring stations are in coastal regions, and many are in or near urban areas. None of the monitoring stations is sited at or near Army training areas. The monitoring stations on the island of Hawaiʻi have been located primarily to monitor the impacts of emissions from volcanic eruptions and geothermal development. Based on available monitoring data and the locations of recognized emission sources, the EPA has concluded that no locations in Hawaiʻi exceed federal ambient air quality standards.

Most of the monitoring data collected on Hawaiʻi in recent years show that ambient air quality levels are well below the values of the relevant state and federal ambient air quality standards.

3.3 Geology and Topography

The Hawaiian Islands formed as the Pacific Plate moved over a relatively permanent hot spot in the mantle beneath the Pacific Plate (USAEC 2008), which is currently under the island of Hawaiʻi. The Hawaiian Islands are seismically active. Earthquakes on the islands are caused by molten rock rising through the earth's crust or the earth's crust settling under the weight of accumulated lava.

The island of Hawaiʻi consists of five volcanic mountains: Kohala Mountain, Mauna Kea, Mauna Loa, Hualālai, and Kilauea (Macdonald and Abbott 1970). All five of these volcanic mountains are considered young. Kohala Mountain is the oldest and is now extinct. It dates approximately 700,000 years old by potassium-argon dating. Mauna Kea is younger as its eruptions bury parts of the Kohala Volcano. Mauna Kea is considered dormant. Hualālai is located on the west side of the island and is younger than Mauna Kea but older than Mauna Loa, as evidenced by magmatic evolution stages. Kilauea is located to the southeast of Mauna Loa. Both Kilauea and Mauna Loa are considered active. Differing magmatic stages between Mauna Loa and Kilauea indicate separate magma bodies feeding each, so it is believed that Kilauea is a completely independent volcano. This is also supported by the difference in their eruptive centers, one at 13,000 ft (3,962 m) above mean sea level (amsl) and the other at less than 4,000 ft (1,219 m) amsl.

The principal features of each volcano are listed in Table 3-2. Mauna Loa takes up the bulk of the island at 50.5%; Mauna Kea follows as the second largest area on the island with 22.8%. Mauna Kea and Mauna Loa are also the two highest peaks on the island, with their summits reaching 13,796 and 13,680 ft (4,200 and 4,169 m) amsl, respectively (Stearns 1985).

The stratigraphy of Hawaiʻi is outlined in Table 3-3, and the geologic map is shown in Figure 3-2. Paleomagnetism studies on the island have indicated none of the rocks on the island has reversed magnetism (Stearns 1985). The last reversal of magnetism occurred 750,000 years ago. This concludes that all rocks on the island of Hawaiʻi must be Pleistocene in age or younger.

The Pahala ash is found on many parts of the island (MacDonald and Abbot 1970). It is named for the town of Pahala, which contains the remnants of the Ninole Volcano. The ash is more than 50 ft (15 m) thick and is yellowish. It contains vitric ash and fragments of pumice. The thickness of the ash varies across the island. The ash is often altered by weathering, which disguises the original composition of the material, making its source uncertain. However, as shown in Figure 3-2, it is the only rock formation that is found on more than one of the volcanic mountains, making this unit quite noteworthy (Stearns 1985). The ash provides a means of correlating volcanic activity, though it is not certain the Pahala ash is of the same age everywhere across the island.

Table 3-2. Principal features of the volcanoes on the island of Hawai‘i from Stearns (1985).

Name	Length (miles)	Width (miles)	Area (square miles)	Percentage of Hawai‘i Island	Summit Elevation (ft amsl)
Mauna Loa	75	64	2,035	50.5	13,680
Kilauea	51	14	552	13.7	4,090
Hualālai	24	20	290	7.2	8,251
Mauna Kea	51	25	919	22.8	13,796
Kohala	22	15	234	5.8	5,505

Table 3-3. Stratigraphic units from Stearns (1985).

STRATIGRAPHIC ROCK UNITS IN THE ISLAND OF HAWAII

(The volcanic rocks of Mauna Loa, Mauna Kea, and Hualalai, those of Mauna Kea and Kohala, and those of Mauna Loa and Kilauea interfinger)

Age	Hualalai	Kohala Mountain	Mauna Loa	Kilauea	Mauna Kea
Historic	Historic member of the Hualalai volcanic series (1800–01)	Unconsolidated alluvium, dunes and landslides	Historic member of volcanic series (1832–1950); Mud flow of 1868	Historic member of the Puna volcanic series (1790–1965)	Ribbons of gravel and small alluvial fans
Holocene	Prehistoric member of the Hualalai volcanic series		Dunes; Prehistoric member of the Kau volcanic series	Dunes; Prehistoric member of the Puna volcanic series	Upper member of the Laupahoehoe volcanic series; Glacial debris and fluvial conglomerates
Late Pleistocene	Pahala ash (exposed on Waawaa volcanics only)	Fluvial conglomerates; Pahala ash (not differentiated)	Pahala ash	Pahala ash	Lower member of the Laupahoehoe volcanic series; Local erosional unconformity; Pahala ash
Early and middle Pleistocene	Waawaa volcanics and lower unexposed part of Hualalai volcanic series	Fluvial conglomerates; Hawi volcanic series	Kahuku volcanic series	Hilina volcanic series	Hamakua volcanic series
Early Pleistocene		Great erosional unconformity; Pololu volcanic series	unconformity; Ninole volcanic series		

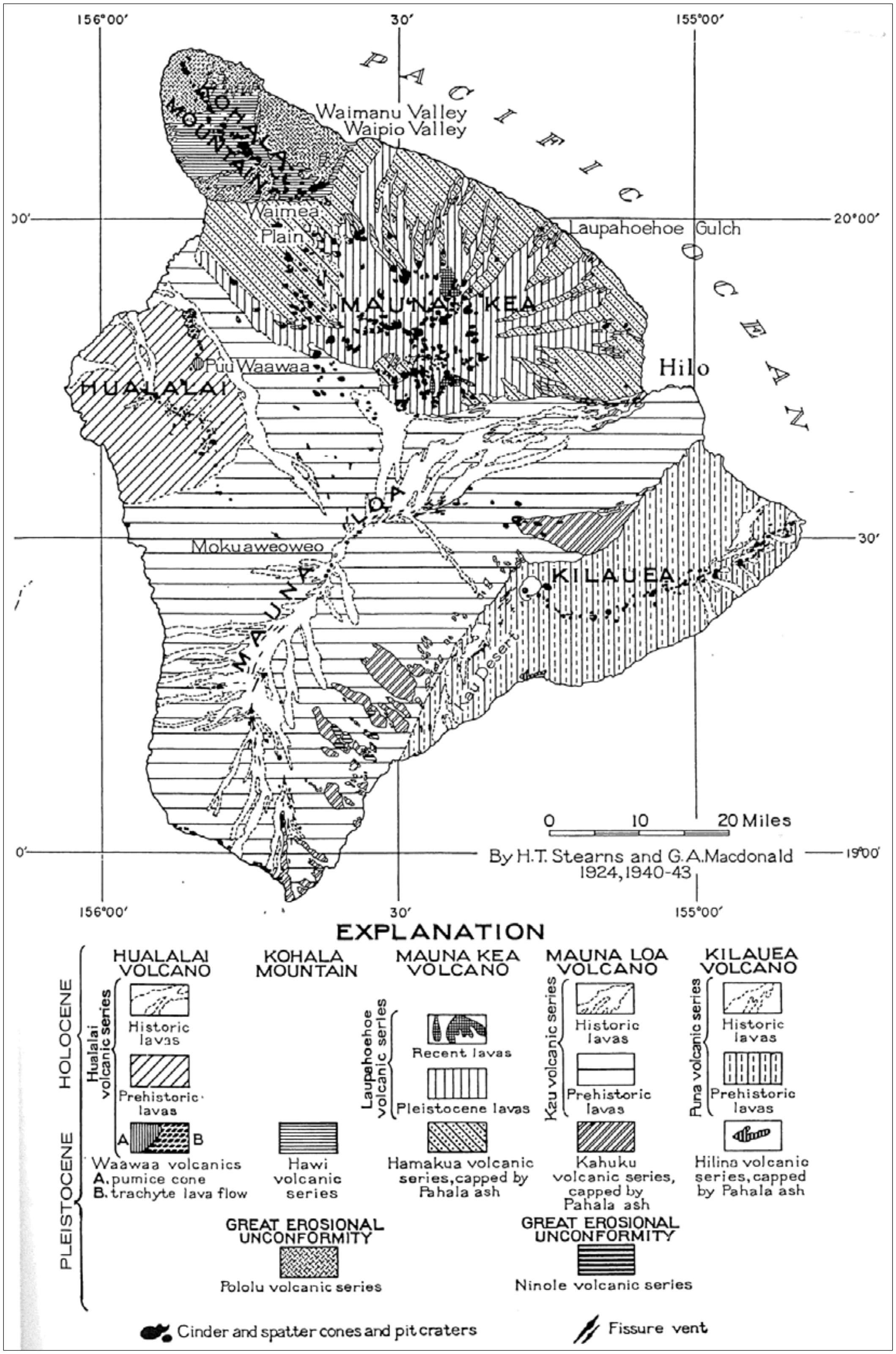

Figure 3-2. Geologic map of the island of Hawai‘i from Stearns (1985).

3.3.1 Mauna Kea

This dormant shield volcano is the highest of the five at 13,796 ft (4,200 m) amsl, and it is the highest mountain in the interior Pacific Basin. Because of its elevation, Mauna Kea's summit has been repeatedly glaciated during the past few hundred thousand years and preserves the best glacial record of any oceanic volcano on Earth (University of Hawaiʻi 2010).

Mauna Kea has erupted 12 times within the past 10,000 years, and though it has been at least 4,600 years since its last eruption, it is anticipated that the volcano will erupt again; such an eruption would likely occur on the flanks of the volcano, below the summit and astronomical facilities (University of Hawaiʻi 2010).

The potential for renewed volcanic activity in this region in the foreseeable future is extremely remote. The most significant geologic hazard is seismic activity (University of Hawaiʻi 2010). The island of Hawaiʻi is one of the most seismically active areas on Earth, and about two dozen earthquakes with magnitude of 6 or greater have been documented on Hawaiʻi since the devastating earthquakes of 1868. Earthquakes will continue to impact the Mauna Kea summit area in the future, and any future construction must include design considerations for significant seismic forces (University of Hawaiʻi 2010).

No soils in the conventional sense are present, because the only fragmental material present has not had enough time to weather and become soil in the arid, alpine environment (University of Hawaiʻi 2010). This fragmental material is present in most low-lying areas, though, and could be classified as nonweathered soil. It consists of unconsolidated debris derived from glacial erosion and mechanical weathering of the adjacent lavas, and nowhere is it more than 1 or 2 ft thick (0.3 to 6.1 m).

Lake Waiau is located below the summit of Mauna Kea at an elevation of 13,020 ft (3,968 m) amsl. Slopes are as steep as 8 degrees southward in the north/upper area but less than 2 degrees in the south/ lower portion. The prospective LZs lie on the southeast side of Mauna Loa between 10,800 and 11,500 ft (3,291 and 3,505 m) amsl, as shown on Figure 2-14.

The stratigraphy on Mauna Kea is divided into two series: Hamakua Volcanic Series and the younger Laupāhoehoe Volcanic Series (Stearns 1985). The geologic map of these series is shown in Figure 3-3.

The Hamakua Volcanic Series has upper and lower members. The lower member of the Hamakua Series has tholeiitic basalts, olivine basalts, and oceanites (Stearns 1985). It is exposed along Hamakua Coast north of Hilo. These rocks are thin beds of pāhoehoe and ʻaʻā and grade gradually upward to the upper member. The upper member consists of alkali olivine basalts, hawaiites, and ankaramites. They are well exposed in highway cuts along Hamakua Coast and are covered by Pahala ash that is 6–25 ft (1.8–7.6 m) thick.

The Laupāhoehoe Series is found on the top of Mauna Kea. It consists of hawaiite, with lesser amounts of alkali olivine basalt and ankaramite (MacDonald and Abbott 1970). The hawaiite flows are well exposed along the highway between Honokaʻa and Kamuela. These flows are thick with hummocky tops. The Laupāhoehoe Series built big cinder cones, some more than 1 mile (1.6 kilometers) across and several hundred feet tall. These cinder cones are well exposed on the Humuʻula Saddle, between Mauna Kea and Mauna Loa.

Mauna Kea started as a broad shield volcano that is buried by the cones of the Laupāhoehoe Series and the upper member of the Hamakua Series. It is probable that a former caldera lies beneath these later lava flows (MacDonald and Abbott 1970).

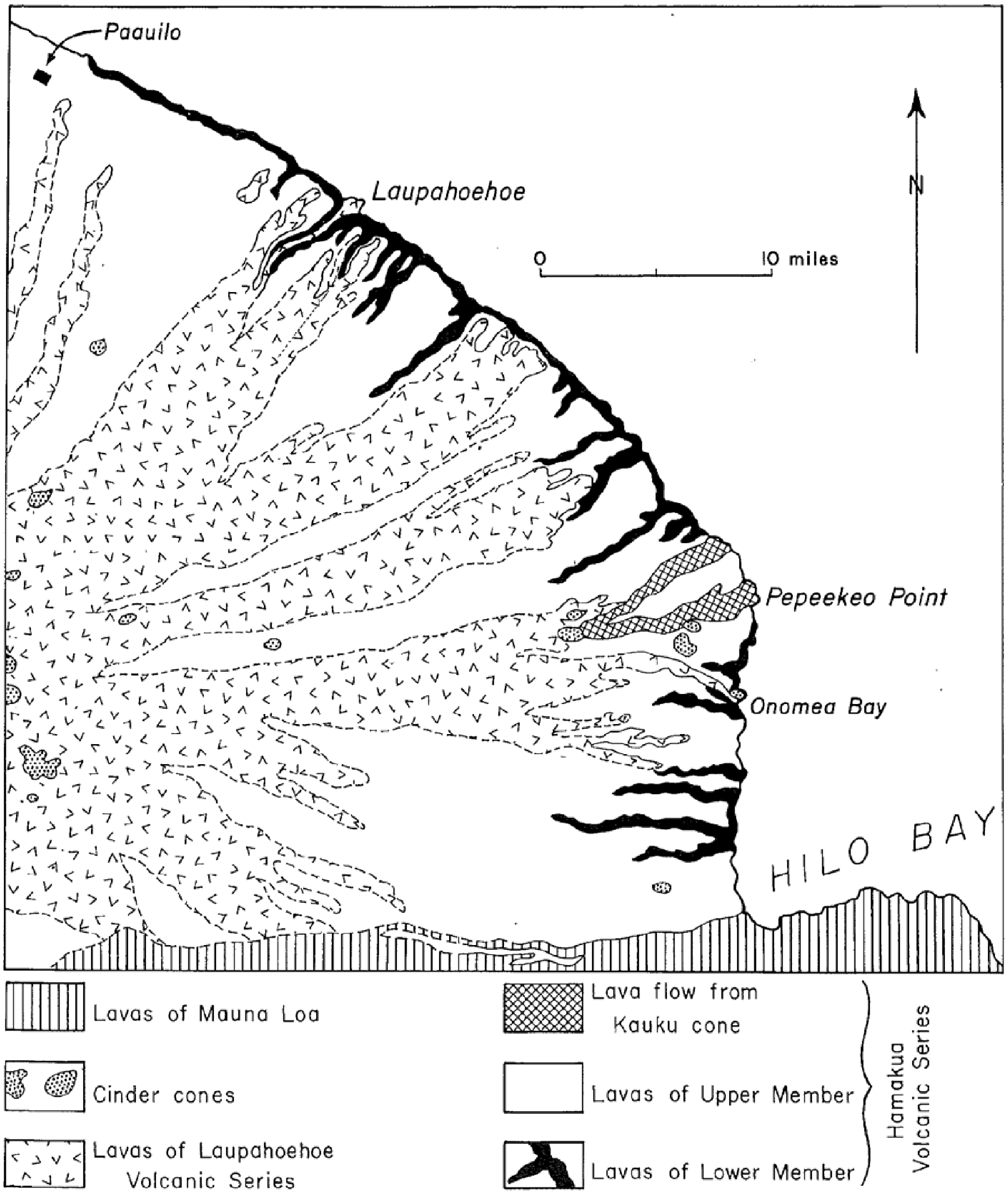

Figure 3-3. Geologic map of Mauna Kea from MacDonald and Abbott (1970).

3.3.2 Mauna Loa

Mauna Loa is a shield volcano comprising at least three separate shield volcanoes built around three separate eruptive centers (MacDonald and Abbott 1970). Mauna Loa is about 75 miles (121 kilometers) long and about 64 miles (103 kilometers) wide (Table 3-2). It is one of the most productive volcanoes on Earth. Since 1832, Mauna Loa has averaged one caldera outbreak every 4 years and a lava flow every 7 years, though the latest eruption was in 1984 (Table 3-4) (Stearns 1985). Mauna Loa contains a caldera named Moku‘aweoweo at its summit.

Mauna Loa has well-defined, southwest-northeast rift zones and a weak northerly rift zone (Stearns 1985). Most eruptions from Mauna Loa start in the caldera as high, short-lived lava fountains and then change to lava pouring out from vents along the rifts. The rift zones are marked by scores of open cracks that range from just inches to 10 ft (3 m) wide. More than 160 fissures and cinder-and-spatter cones have been found on Mauna Loa.

The eruption in 1984 began as a sudden eruption that followed 3 years of increasing earthquake activity (USGS 2004). Lava broke through the surface of Moku‘aweoweo caldera on March 25, 1984. The eruptive fissures migrated rapidly down the southwest rift zone to 12,750 ft (3,886 m) amsl (Flow A on Figure 3-4). Lava fountains extended across the northeast half of Moku‘aweoweo caldera and into the upper reaches of the northeast rift zone (Flow B on Figure 3-4). A narrow flow moved about 3 miles (4.8 kilometers) down the southeast flank toward Kilauea Volcano (Flow C on Figure 3-4). Four parallel flows moved down the northeast flank (Flow D on Figure 3-4). By March 26, 1984, the vents were feeding lava to a fast-moving flow that had advanced 5.5 miles (8.8 kilometers) to the northeast (Flow E on Figure 3-4) and three less active, shorter flows (Flow D on Figure 3-4) that were advancing toward Kulani Prison. On March 29, 1984, a levee along the lava channel broke, and lava from Flow E diverted into a subparallel flow (Flow F on Figure 3-4); on April 5, 1984, a third subparallel flow (Flow G on Figure 3-4) was formed as another levee broke. The eruption ended on April 15, 1984. Lava flows extended no more than 1.2 miles (1.9 kilometers) from the vents.

The stratigraphy of Mauna Loa is composed of tholeiitic basalts, olivine basalts, and oceanites. There are three stratigraphic series on Mauna Loa (Table 3-3): The Ninole Volcanic Series is the oldest, followed by the Kahuku Volcanic Series, and the youngest is the Ka‘u Volcanic Series (Stearns 1985). The Ninole Volcanic Series has thin layers of pāhoehoe and ‘a‘ā exposed in the sides of the Ninole Shield. This series forms the core of the mountain. A steep, angular, erosional unconformity separates the Ninole Series from the overlying Kahuku Series. The Kahuku Series is approximately 600 ft (182 m) thick and is overlain by 5–15 ft (1.5–4.5 m) of Pahala ash. Overlying the Pahala ash is the Ka‘u Series, which consists of fairly fresh lavas and contains the most recent eruptions. The rocks in the Ka‘u Series are rarely more than 25 ft (7.6 m) thick, except in the upper part of Mauna Loa, where they are more than 800 ft (243 m) thick.

The summit of Mauna Loa is 13,680 ft (4,169 m) amsl. The LZs lie on the north face of Mauna Loa, northeast of the summit. LZ-1 is at about 7,840 ft (2,390 m) amsl, LZ-2 is at about 8,010 ft (2,441 m) amsl, and LZ-3 is at about 8,880 ft (2,707 m) amsl. The slopes for LZ-1 and LZ-3 are approximately 9%. The slope for LZ-2 is about 10.4%.

Table 3-4. Historic eruptions of Mauna Loa from Stearns (1985).

Date of commencement		*Approximate duration (days)*						
Year	*Month and day*	*Summit eruption*	*Flank eruption*	*Location of principal outflow*	*Altitude of main vent (feet)*	*Approximate repose period since last eruption (months)*	*Area of lava flow (square miles)*	*Approximate volume of lava (cubic yards)*
1832	June 20	21	(?)	Summit	13,000(?)	......	......	....
1843	Jan. 9	5	90	N. flank	9,800	126	20.2	250,000,000
1849	May	15	....	Summit	[4]13,000	73	......	....
1851	Aug. 8	21	(?)	Summit	13,300	26	6.9	90,000,000
1852	Feb. 17	1	20	NE. rift	8,400	6	11.0	140,000,000
1855	Aug. 11	.....	450	NE. rift	10,500(?)	41	[2]12.2	150,000,000
1859	Jan. 23	<1	300	N. flank	9,200	26	[3]32.7	[3]600,000,000
1865	Dec. 30	120	....	Summit	13,000	73	......	....
1868	Mar. 27	1	[5]15	S. rift	3,300	23	[3]9.1	[3]190,000,000
1870	Jan. 1(?)	14	....	Summit	13,000	21	......	....
1871	Aug. 1(?)	30	....	Summit	13,000	18	......	....
1872	Aug. 10	60	....	Summit	13,000	11	......	....
1873	Jan. 6	2(?)	....	Summit	13,300	3	......	....
1873	Apr. 20	547	....	Summit	13,000	3	......	....
1875	Jan. 10	30	....	Summit	13,000	2	......	....
1875	Aug. 11	7	....	Summit	13,000	6	......	....
1876	Feb. 13	Short	....	Summit	13,000	6	......	....
1877	Feb. 14	10	[7]1	W. flank	−180±	12	......	....
1880	May 1	6	....	Summit	13,000	38	......	....
1880	Nov. 1	.....	280	NE. rift	10,400	6	24.0	[3]300,000,000
1887	Jan. 16	.....	10	SW. rift	5,700	65	[3]11.3	[3]300,000,000
1892	Nov. 30	3	....	Summit	13,000	68	......	....
1896	Apr. 21	16	....	Summit	13,000	41	......	....
1899	July 4	4	19	NE. rift	10,700	38	16.2	200,000,000
1903	Oct. 6	60	....	Summit	13,000	50	......	....
1907	Jan. 9	<1	15	SW. rift	6,200	37	8.1	100,000,000
1914	Nov. 25	48	....	Summit	13,000	94	......	....
1916	May 19	.....	14	SW. rift	7,400	16	6.6	80,000,000
1919	Sept. 29	Short	42	SW. rift	7,700	40	[3]9.2	[3]350,000,000
1926	Apr. 10	Short	14	SW. rift	7,600	77	[8]13.4	[3]150,000,000
1933	Dec. 2	17	<1	Summit	13,000	91	2.0	100,000,000
1935	Nov. 21	<1	42	NE. rift	12,100	23	[9]13.8	[1]60,000,000
1940	Apr. 7	133	<1	Summit	13,000	51	[10]3.9	100,000,000
1942	Apr. 26	2	13	NE. rift	9,200	20	[11]10.6	100,000,000
1943	Nov. 21	3	....	Summit	13,000	18	(?)	(?)[12]
1949	Jan. 6	145	2	Summit	13,000	61	5.6	77,000,000
1950	June 1	<1	23	SW. rift	8,000	12	[13]35.0	[13]600,000,000
1975	July 5	2	....	Summit	13,000	181	5.2	32,500,000
1984	Mar. 25	Short	[14]22	NE rift	9,400	108	4.1	[13]232,000,000
Total		1,330	1,374				260.1	4,301,500,000

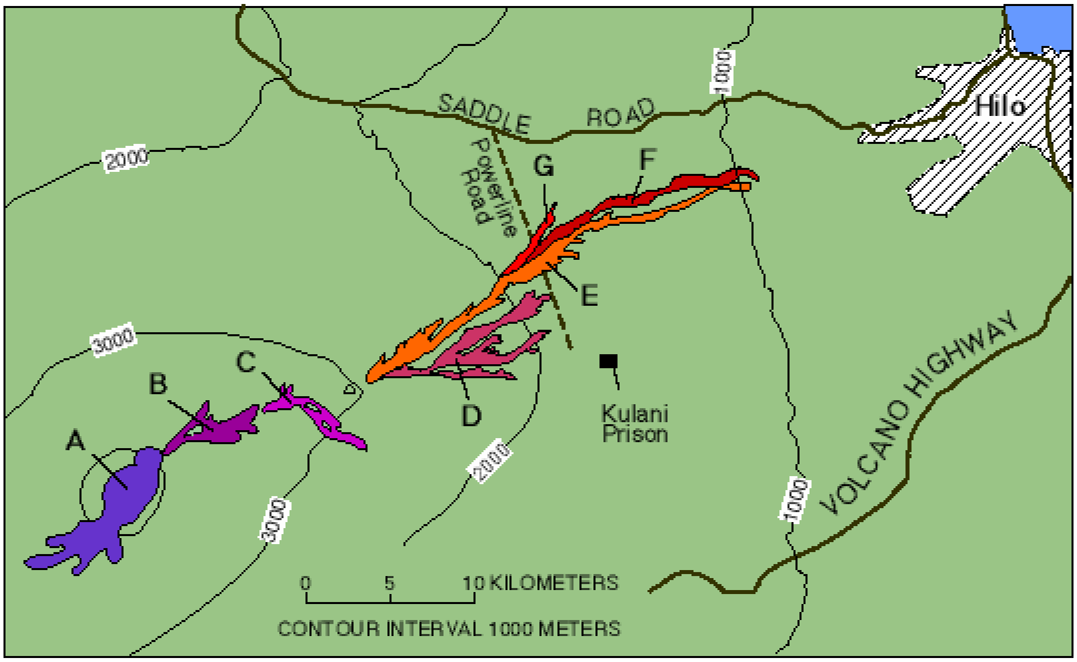

Figure 3-4. Map of Mauna Loa’s 1984 flows from USGS (2004).

3.3.3 Kilauea

Kilauea is the youngest and southeasternmost volcano on the Big Island of Hawai‘i. Topographically, Kilauea appears as only a bulge on the southeast flank of Mauna Loa, so for many years Kilauea was thought to be a mere satellite of its giant neighbor, not a separate volcano (USGS 2009). However, research over the past few decades shows clearly that Kilauea has its own magma-plumbing system, extending to the surface from more than 37 miles (60 kilometers) deep in the earth. Since 1952, there have been 34 eruptions. Since January 1983, eruptive activity has been continuous along the east rift zone (USGS 2009). The eruption of Kilauea Volcano that began in 1983 continues at the cinder-and-spatter cone of Pu‘u ‘Ō ‘ō. Beginning in 1983, a series of short-lived lava fountains built the massive cinder-and-spatter cone of Pu‘u ‘Ō ‘ō. In 1986, the eruption migrated 1.8 miles (2.9 kilometers) down the east rift zone to build a broad shield, Kupaianaha, which fed lava to the coast for the next 5.5 years (USGS 2008).

When the eruption shifted back to Pu‘u ‘Ō ‘ō in 1992, flank-vent eruptions formed a shield banked against the west side of the cone (USGS 2008). From 1992 to 2007, nearly continuous effusion from these vents has sent lava flows to the ocean, mainly inside Hawai‘i Volcanoes National Park. Flank vent activity undermined the west and south sides of the cone, resulting in the collapse of the west flank in January 1997.

Since 1997, the eruption has continued from a series of flank vents on the west and south sides of the Pu‘u ‘Ō ‘ō cone (USGS 2008). During this time, the composite flow field has expanded westward, and tube-fed pāhoehoe forms a plain that spans 9.7 miles (15.6 kilometers) at the coast.

Figure 3-5 (USGS 2010a) shows the extent of the various flows starting in 1983 and continuing through today.

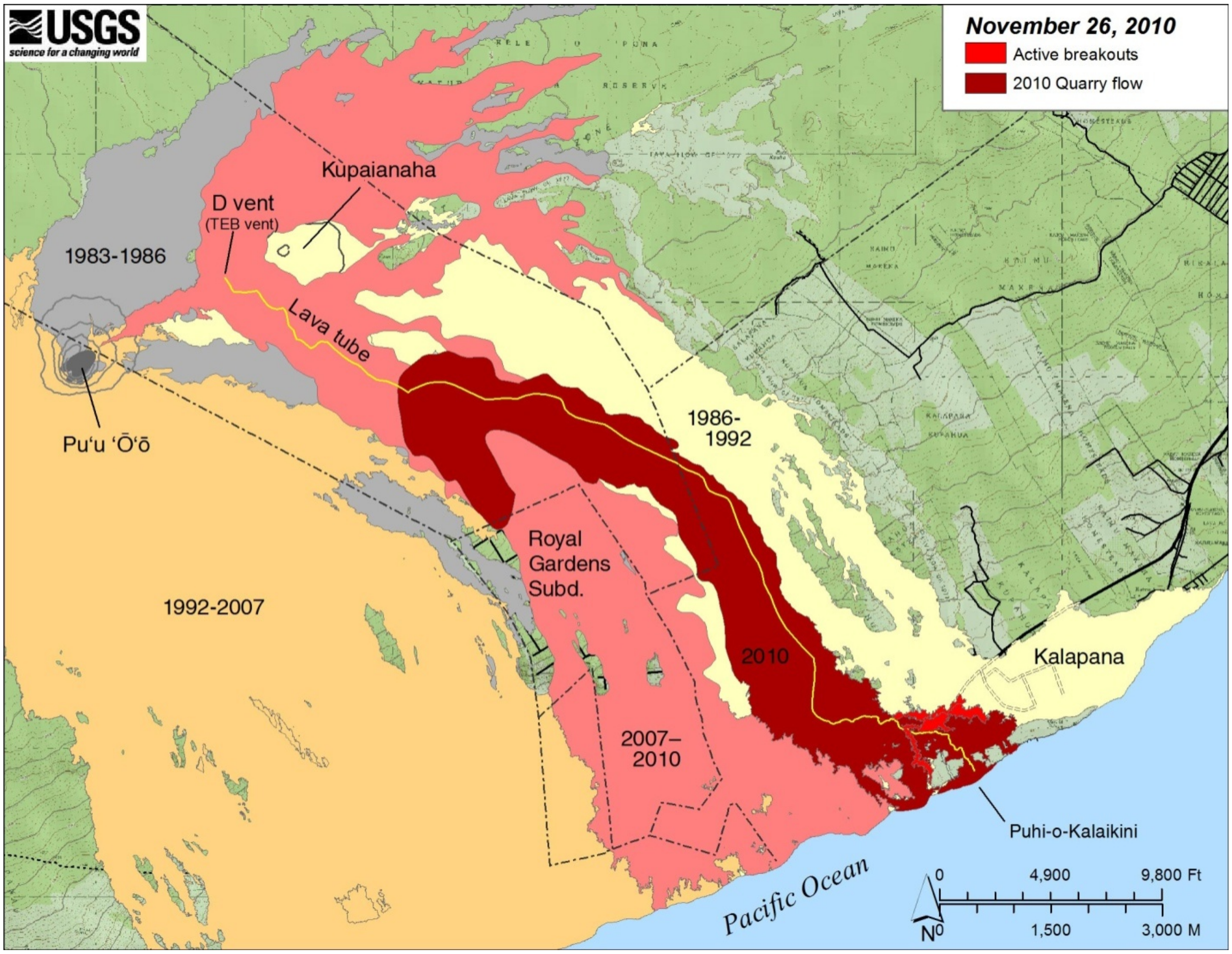

Figure 3-5. Map showing the current extent of the various flows from Kilauea beginning in 1983 from USGS (2010a).

3.4 Soils and Hydraulic Properties

The soils vary across the islands due to differences in climate, slope, drainage, and ages of the islands. There are 11 soil orders found on the islands. Figure 3-6 shows the soil order distribution on the island of Hawai‘i (Lau and Mink 2006). Andisols are volcanic ash soils that have high phosphorus uptake. Andisols, Inceptisols, and several combination orders (Andisols-Inceptisols, Histosols-lava, and Histosols-lava-Andisols) are prevalent in the relatively high-rainfall areas on the island of Hawai‘i. Histosols are thin, highly organic soils that are formed from decomposed forest litter on young lava flows. These soils are well drained and occur in moderate rainforests. Inceptisols from volcanic ash are young soils with a thin mantle and weakly developed horizons on sloping surfaces. Aridisols are desert soils found only in the arid lee areas of the island of Hawai‘i (Lau and Mink 2006).

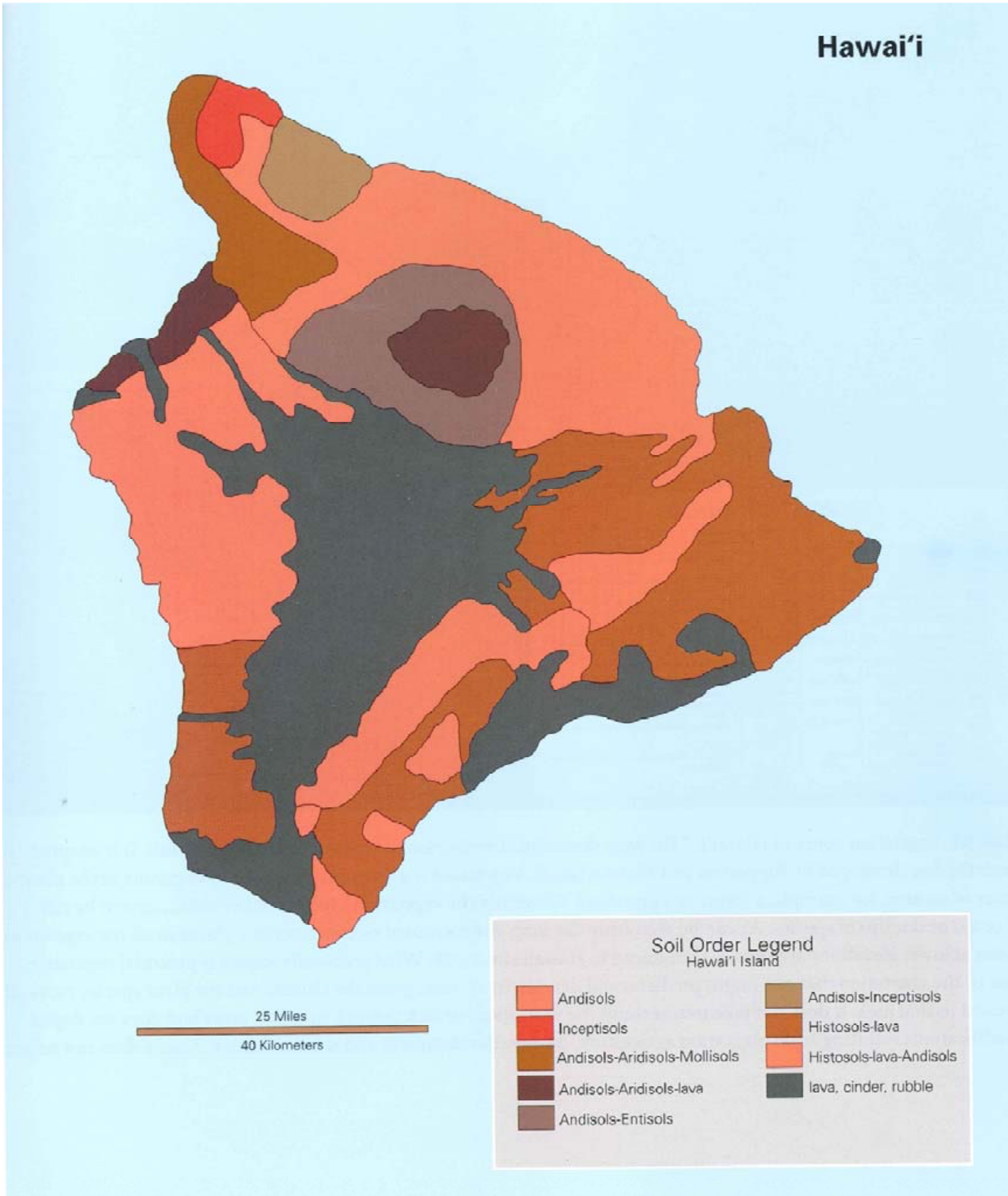

Figure 3-6. Soil orders of the island of Hawai‘i from Lau and Mink (2006).

The three LZs (4, 5, and 6) on Mauna Kea exist on soils composed of cinders (Figure 3-7). LZ-4 lies in the vicinity of neighboring very stony soil. The three LZs (1, 2, and 3) on Mauna Loa exist on soils composed of ‘a‘ā lava flows (Figure 3-7). Nearby soils are composed of cinders.

The values of porosity and water-retentive properties are high for virtually all of the great soil groups of Hawai‘i. Total porosity in Hawai‘i soils ranges from 68–74%, and macroporosity ranges from 10–18%. Field capacity is within a narrow range of 56–58%, wilting point from 28–38%, and available water from 19–28%. These values differ from other typical values found in the continental United States due to the strongly aggregated structure and the typically non-swelling clay minerals of Hawai‘i soils (Lau and Mink 2006).

The values of saturated hydraulic conductivity, K_s, in Hawai‘i soils are typically a few meters per day. However, they are about three orders of magnitude smaller than that for unweathered basalts, the parent rock. Surface crusting and sealing are not common in Hawai‘i soils (Lau and Mink 2006).

3.5 Water Resources

The ocean surrounding the Hawaiian Islands receives 25–30 in. (63.5–76.2 cm) of rainfall per year. The islands receive 10–15 times as much in some places (Lau and Mink 2006). The maximum rainfall occurs at elevations between 2,000–3,000 ft (610–914 m) and on the windward (eastern) sides of the islands due to the northeasterly trade winds. Rainfall decreases rapidly at elevations higher than 3,000 ft (914 m).

The high permeability of the lava flows on Mauna Kea and Mauna Loa allow for little to no erosion to occur (Lau and Mink 2006). Instead of running off, the water sinks through the porous rock. The bulk of water found on the island is groundwater. The order of potential yield, in general, for basalts is (1) interstitial spaces in ‘a‘ā, (2) cavities between lava flow beds, (3) shrinkage cracks, (4) lava tubes, (5) gas vesicles, (6) cracks produced by mechanical forces after the flow has come to rest, and (7) tree mold holes (Lau and Mink 2006). Some lava tubes are 30 ft (9 m) in diameter and are capable of transmitting vast quantities of water.

There is at least one perennial stream, on Hawai‘i’s northern coast. It is called Waikoloa Stream, and it heads in the Kohala Mountains, runs along the foot of Kohala Mountain, and discharges into Kawaihae Bay.

Because of the younger age of the island of Hawai‘i and continuing volcanic activity, groundwater is not well studied. There are very few groundwater wells on the island of Hawai‘i. The Commission on Water Resource Management (2009) owns two wells on the western coast. One of these wells (Keopu) is currently under repair and has no water-level measurement data available. The other well (Kahalu‘u) has an average water level at approximately 2 ft (0.61 m) amsl (Commission on Water Resource Management 2009). The USGS (2010b) network of wells on Hawai‘i contains 13 wells. The closest well to the LZs is located in Hawai‘i Volcano National Park. The highest water level recorded for this well was 2,060 ft (628 m) amsl, which occurred in 1998 (USGS 2010b).

Aquifers in Hawai‘i consist of either volcanic rock or sedimentary rock (Lau and Mink 2006). Volcanic aquifers are much larger and more extensive than sedimentary aquifers and constitute the only aquifers capable of supplying potable water. The yield of sedimentary aquifers is almost always brackish water, and usage is restricted to irrigation without further treatment.

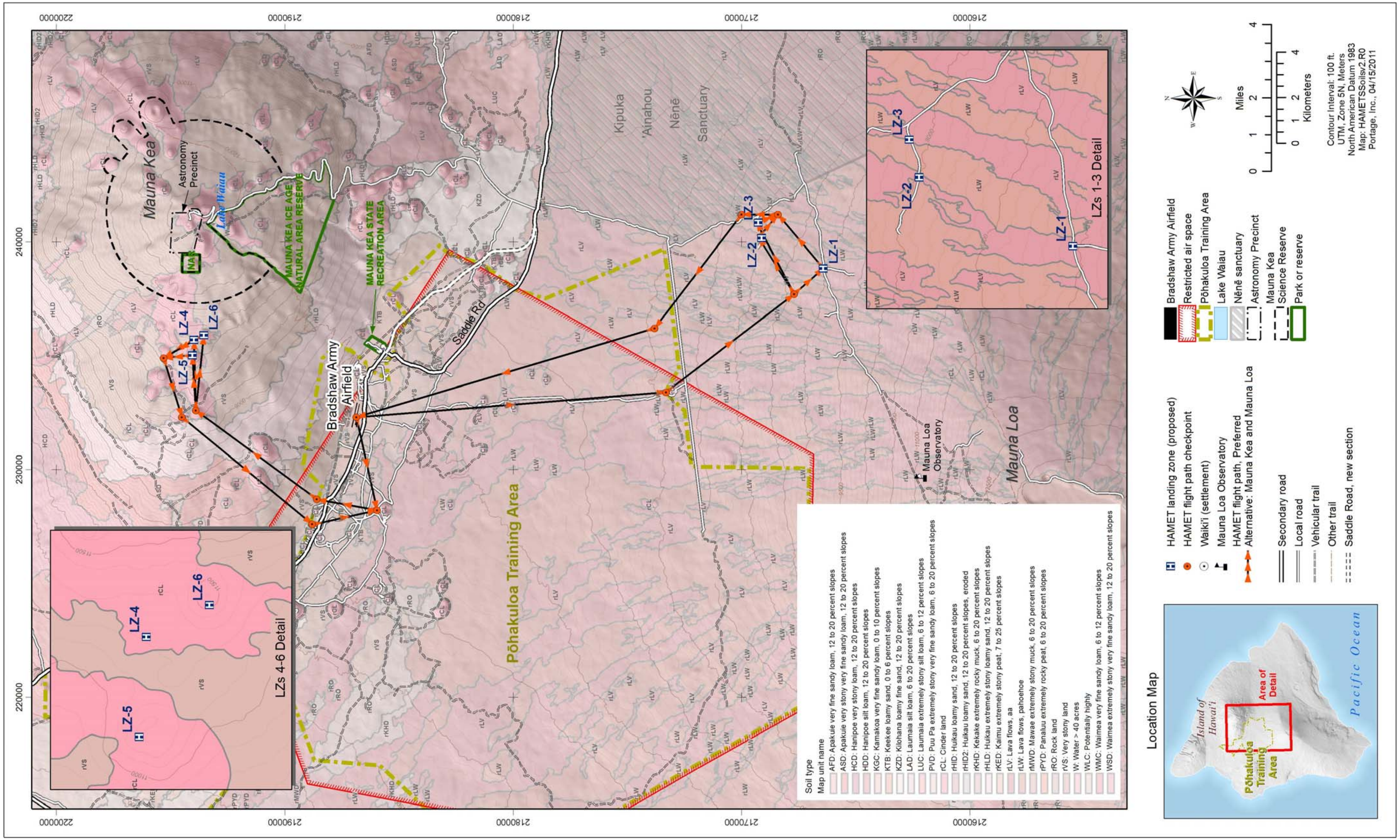

Figure 3-7. Soil types and locations.

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“High-level” and “basal” are the two fundamental varieties of groundwater on Hawaiʻi (University of Hawaiʻi 2010). High-level groundwater is either isolated from, or beyond the reach of, seawater intrusions. Basal groundwater rests on, and is hydraulically continuous with, underlying seawater.

3.5.1 Mauna Kea

The following subsections describe Mauna Kea water resources.

3.5.1.1 Surface Water. Figure 3-8 shows the perennial streams on the island of Hawaiʻi. They are all on the northeast side of the island. There are no regularly flowing or perennial streams in the Mauna Kea Science Reserve or in the vicinity of Hale Pōhaku (University of Hawaiʻi 2010). Near the Mauna Kea summit region, the Wailuku River is the only river whose numerous gulches extend along the upper flanks of Mauna Kea, and stream flow is considered to be perennial where gulches comes together, downslope near an elevation of 10,000 ft (3,048 m) amsl. The only surface water present in the summit region is Lake Waiau within the adjacent Mauna Kea Ice Age NAR (University of Hawaiʻi 2010).

Lake Waiau is located at the bottom of Puʻu Waiau and is one of Hawaiʻi’s few confined surface water bodies and one of the highest alpine lakes in the United States (University of Hawaiʻi 2010). The lake freezes almost entirely during colder times of the year and has never been known to dry up. Lake Waiau is believed to have formed approximately 15,000 years ago following the last glacial retreat. It is 300 ft (91 m) in diameter and reaches a depth of approximately 7.5 ft (2.3 m) at full capacity. Topography limits the lake’s watershed to about 35 acres (14.2 hectares). The lake’s water is mostly snowmelt and precipitation within the watershed. The presence of Lake Waiau is attributable to an impermeable layer within Puʻu Waiau that creates a perched aquifer, which is limited and occurs above the regional aquifer. Lake Waiau is considered traditional cultural property and is not used for drinking water purposes (University of Hawaiʻi 2010).

3.5.1.2 Groundwater. There are several aquifers below Mauna Kea (Figure 3-9) (Commission on Water Resource Management 2008). They are divided into two regions: West and East Mauna Kea. The sustainable yield for each aquifer is listed on Figure 3-9 in million gallons per day (MGD); the total sustainable yield for Mauna Kea aquifers is 412 MGD (1.6 m^3 per day).

The regional aquifer beneath the summit of Mauna Kea (Waimea aquifer) is what is referred to in Hawaiʻi as high-level, which means that the aquifer is entirely fresh water (not fresh water floating on salt water), and geologic structures, such as volcanic sills and dikes, isolate the water. Although groundwater is the primary source of drinking water in Hawaiʻi, there are no wells extracting groundwater near the summit, because it is considered uneconomical to drill a well deep enough to reach the groundwater and pump it to the surface (University of Hawaiʻi 2010). The nearest well is located approximately 12 miles (19 kilometers) away in Waikiʻi Ranch along Saddle Road. The ground elevation at this well is 4,260 ft (1,298 m) amsl, and the static water level in the well in 1988 was measured at 1,280 ft (390 m) amsl.

Near the Hale Pōhaku Facilities, there are modest springs and seeps and shallow groundwater (University of Hawaiʻi 2010). The most prominent of these springs and seeps is the series of springs found near Pōhakuloa and Waikahalulu gulches. The gulches are on Mauna Kea’s south flank at a distance of 3.25 and 1.25 miles (5.2 and 2.0 kilometers) west of Hale Pōhaku, respectively. Analyses of the water show it comes from rainfall at the summit. Hale Pōhaku is located above the Onomea aquifer system (Figure 3-9). There are no wells in the vicinity, and because the groundwater is at such a great depth, it is uneconomical to use it. Mauna Kea Observatory Support Services has trucks deliver approximately 30,000 gal (114 m^3) of water per week from Hilo to Hale Pōhaku (University of Hawaiʻi 2010). Each year, 502,500 gal (1,902 m^3) of water is trucked to the summit observatories.

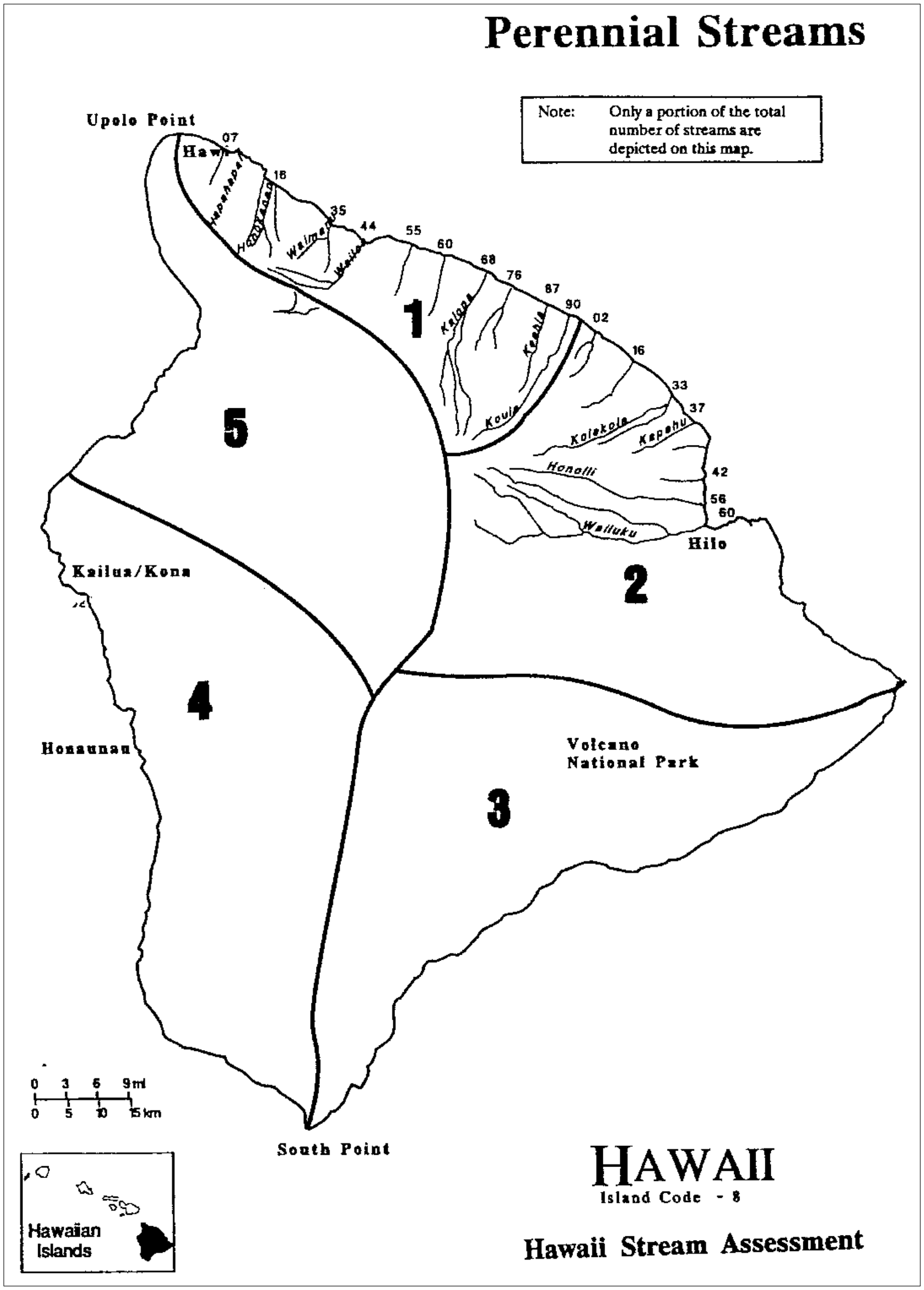

Figure 3-8. Perennial streams on Hawai‘i from Hawai‘i Cooperative Park Service Unit (1990).

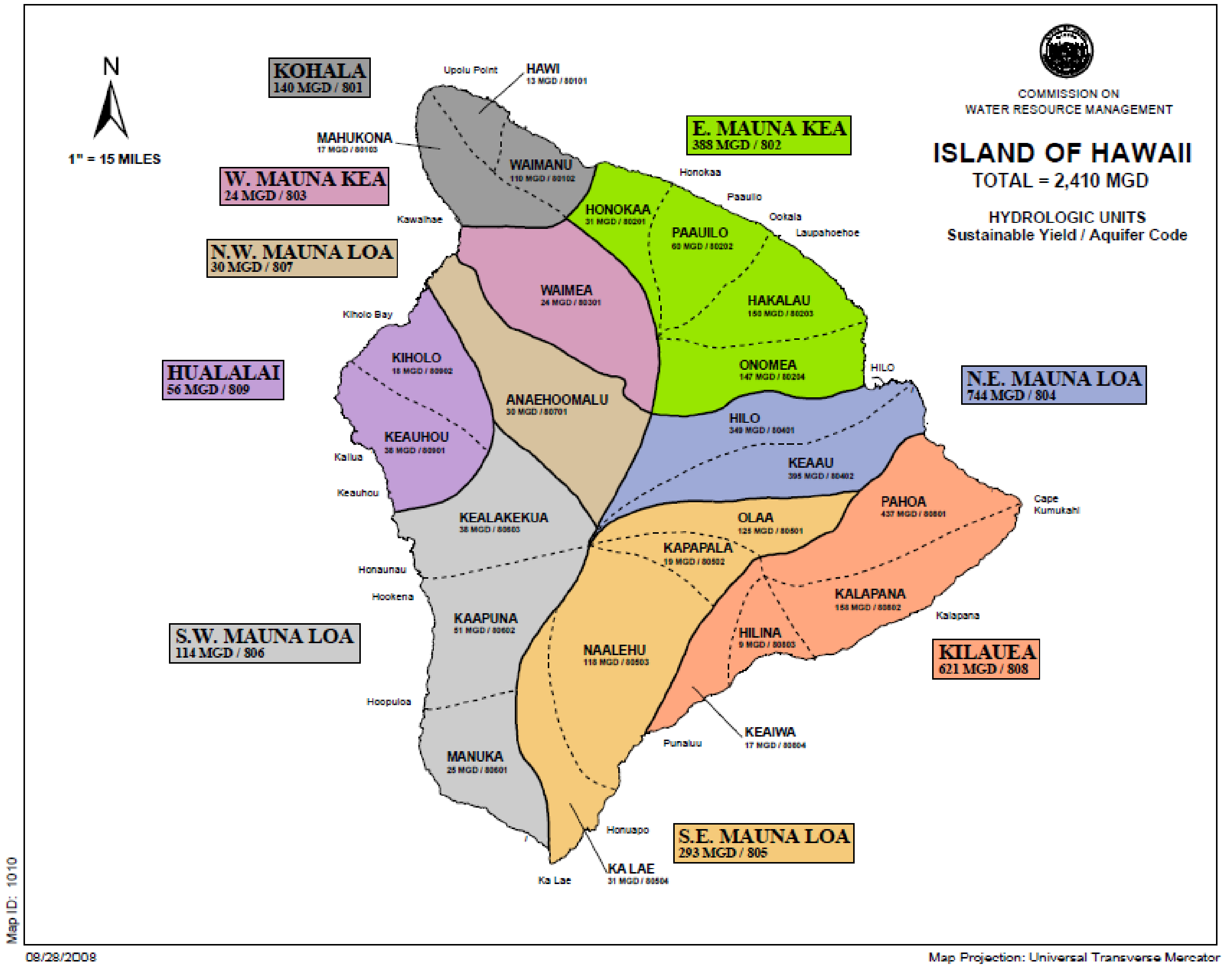

Figure 3-9. Groundwater aquifers on Hawai‘i from Commission on Water Resource Management (2008).

3.5.2 Mauna Loa

The following subsections describe Mauna Loa water resources.

3.5.2.1 Surface Water. Figure 3-8 shows the perennial streams on the island of Hawai‘i. All of them are located on the northeast side of the island. There are no regularly flowing or perennial streams on or near Mauna Loa.

3.5.2.2 Groundwater. There are several aquifers below Mauna Loa (Figure 3-9). They are divided into four regions: Northwest, Northeast, Southeast, and Southwest Mauna Loa. The sustainable yield for each aquifer is listed on Figure 3-9 in MGD; the total sustainable yield for Mauna Loa aquifers is 1,181 MGD (4.5 million m^3 per day) (Commission on Water Resource Management 2008).

The largest basal aquifer in Hawai‘i (Kea‘au aquifer) lies in Mauna Loa flank lavas between the Hilo Coast and the high-rainfall area to about the 5,000-ft (1,524-m) elevation. An enormous volume of cool, fresh groundwater moves through the aquifer to discharge freely at the coast, unimpeded by a caprock. Discharged as a spring, it would be among the most voluminous in the world (Lau and Mink 2006).

Hawaiian Springs, LLC, is a water bottling company established in February 1995. Its source of water is located on Mauna Loa in the Puna District. Hawaiian Springs uses artesian wells at the mountain's base. The company's Web site (Hawaiian Springs 2008) states that its well system uses water from the Hilo and Kea'au aquifers, which are part of the Northeast Mauna Loa aquifer system (Figure 3-9). The pump intake is located 241 ft (73.5 m) below ground surface (bgs). According to the Hawaiian Springs Web site, rainfall on the slopes is up to 200 in. (612 cm) per year (6.7 million gal per square mile). This translates to 1.38 billion gal of rainfall per day, with a recharge rate of 740 MGD. The Kea'au aquifer is described as a basal lens and lies near sea level. Hawaiian Springs claims the water is bottled within approximately 30 days from the time it falls as precipitation. This indicates a very high percolation rate.

3.6 Biological Resources

Biological resources include plant and animal species and the habitats or communities in which species occur. This subsection describes the biological resources that have the potential to occur within or near the proposed alternative flight paths and LZs for HAMET. Threatened and endangered vegetation and wildlife species, special status species, sensitive habitats, and other species of concern that have been recorded in, or that have the potential to be found within, or near the proposed alternative flight paths and LZs are discussed in this subsection (USACE and COE 2009).

The Mauna Loa and Mauna Kea LZs are located in what are essentially alpine stone deserts, with sparse vegetation scattered over lava, barren rock, and cinders. These plant communities consist mostly of the perennial native grasses Hawaiian bentgrass (*Agrostis sandwicensis*) and pili uka (*Trisetum glomeratum*) and the perennial native fern 'iwa'iwa (*Asplenium adiantum-nigrum*). Wildlife inhabiting the alpine stone deserts consists mainly of (a) arthropods, such as the Mauna Loa bug (*Nysius aa*) and wekiu bug (*Nysius wekiuicola*) and (b) vertebrates that include several species of birds, rodents, and a few ungulates (such as feral sheep [*Ovis aries*], goats [*Capra hircus*], and the mouflon sheep [*Ovis musmon*]) (University of Hawai'i 2009). Detailed information and methods on the vegetation, bird, bat, and arthropod surveys conducted at the Mauna Loa and Mauna Kea LZs are found in various memoranda for record (Peshut 2011; Peshut and Evans 2011; Peshut and Doratt 2011a; Peshut and Doratt 2011b; Peshut and Doratt 2011c; Peshut and Schnell 2011a; Peshut and Schnell 2011b). The flight paths from Bradshaw Army Airfield over PTA to the LZs on Mauna Kea and Mauna Loa are above subalpine dry forests and shrublands. These vegetation communities include, but are not limited to, fountain grass (*Pennisetum setaceum*), 'a'ali'i (*Dononaea viscosa*), naio (*Myoprum sandwicense*), 'ulei (*Osteomeles anthyllidifolia*), and māmane (*Sophora chrysophylla*). The flight path is also over a portion of palila critical habitat (PCH), which is made up of a subalpine māmane dry forest. The wildlife in the subalpine dry forests and shrublands include birds, such as the palila [*Loxiodes bailleui*], rodents, and feral ungulates (such as feral sheep [*Ovis aries*], goats [*Capra hircus*], and mouflon sheep [*Ovis mismon*]) (University of Hawai'i 2009). Wildlife and vegetation species under the flight paths are not anticipated to be impacted from HAMET activities.

The biological resources within or near the proposed alternative flight paths or LZs include those designated as threatened and endangered species, sensitive species, and their corresponding habitats. Information presented in this subsection includes findings from vegetation and wildlife surveys conducted in conjunction with other assessments, in the vicinity of the LZs, and surveys conducted for this EA.

Under the ESA (16 USC 35 § 1531 et seq.), vegetation and wildlife species may be listed as either threatened or endangered with the purpose to protect and recover those species and the habitat on which they depend. A species may be listed as endangered when the "species is in danger of extinction throughout all or a significant portion of its range" (16 USC 35 § 1531 et seq.). A species may be listed as threatened when the species “is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (16 USC 35 § 1531 et seq.).

Sensitive species are defined as species that are categorized as special status or regulated by federal or state agencies. Species can be listed as endangered, threatened, candidate, or proposed candidate species (USAEC 2008). Species that experience population declines or habitat loss should also be considered sensitive species (USAEC 2008). Table 3-5 lists sensitive species or potential sensitive species, including wildlife and vegetation potentially occurring below the flight paths to LZs on Mauna Loa and Mauna Kea but not occurring within the LZ survey area.

Critical habitat areas are defined by the ESA as “(1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.” These areas may require special management considerations or protection. The *Final Environmental Impact Statement, Permanent Stationing of the 2/25th Stryker Brigade Combat Team* (USAEC 2008) states, “Critical habitat may be designated on private or government lands, activities on these lands are not restricted unless there is federal involvement in the activities or direct harm to listed wildlife.” In addition, USAEC (2008) states, “Federal agencies are required to conduct Section 7 consultation if a proposed action could affect designated critical habitat, even if the effects are expected to be beneficial. The Army, as a federal agency, is prohibited from adversely modifying critical habitat.” The Mauna Loa and Mauna Kea LZs are not located in areas that have been designated as critical habitat. Helicopter flight paths to the Mauna Kea LZs maintain a minimum flight elevation of 2,000 ft (610 m) above the PCH.

Recovery plans are documents that detail the management practices, goals, and tasks needed for sensitive species to recover (USACE and COE 2009). Prepared by the USFWS, recovery plans provide guidelines for private, federal, and state agencies to conserve sensitive species and their habitat (USACE and COE 2009). Recovery plans include a description of management plans and goals, criteria for measuring populations and goals to delist the species, and estimates time and costs to carry out recovery goals (USACE and COE 2009).

In February, March, May and June 2011, presence surveys for vegetation, birds, bats, and arthropods were conducted at the proposed LZs on Mauna Kea and Mauna Loa. The surveys were conducted by the Army and the Center for Environmental Management of Military Lands (CEMML). Vegetation surveys were conducted to determine the presence of listed species near the LZs, and no listed species were located within a 328-ft (100-m) radius of the LZs (Peshut and Evans 2011). The nearest known population of silversword is located 2,500 meters (8,202 ft) west of Mauna Kea LZ-5.Surveys for birds occurred within a 2,000-ft (610-m) buffer around each LZ and generally observed limited resources for bird habitat near the LZs, which would limit bird occurrence near those areas (Peshut and Schnell 2011a). The survey for bats concluded that there is little vegetation near the LZs or in the genral region of the LZs where the Hawaiian hoary bats can roost (Peshut and Doratt 2011a). Surveys for arthropods near the LZs on Mauna Kea found no wekiu bugs or invasive ants (Peshut and Doratt 2011b; Peshut and Doratt 2011c).

Table 3-5. Federal- and state-listed endangered, threatened, and candidate species and species of concern (sensitive species) potentially occurring below the flight paths to LZs on Mauna Loa and Mauna Kea but not occurring within the LZ survey area.

Species	Federal Status[a]	State Status[b]	Occurrence in Flight Path[c]
Plants			
Mauna Loa silversword (*Argyroxiphium kauense*)	1	1	5
Mauna Kea silversword (*Argyoxiphium sandwicense*)	1	1	5
Fragile fern (*Asplenium peruvianum* ssp. *insulare*)	1	1	2
Honohono/Hawaiian mint (*Haplostachys haplostachya*)	1	1	4
Kioele/leather leaf sweet ear (*Hedyotis coriacea*)	1	1	3
Ma‘aloa/spotted nettle bush (*Neraudia ovata*)	1	1	4
Kiponapona (*Phyllostegia racemosa* var. *racemosa*)	1	1	3
Po‘e, ‘ihi, ‘ihi makole (*Portulaca sclerocarpa*)	1	1	2
Lanceleaf catchfly (*Silene lanceolata*)	1	1	3
Poplo, popolo ku mai (*Solaum incompletum*)	1	1	3
Hawaiian parsley (*Spermolepis hawaiiensis*)	1	1	3
Creeping mint (*Stenogyne angustifolia*)	1	1	1
Tetramolopium arenarium var. *arenarium*	1	1	4
Hawaiian vetch (*Vicia menziesii*)	1	1	3
Ae/Hawaiian yellow wood (*Zanthoxylum hawaiiense*)	1	1	3
Hawaiian catchfly (*Silene hawaiiensis*)	2	2	2
Makou (*Ranunculus hawaiiensis*)	3	5	6
‘Akoko (*Chamaesyce olowaluana*)	5	5	1
Douglas bladderfern (*Cystopteris douglasii*)	–	5	1
Mauna Kea dubautia or na‘ena‘e (*Dubautia arborea*)	5	5	1
Hawai‘i black snakeroot (*Sanicula sandwicensis*)	–	5	1
Invertebrates			
Blackburn’s sphinx moth (*Manduca blackburni*)	1	–	3
Koa bug (*Coleotichus blackburniae*)	5	–	4
Yellow-faced bee (*Hylaeus difficilis*)	5	5	4
Succineid snail (*Succinea konaensis*)	5	–	3
Zonitid snail (*Vitrina tenella*)	5	–	4
Picture-wing fly (*Drosophilia heteroneura*)	1	3	4

Table 3-5. (continued).

Species	Federal Status[a]	State Status[b]	Occurrence in Flight Path[c]
Picture-wing fly (*Drosophilia mulli*)	1	3	4
Picture-wing fly (*Drosophilia ochrobasis*)	1	–	4
Flying earwig Hawaiian damselfly (*Megalagrion nesiotes*)	4	3	4
Pacific Hawaiian damselfly (*Megalagrion pacificum*)	4	3	4
Black-veined agrotis noctuid moth (*Agrotis melanoneura*)	–	5	4
Wekiu bug (*Nysius wekiuicola*)	5	2	4
Yellow-faced bee (*Hylaeus flavipes*)	–	5	4
Birds			
Nēnē or Hawaiian goose (*Branta sandvicensis*)	1	1	2
Hawaiian Hawk or ‘io (*Buteo solitarus*)	1	1	2
Hammerhead or ‘akiapola‘au (*Hemignathus munroi*)	1	1	2
Palila (*Loxioides bailleui*)	1	1	2
Hawaiian petrel or ‘ua‘u (*Pterodroma sandwichensis*)	1	1	1
Band-rumped storm petrel or ‘ake ‘ake (*Oceancodroma castro*)	3	1	1
Hawai‘i ‘elepaio (*Chasiempis sandwichensis*)	5	–	3
‘Amakihi (*Hemignathus virens virens*)	5	–	4
‘Apapane (*Himatione sanquinea*)	5	–	4
Kolea (*Pluvialis fulva*)	5	–	4
Mammals			
Hawaiian hoary bat or ‘ope‘ape‘a (*Lasiurus cinereus semotus*)	1	1	2

a. Federal status definitions:	b. State status definitions:	c. Occurrence status:
1. Endangered	1. Endangered	1. Species may occur
2. Threatened	2. Threatened	2. Species confirmed
3. Candidate	3. Candidate	3. Species unlikely
4. Proposed	4. Proposed	4. Potential habitat, but species not known to occur
5. Species of Special Concern	5. Species of Special Concern	5. Potential habitat; species may have occurred historically; species is not known to occur
		6. No potential habitat, and species is not known to occur

Sources: The *Mauna Kea Comprehensive Management Plan* (University of Hawai‘i 2009), PTA EA (U.S. Army 2004b), Mākua EIS (USACE and COE 2009), *Hawai‘i’s Comprehensive Wildlife Conservation Strategy* (Mitchell et al. 2005), *Hawaiian Islands Plants* (USFWS 2010a), *Hawai‘i Islands Animals* (USFWS 2010b), Stryker Brigade Combat Team final EIS (USAEC 2008)

3.6.1 Endangered and Threatened Species

Table 3-5 lists the endangered and threatened vegetation and wildlife species that could potentially occur in the ROI. An assessment of the likelihood of a species occurring was made based on the habitat requirements of the species, geographic distribution of the species, and biological surveys (USAEC 2008). Descriptions of endangered and threatened species of vegetation and wildlife that could potentially occur within or near the flight paths or LZs are provided below, and specific locations, if known, are shown in Figures 3-10 and 3-11.

3.6.1.1 Fragile fern (Asplenium peruvianum ssp. insulare). Fragile fern (*Asplenium peruvianum* ssp. *insulare*) is a federally listed endangered species that is found on PTA (USFWS 2010a). Fragile fern has been identified in montane wet, mesic, and dry forest habitats as well as subalpine dry forests and shrubland. There are several populations on PTA, and fragile fern can occur at elevations from 5,250–7,800 ft (1,600–2,377 m) (Belfield and Pratt 2002). Locations of fragile fern (*Asplenium peruvianum* ssp. *insulare*) are shown in Figure 3-10.

3.6.1.2 Poʻe (Portulaca sclerocarpa). The poʻe is a federally listed endangered species that is found on PTA (USFWS 2010a). The poʻe (*Portulaca sclerocarpa*) is a perennial herb with long stems and grayish-green leaves and white or pink flowers. The poʻe is found in dry habitats at elevations from 3,300–5,300 ft (1,006–1615 m) (University of Hawaiʻi 2000a). Locations of the poʻe (*Portulaca sclerocarpa*) are shown in Figure 3-10.

3.6.1.3 Honohono (Haplostachys haplostachya). The honohono (*Haplostachys haplostachya*) is a listed endangered species found on PTA (USFWS 2010a). The honohono (*Haplostachys haplostachya*) is endemic to the Hawaiian Islands. It has long stems, broad leaves, and white flowers (USBG 2010). The honohono is particularly sensitive to the affects of grazing and invasive species (USBG 2010). Locations of honohono (*Haplostachys haplostachya*) are shown in Figure 3-10.

3.6.1.4 Hawaiian Catchfly (Silene hawaiiensis). The Hawaiian catchfly is a federally listed threatened species that is found at several locations on PTA (USFWS 2010a). The Hawaiian catchfly (*Silene hawaiiensis*) is a sprawling shrub with slender leaves and greenish-white flowers. This plant is endemic to the Big Island of Hawaiʻi and is usually found in dry forests, shrublands, and grasslands on lava flows and ash deposits at elevations from 3,000–4,300 ft (900–1,300 m) (Mitchell et al. 2005). Locations of the Hawaiian catchfly (*Silene hawaiiensis*) are shown on Figure 3-10.

3.6.1.5 Hawaiian Hawk or ʻIo (Buteo solitarius). The Hawaiian hawk or the ʻio (*Buteo solitarius*) is an endangered species that is a small, broad-winged hawk and is endemic to the Hawaiian Islands, but it mostly occurs on the island of Hawaiʻi. This solitary hawk is a territorial bird that remains in areas where it is nesting in native forests. Being opportunistic predators, however, these hawks have been known to use broad ranges to forage for foods (USFWS 2010c). The Hawaiian hawk is listed as a federal and state endangered species, but, as of 2008, the USFWS was proposing to remove the bird from its list of endangered and threatened wildlife because of stable populations for the past 20 years (USFWS 2008). Based on anecdotal information, the Hawaiian hawk's habitat has been recorded over the Mauna Loa LZs, and the helicopter flight path from Bradshaw Army Airfield to the LZs would cross Hawaiian hawk locations. However, with the lack of vegetation and wildlife resources near the LZs, the Hawaiian hawk would not likely frequent the area, and it is anticipated that the population densities of ʻio at the LZs on Mauna Loa and Mauna Kea is zero (U.S. Army 2011b). The range of the Hawaiian hawk or the ʻio (*Buteo solitarius*) is shown on Figure 3-11. Further analysis of the Hawaiian hawk is provided via the discussion of endangered and threatened species in Subsection 4.6.

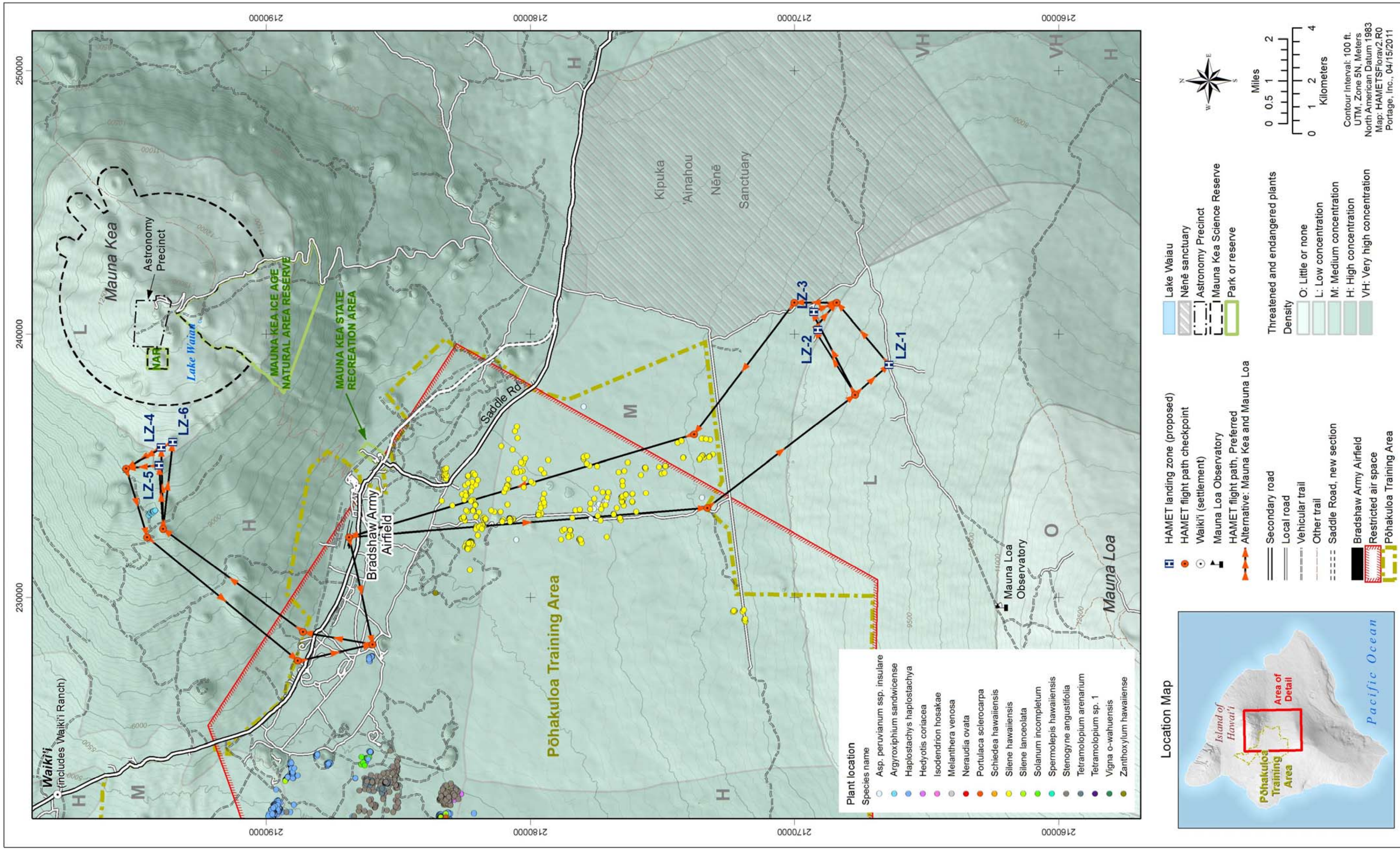

Figure 3-10. Threatened and endangered plant density and locations.

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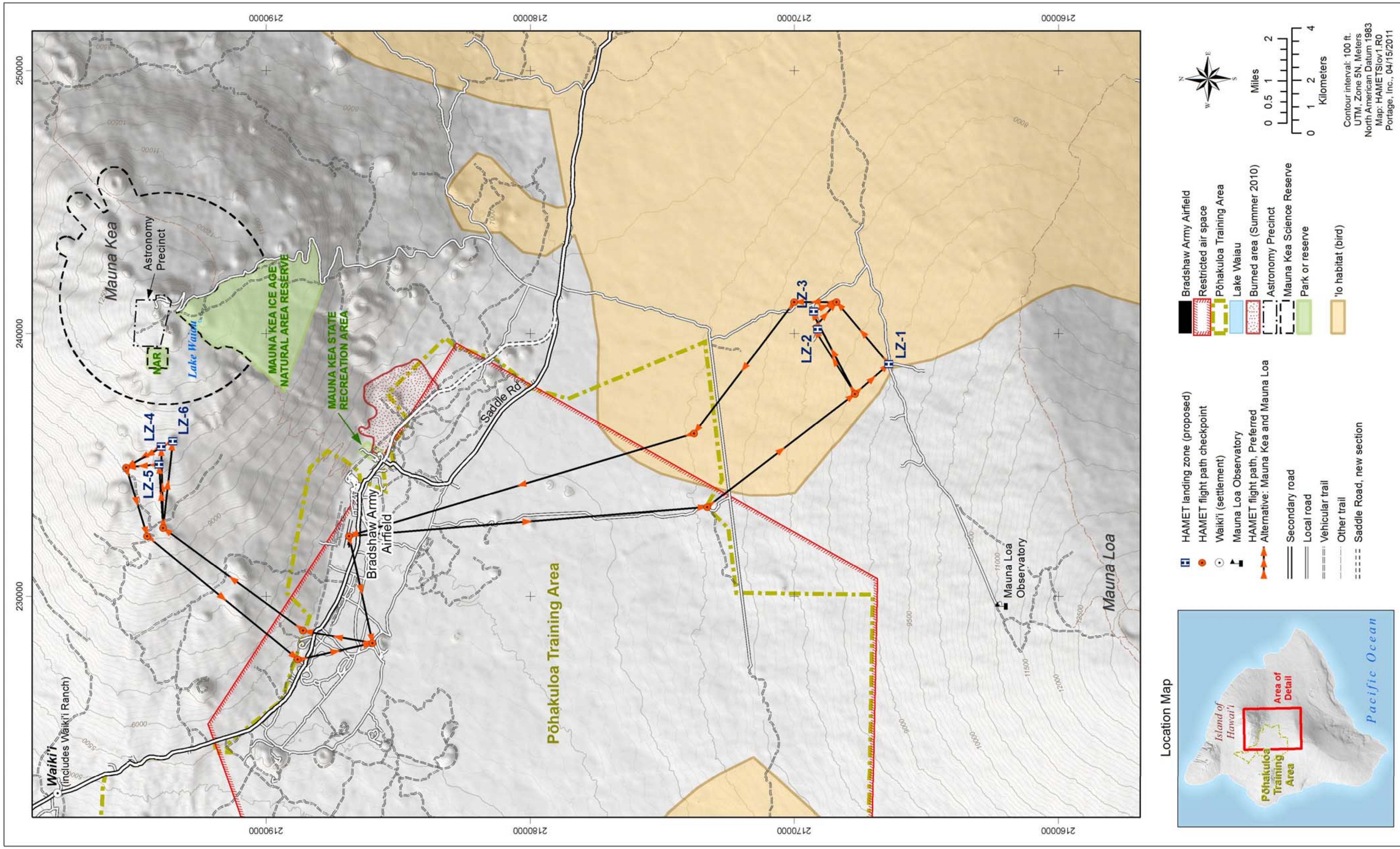

Figure 3-11. Range of the Hawaiian hawk or 'io (*Buteo solitarius*).

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3.6.1.6 Hawaiian Hoary Bat or ‘Ope‘ape‘a (Lasiurus cinereus semotus). The Hawaiian hoary bat or ‘ope‘ape‘a (*Lasiurus cinereus semotus*) is listed as an endangered species, has a range from sea level to 7,500 ft (2,286 m) on the island, and has been spotted at the mountain summits; these bats have been known to occur near the elevations of the LZs but would not be expected to depend on this habitat for resources, because the bats are mostly associated with their native vegetation (Jacobs 1994; USFWS 1994; Peshut and Doratt 2011a). The Hawaiian hoary bat is solitary, is only active from sunset to sunrise, and roosts in trees in forested areas (USFWS 2010d). The USFWS has issued reasonable and prudent measures to minimize incidental take of the Hawaiian hoary bat from PTA activities (USAEC and COE 2009). However, with the lack of vegetation and wildlife resources in the vicinity of the LZs, the Hawaiian hoary bat would not likely frequent these areas, and sightings of this bat are rare. Currently, there is no designated USFWS critical habitat for the Hawaiian hoary bat (USFWS 1994). Further analysis of the Hawaiian hoary bat is provided via the endangered and threatened species discussion in Subsection 4.6.

3.6.1.7 Palila (Loxioides bailleui). The palila (*Loxioides bailleui*) is a listed endangered species, is endemic to Hawai‘i, and has a range from 6,000–9,000 ft (1,829–2,743 m) (USFWS 2010e). The palila has a golden-yellow head and breast, with a gray back and gray/white belly (USFWS 2010e). The palila (*Loxioides bailleui*) is concentrated on the west slope of Mauna Kea, where the palila is dependent on the māmane tree as a food source in the subalpine māmane dry forest (USGS 2006; U.S. Army 2011b). As part of the recovery plan, the USFWS established the PCH in 1977 with 60,187 acres (24,356 hectares) (USAEC 2008). In August 2010, a wildfire burned approximately 1,387 acres (561 hectares) of PCH prior to containment. The 2,000-ft (610-m) AGL flight elevation has been established to protect the palila and its habitat from planned operations. The range and the designated critical habitat for the palila (*Loxioides bailleui*) are shown on Figure 3-12. Further analysis of the proposed activities is included in Section 4.6.

3.6.1.8 Hammerhead or ‘Akiapola‘au (Hemignathus munroi). The hammerhead or ‘akiapola‘au (*Hemignathus munroi*) is a listed federal and state endangered species, is endemic to Hawai‘i, and only lives in the high-elevation forests near the tree line on the island of Hawai‘i (USFWS 2010f). The hammerhead has a curved bill with a yellow head and olive-green upper body. The habitat of the hammerhead is to the west and the south of the Mauna Kea LZs at the tree line. Currently, there is no USFWS designated critical habitat for the hammerhead. The helicopter flight path is above the hammerhead range on Mauna Kea and, with established mitigation measures operations, should have no effect. The range of the hammerhead or ‘akiapola‘au (*Hemignathus munroi*) located within the area shown on Figure 3-13. Further analysis of the hammerhead is provided via the endangered and threatened species discussion in Subsection 4.6.

3.6.1.9 ‘Ua‘u or Hawaiian Dark-Rumped Petrel (Pterodroma sandwichensis). The Hawaiian dark-rumped petrel or Hawaiian petrel (*Pterodroma sandwichensis*) is a federal endangered bird species that could potentially occur within the proposed flight path and near the LZs on Mauna Loa. The Hawaiian petrel has a dark-gray head, wings, and tail with a white forehead (USFWS 2010g). The Hawaiian petrel is a nocturnal seabird that nests in burrows in areas of sparse vegetation at elevations above 7,200 ft (USFWS 1983). The Hawaiian petrel feeds on crustaceans, squids, and other marine wildlife during the day and returns to the nests at night (Peshut and Schnell 2011b).

Breeding colonies of the Hawaiian petrel have been documented within the Hawai‘i Volcanoes National Park, south of the proposed LZs on Mauna Loa (Swift and Burt-Toland 2009). There are no identified active petrel breeding colonies near (within the 2000-ft radius survey area) the Mauna Kea and Mauna Loa LZs (Peshut and Schnell 2011a; Peshut and Schnell 2011b). It has been documented that while Hawaiian petrels are flying toward their breeding colonies, they will fly close to the terrain (Swift and Burt-Toland 2009). Several conservation actions are in place to manage current populations. These actions include protecting suspected habitat, controlling nonnative predatory species, determining the distribution of the populations, controlling direct mortalities, and minimizing the effects of artificial lighting (USFWS 1983). Currently, there is no USFWS designated critical habitat for the Hawaiian petrel (USFWS 2010g). The Hawaiian petrel is not expected to be affected by the Proposed Action; thus, further analysis of the Hawaiian petrel is via the endangered and threatened species discussion in Subsection 4.6.

3.6.2 Sensitive Species

Sensitive species that have the potential to occur within the ROI but not within the direct flight paths or LZs are described below and listed in Table 3-5. Locations and descriptions of these sensitive species are based on botanical and wildlife surveys, habitat requirements, and geographic distribution of the species, EISs, and suspected habitats.

In March 2011, surveys were conducted to determine the presence of Migratory Bird Treaty Act (MTBA) listed species that potentially could occur within a 2,000-ft (610-m) buffer for the proposed LZs (16 USC 7 § 703-712 et seq.; Peshut and Schnell 2011a). The results of the survey found two house finches (*Carpodacua mexicanus*) near the Mauna Kea LZs (U.S. Army 2011b). It is expected that these birds were commuting between forested areas and not using this habitat (U.S. Army 2011b). Results of the survey at the Mauna Loa LZs observed 32 ʻapanane (*Himatione sanguine*), 40 ʻōmaʻo (*Myadestes obscures*), and three house finches (*Carpodacua mexicanus*). The observed species near the LZs are not expected to be negatively impacted by HAMET operations (U.S. Army 2011b). Other MTBA-listed species that could potentially occur near the LZs are the Hawaiʻi ʻamakihi (*Hemignathus virens*), northern mockingbird (*Mimus ployglottus*), sky lark (*Alauda arvensis*), Pacific golden-plover (*Pluvialis fulva*), barn owl (*Tyto alba*), and pueo (*Asio flammeus sandwichensis*). It is not anticipated that the HAMET operations will impact these bird species because of the lack of suitable cover and habitat. In addition, it is anticipated that birds would vacate the area while noise levels are high and return to the area once noise levels have abated (U.S. Army 2011b). Further analysis of MTBA listed species is via the sensitive species discussion Subsection 4.6.

3.6.2.1 ʻAkeʻakē or Band-Rumped Storm-Petrel (Oceanodroma castro). The band-rumped storm-petrel (*Oceanodroma castro*) is a federal candidate species and a state listed endangered species that could potentially occur within the proposed flight path and near the LZs on Mauna Loa. The band-rumped storm petrel is blackish-brown with a white band across the rump area (Mitchell et al. 2005). The band-rumped storm petrel is a nocturnal seabird that is suspected to nest in burrows at above 3,900 ft (1,189 m) on barren lava flows within Hawaiʻi Volcanoes National Park (Mitchell et al. 2005). Currently, little is known about the population size and distribution on Hawaiʻi, and no known colonies or nests have been found within Hawaiʻi Volcanoes National Park south of the proposed LZs on Mauna Loa, but there is one suspect nest and evidence that these birds breed within the park (Swift and Burt-Toland 2009). Additionally, use of the habitat in the Saddle region by band-rumped storm-petrels has been documented (Peshut and Schnell 2011a). There are no identified active band-rumped storm petrel breeding colonies near (within the 2000-ft radius survey area) the Mauna Kea and Mauna Loa LZs (Peshut and Schnell 2011a; Peshut and Schnell 2011b).Several conservation actions are in place to manage current populations. These actions include protecting suspected habitat, controlling nonnative predatory species, identifying hazardous substances that could affect the species, and minimizing the effects of artificial lighting (Mitchell et al. 2005).

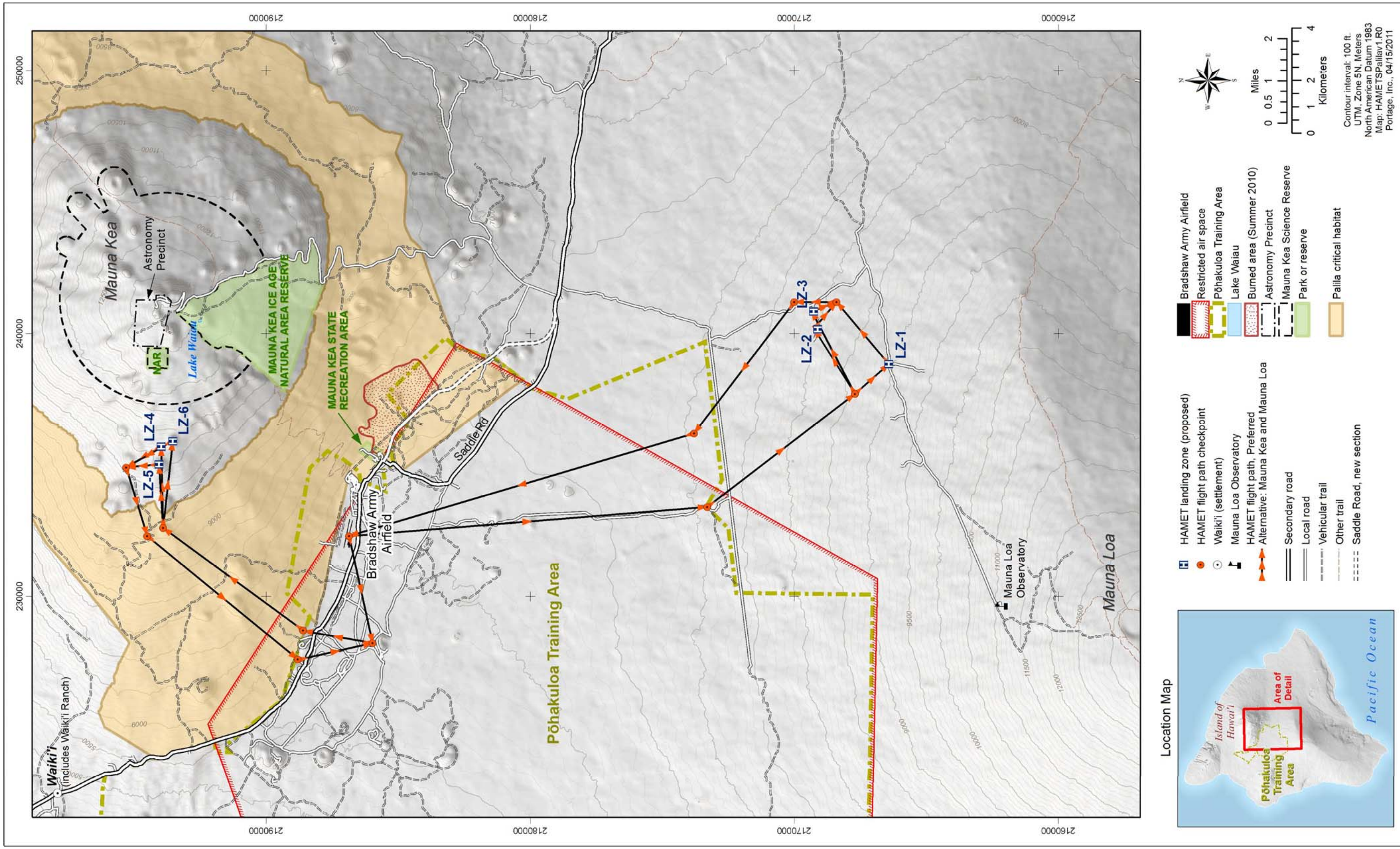

Figure 3-12. Range of the palila (*Loxioides bailleui*).

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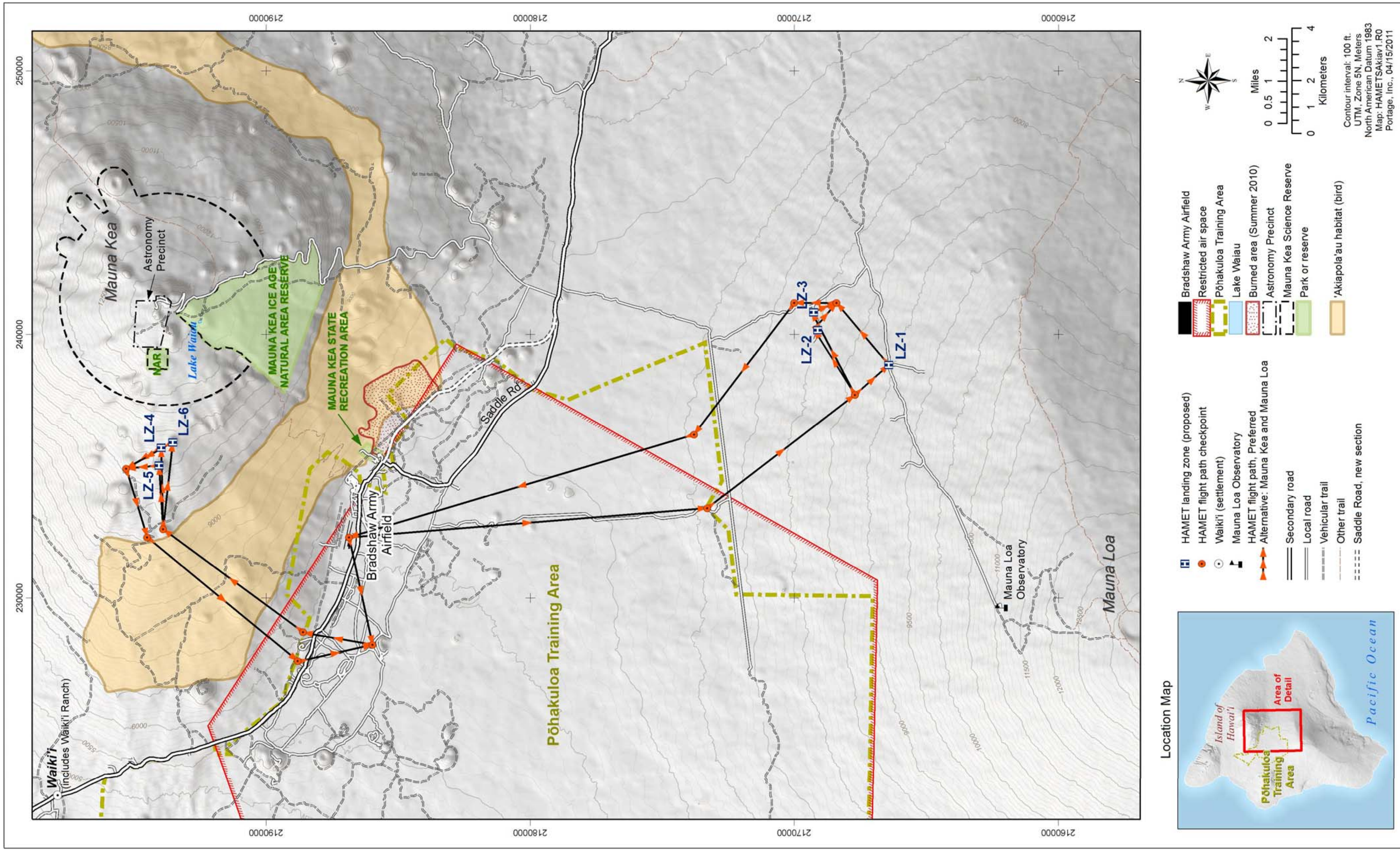

Figure 3-13. Range of the hammerhead or ‘akiapola‘au (*Hemignathus munroi*).

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Currently, there is no designated critical habitat for the band-rumped storm-petrel (Mitchell et al. 2005). The band-rumped storm-petrel shares similar habitat to the Hawaiian petrel, and additional surveys will be conducted between May and August (U.S. Army 2011b). The band-rumped storm-petrel is not expected to be affected by the Proposed Action; thus, further analysis of the band-rumped storm petrel is via the sensitive species discussion in Subsection 4.6.

3.6.2.2 Nēnē or Hawaiian Goose (Branta sandvicensis). The nēnē (*Branta sandvicensis*) is a listed endangered species that could potentially occur within the ROI. The State of Hawaiʻi has established the Kipuka ʻAinahou Nēnē Sanctuary (State of Hawaiʻi 1981). It is a designated area for the nēnē populations and is located to the east of planned LZs on Mauna Loa. The nēnē is endemic to the Hawaiian Islands. It is mostly dark brown, has a black face and crown, and has black streaks and cream-colored cheeks (Mitchell et al. 2005). The nēnē habitat consists of lowland dry forest, shrublands, grasslands, sparsely vegetated low- and high-elevation lava flows, alpine deserts, alpine grasslands, and shrublands from sea level to 8,000 ft (2,438 m) (Mitchell et al. 2005; USFWS 2004). Recently, studies have shown that the nēnē moves between Hawaiʻi Volcanoes National Park and the Hakalau Forest National Wildlife Refuge, north and east of the PTA, and to the south slopes of Mauna Kea (U.S. Army 2011b). In addition, the nēnē has been known to cross the PTA from the Kipuka ʻAunahou Nēnē Sanctuary to Mauna Kea, but specific flight paths of the nēnē are not known at this time, and research by the USGS is continuing (Peshut and Schnell 2011a). Several conservation actions are in place to manage current populations. These actions include captive propagation, predator control, habitat enhancement, and research with continued monitoring (USFWS 2004). Currently, there is no USFWS designated critical habitat for the nēnē (USFWS 2004). The range of the nēnē (*Branta sandvicensis*) within the Proposed Action area is shown on Figure 3-14. Further analysis of the nēnē is via the sensitive species discussion in Subsection 4.6.

3.6.2.3 Wekiu Bug (Nysius wekiuicola). The wekiu bug (*Nysius wekiuicola*) is a federal candidate species being considered for listing as a threatened species (University of Hawaiʻi 2009). The wekiu bug has been observed mostly in the Mauna Kea Science Reserve; however, recent field surveys for the wekiu bug found no species at elevations similar to those for the proposed LZs on Mauna Kea (Englund et al. 2005). The wekiu bug has been observed mostly near crater rims of cinder cones and edges of glaciers and snowfields. A key part of the wekiu bug habitat is the aeolian drift that carries food sources from lower elevations (University of Hawaiʻi 2009). Another key part of the wekiu habitat is the presence of ants. Ants are not native species and are a wekiu bug predator. Surveys for arthropods near the LZs found no wekiu bugs or ants (Peshut and Doratt 2011a; Peshut and Doratt 2011b). Currently, there is no USFWS-designated critical habitat for the wekiu bug. The Proposed Action is not anticipated to have any effect on the wekiu bug (*Nysius wekiuicola*) because of the distance of the LZs from the known habitat. Detailed information and the range of the wekiu bug's habitat can be found in the *Mauna Kea Comprehensive Management Plan*, *UH Management Areas* (CMP) (University of Hawaiʻi 2009). Further analysis of the wekiu bug is covered via the sensitive species discussion in Subsection 4.6.

3.6.3 Other Vegetation and Wildlife Species

Vegetation and wildlife species that are not listed as endangered or threatened or those that have been designated sensitive species have been recorded throughout PTA within or near to the proposed flight paths and LZs. These species have been recorded in botanical and wildlife field surveys by the University of Hawaiʻi, the Bishop Museum Hawaiian Heritage Program, the CEMML, and other organizations (USAEC 2008). In February, March, May and June 2011, surveys for birds, bats, arthropods, and vegetation within survey areas up to 2,000-ft (610-m) radius of LZs on Mauna Kea and Mauna Loa were conducted to determine whether significant resources were present, and no significant resources were found at those locations (Peshut and Evans 2011; Peshut and Doratt 2011a; Peshut and Doratt 2011b; Peshut and Doratt 2011c; Peshut and Schnell 2011a; Peshut and Schnell 2011b).

Vegetation and wildlife species found include endemic and nonnative species. Examples of the vegetation species found are lichens, such as *Stereocoulon vulcani*; ferns, such as *Pellea ternifolia*; shrubs, such as *Dodonaea viscosa*; and trees, such as *Myoporum sandwicense* (USAEC 2008). Examples of the wildlife species found include native invertebrates, such as *Helicoverpa confusa*; native birds, such as *Himatone sanguine*; nonnative reptiles, such as *Anolis carolinenesis*; nonnative amphibians, such as *Rana catesbeiana*; and nonnative mammals, such as *Herpestes auropunctatus* (USAEC 2008). No aquatic systems are within the proposed flight paths or LZs.

3.7 Cultural Resources

The following cultural summary is detailed further in the Mauna Kea CMP (University of Hawai‘i 2009) and the *Final Environmental Impact Statement, Thirty Meter Telescope Project, Island of Hawai‘i* (University of Hawai‘i 2010). Additional cultural resources investigation information was gathered from the *Final Environmental Impact Statement, Permanent Stationing of the 2/25th Stryker Brigade Combat Team* (USAEC 2008); *Environmental Assessment for Range Modernization Pōhakuloa Training Area, Island of Hawai‘i* (U.S. Army 2004b); *Final Environmental Impact Statement, Military Training Activities at Mākua Military Reservation, Hawai‘i* (USACE and COE 2009); *Mauna Loa Trail System Feasibility Study* (Nature Conservancy of Hawai‘i 2005); and three Army Memoranda for the Record (Godby 2003; Godby and Head 2003; Rumsey 2009).

Cultural resources are defined as historic properties or those that are eligible for listing on the National Register of Historic Places (NRHP), cultural items, archaeological resources, sacred sites, or collections subject to protection under the NHPA (16 USC 1A § 470 et seq.), ARPA (16 USC 1B §§ 470aa-mm), Native American Graves and Repatriation Act (25 USC 32 § 3001 et seq.), Executive Order 13007– Indian Sacred Sites (61 FR 104), American Indian Religious Act (42 USC 1996a and 1996b), American Antiquities Act of 1906 (16 USC 431-433), and the guidelines on “Curation of Federally Owned or Administered Archaeological Collections” (36 CFR I § 79). Native Hawaiian cultural resources to be considered are those of importance to Native Hawaiian groups and include cultural beliefs and practices, sacred sites, prehistoric and historic archaeological sites, historic buildings and structures, and areas of cultural importance. Areas of cultural importance include traditional resources, use areas, and sacred sites that are potentially eligible for the NRHP as traditional cultural properties (TCPs) (U.S. Army 2004b). A TCP is generally defined as “one that is eligible for inclusion in the National Register [of Historic Places] because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community” (U.S. Army 2004b, p. 3-72).

Also important to the consideration of Native Hawaiian resources are concepts, culture, and landscapes. The *Final Environmental Impact Statement, Permanent Stationing of the 2/25th Stryker Brigade Combat Team* (USAEC 2008) defines five cultural landscape types that “reflect the importance of culturally significant natural resources and man-made resources such as archaeological sites.” They include the following:

1. Areas of naturally occurring or cultivated resources used for food, shelter, or medicine

2. Areas that contain resources used for expression and perpetuation of Hawaiian culture, religion, or language

3. Places where known historical and contemporary religious beliefs or customs are practiced

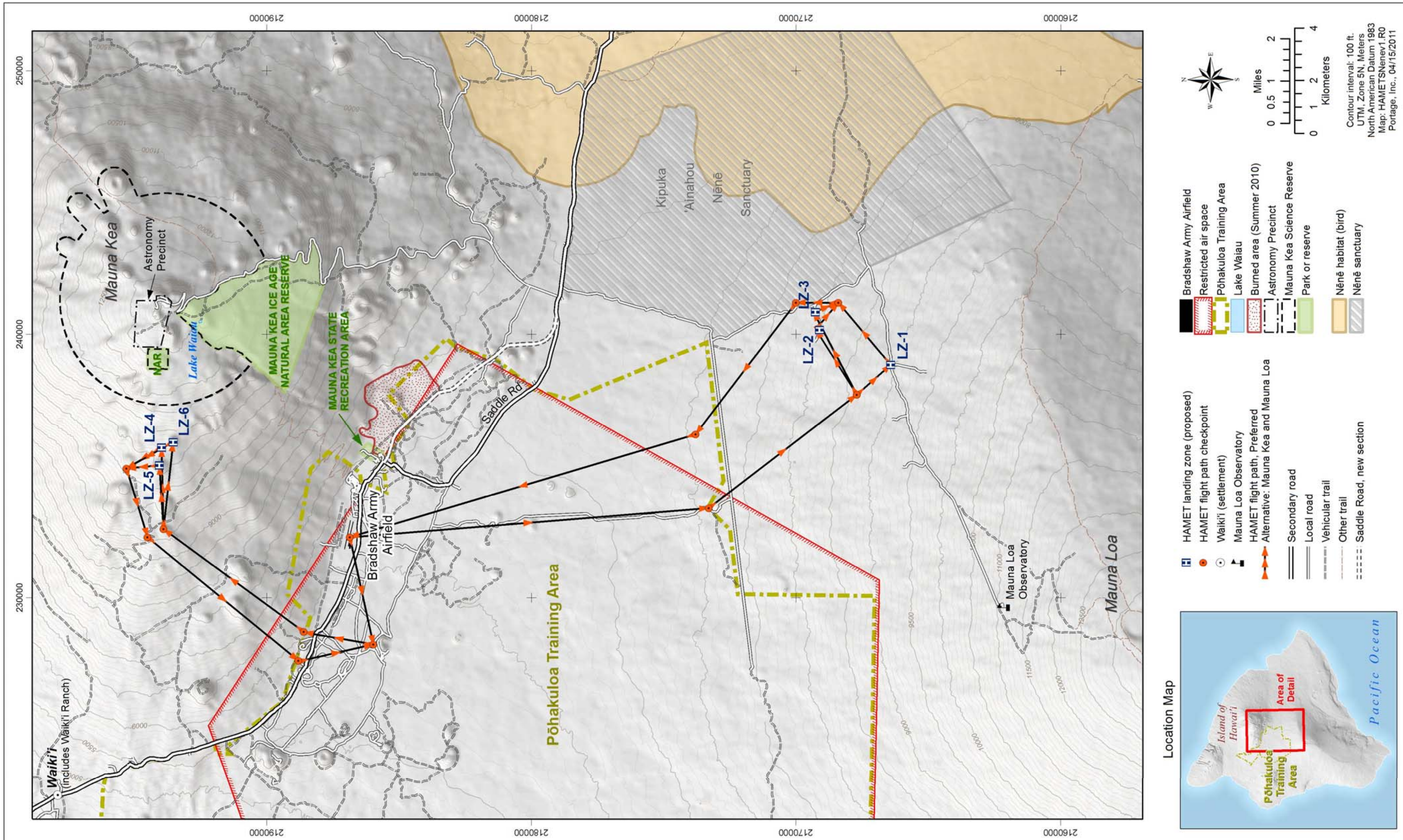

Figure 3-14. Range of the Hawaiian goose or nēnē (*Branta sandvicensis*).

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4. Areas where natural or cultivated endangered terrestrial or marine flora and fauna used in Native Hawaiian ceremonies are located or where materials for ceremonial art and crafts are found

5. Areas that provide natural and cultural community resources for the perpetuation of language and culture, including place names and natural, cultural, and community resources for art, crafts, music, and dance.

A literature search was conducted for this study, including gathering information on cultural significance and field surveys. The results of this search are summarized in following subsections.

3.7.1 Cultural Overview

It was the nature of place that shaped the cultural and spiritual view of the Hawaiian people. "Cultural attachment" comprises both the tangible and intangible values of a culture – how a people identify with and personify the environment around them. It is the intimate relationships (developed over generations of experiences) that people of a particular culture feel for the environment that surrounds them – their sense of place. This attachment is deeply rooted in the beliefs, practices, cultural evolution, and identity of a people (Kent et al. 1995).

In Hawaiian culture, natural and cultural resources are one and the same. Native traditions describe the formation (literally the birth) of the Hawaiian Islands and the presence of life on and around them in the context of genealogical accounts. All forms of the natural environment from the skies and mountain peaks, to the watered valleys and the lava plains, and to the shoreline and ocean depths are believed to be embodiments of Hawaiian gods and deities.

In 1778, British explorer Captain James Cook arrived in Hawaiʻi and began a period of sustained contact between Hawaiians and westerners that began to change Hawaiian culture (University of Hawaiʻi 2009, p. 5-18). In 1782, Kamehameha I became the ruler of Hawaiʻi Island and began his conquest of the other islands to unite them under a single rule. Following Kamehameha I's death in 1819, his son, Kamehameha II, succeeded him. Up until that time, Hawaiian life was regulated under laws of *kapu* (taboo). Kamehameha II ordered the end to the state *kapu* system and placed restrictions on traditional religious practices. He subsequently allowed Protestant missionaries to settle in Hawaiʻi, thus altering Hawaiian cultural and religious systems (NPS 2009). However, traditional beliefs and practices continued to be passed down covertly, especially in places far from the Christian centers (University of Hawaiʻi 2009, p. 5-5). Although some traditional religious beliefs and knowledge were likely lost, individual familial religious practices remained and continue.

Colonial expeditions, traders, whalers, and other foreigners visited the Hawaiian Islands following the Cook expedition. Some of these people took up residence in the islands, and some introduced new species. In 1792, Captain George Vancouver presented Kamehameha I with cattle and goats and requested that they be allowed to propagate for 10 years. Kamehameha I sent the cattle and goats into the mountains of Hawaiʻi Island and placed a *kapu* on killing them. Over the next decades, *kapu* continued, especially on cattle, in an effort to increase the herd. In the mid to late 1800s, land tenure was modified by the Kingdom of Hawaiʻi, with the result that ranch owners could control individually held land. Today, sheep and goats are actively hunted to control their impacts on the fragile ecosystem (University of Hawaiʻi 2009, pp. 6-11–6-16). Evidence of the early ranching and grazing activities are extant on the island of Hawaiʻi (University of Hawaiʻi 2009, pp. 5-17–18).

The ROI considered for cultural resources includes Mauna Kea and the three existing LZs on Mauna Kea, Mauna Loa and the three existing LZs on Mauna Loa, and the flight paths. The ROI falls within the ahupuaʻa of Kaʻohe, Hāmākua District. Kaʻohe Ahupuaʻa begins as a narrow strip of land on the east coast of Hawai‘i Island, but after 5 kilometers it broadens, and 12 kilometers further upslope it broadens again to encompass most of Mauna Kea. The ahupua‘a continues to the west and south to Mokuaweoweo, the crater at the summit of Mauna Loa. Ka‘ohe Ahupua‘a encompasses the complete range of ecotones found on Hawai‘i Island. The following discussion considers those portions of Ka‘ohe within which the project area lies. Recent traditional historical research was consulted for this document (e.g., McCoy, Collins, Clark & Park 2009; Maly 1997, 1999; Maly & Maly 2005) In addition, several organizations representing Native Hawaiian interests on Mauna Kea were consulted. The literature consulted acknowledges the significance of Mauna Kea in Native Hawaiian culture but seeks to find a balance with modern activities. Native Hawaiians generally consider Mauna Kea to be of special cultural significance and many find it difficult to reconcile modern activities based in a foreign culture with the sacredness of the mountain.

3.7.2 Mauna Kea Cultural Aspects

The following subsections describe the cultural aspects of Mauna Kea.

3.7.2.1 Mauna Kea Cultural Beliefs and Practices. Mauna Kea is described as the “most sacred and culturally significant location on the island of Hawai‘i, if not in the whole of Hawai‘i” (University of Hawai‘i 2009, p. 1-3). Native Hawaiians generally believe that the Hawaiian Islands are the sacred keiki (children) of Wākea (sometimes translated as “Sky Father”) and Papahānaumoku (literally, the firmament or wide place who gives birth to islands, also referred to as Papa, the creator goddess of Hawai‘i), who conceived and gave birth to the islands of Hawai‘i. Wākea and Papahānaumoku also gave birth to Komoawa and Ho‘ohōkūkalani. Komoawa is both son and high priest of Wākea. Ho‘ohōkūkalani means the “creator of stars.” She, in union with Wākea, becomes the celestial womb from which Hawai‘i the original native being takes root, gestates, and is born into a sacred landscape (University of Hawai‘i 2009, p. i). Mauna Kea is the piko or navel of the island of Hawai‘i (University of Hawai‘i 2009, p. i). Poli‘ahu (snow), Lilinoe (mist), and Waiau were sister goddesses who are female forms of water, and the three locations on Mauna Kea - cinder cones or pu‘u and a lake - that bear their names are important religious sites (University of Hawai‘i 2009, p. 5-4). Lake Waiau was created by Kane for his daughter Poli‘ahu (University of Hawai’i 2009, p. 5-4). Mauna Kea is believed to be the union between heaven, earth, and stars and, as the highest point throughout Pacific Polynesia, is likened to a sacred alter.

Native Hawaiian traditions state that ancestral *akua* (gods, goddesses, deities) reside within the summit area. These personages are embodied within the Mauna Kea landscape – they are believed to be physically manifested in earthly form as various pu‘u and as the waters of Waiau. Because these *akua* are connected to the Mauna Kea landscape in Hawaiian genealogies, and because elders and *akua* are revered and looked to for spiritual guidance in Hawaiian culture, Mauna Kea is considered a sacred place (McCoy and Nees 2009).

Mauna Kea is thought of as a *lananu‘u mamao* or “sacred tower located within a *heiau* at or upon which worship takes place and offerings to the gods are made” (University of Hawai‘i 2009, p. 1-3). Three *kahua* or levels comprise the *lananu‘u mamao* ocated between approximately 11,000 and the summit. The *lana* is the first level between the 11,000 and 12,000 ft (3,353 and 3,658 m) elevation and is the least restricted *kahua.* This is an area of mundane resource procurement Documented archaeological sites here include ancient offering shrines. The *nu‘u*is the second level between 12,000 and 13,000 ft (3,658 and 3,962 m). Pre-contact archaeological features diminish in this area, but it was traditionally known to have been visited by *maka‘ainana* (commoners) to erect 4their shrines and make offerings to their gods. Viewed as more sacred than the *lana*, *nu‘u* was reserved for priests and their attendants. The most sacred and restricted *kahua* is the *mamao*. Located above 13,000 ft (3,962 m) where only ranking chiefs and high priests with their attendants were allowed to ascend. The relatively few archaeological features that exist within the *mamao*, including burials, are likely associated with the upper echelons of Hawaiian society (University of Hawaiʻi 2009, pp. 1-3, 1-4).

The only known uses of the alpine and subalpine zones on Mauna Kea are a few accounts of adze making and burials. Most of this information regarding traditional land uses is a result of archeological investigations that have taken place since the mid 1970s.

There is also evidence to indicate that the area above the limits of agriculture and permanent settlement was a wilderness, probably only accessed by a small number of Hawaiians engaged in special activities such as ceremonial practices, bird catching, canoe making, adze making, and burial of the dead. Bird catching and canoe making were likely concentrated in the upland forests, except for the capture of ʻuaʻu as these birds nested in the alpine and subalpine regions.

Archeological research indicated that the adze quarry, known as Keanakakoʻi, on the south slope of Mauna Kea (concentrated between 11,500 and 12,400 ft [3,500 and 3,780 m]) was exploited over a period as long as 700 years between the years of 1100 and 1800. The date of the abandonment of the quarry is unknown, but it may have occurred as late as Captain Cook's arrival in 1778 or soon thereafter, and the subsequent introduction of metal knives and tools. More recent archaeological research has documented the remains of ritual activity in the summit region of Mauna Kea (McCoy and Nees 2009). Archaeological work at Pōhakuloa Training Area to the southwest has documented temporary habitation sites, trails, ritual sites, stone resource procurement sites and other archaeological sites spanning the same chronological period as the adze quarry. These archaeological sites demonstrate the use of the mountain lands by Hawaiians throughout their residence in the islands. Historic maps also indicate trails on Mauna Kea, many of which are still known and used today.

Traditional Native Hawaiian beliefs include the concept that Mauna Kea represents the past, the present, and the future (University of Hawaiʻi 2009, pp. 1-4, 5-7, and 5-8) and was the setting for early Hawaiian traditions. In addition, religious practices, tool making at Keanakakoʻi quarry, and the study of the heavens took place on the upper elevations of Mauna Kea. Astronomical research continues today at Mauna Kea's numerous observatories, as do some religious practices that have been categorized broadly as (1) traditional and customary and (2) contemporary. As described in the *Final Environmental Impact Statement, Thirty Meter Telescope Project Island of Hawaiʻi, Hilo, Hawaiʻi* (University of Hawaiʻi 2010), traditional and customary practices include the following:

- Performance of prayer and ritual observances important for the reinforcement of an individual's Hawaiian spirituality, including the erections of *ahu* or shrines
- Collection of water from Lake Waiau for a variety of healing and other ritual uses
- Deposition of *piko* (umbilical cords) at Lake Waiau and the summit peaks of Mauna Kea
- Use of the summit region as a repository for human burial remains, by means of interment, particularly on various puʻu, during early times, and more recently by means of releasing ashes from cremations
- Burial blessings to honor ancestors
- Belief that the upper mountain region of Mauna Kea, from the saddle area up to the summit, is a sacred landscape – as a personification of the spiritual and physical connection between one's ancestors, history, and the heavens

- Association of unspecified traditional navigation practices and customs with the summit area

- Annual solstice and equinox observations that take place at the summit of Kukahauʻula (University of Hawaiʻi 2010 p. 3-21).

Established on modern beliefs, contemporary practices include the following:

- Prayer and ritual observances

- Construction of new alters

- Subsistence and recreational hunting (University of Hawaiʻi, p. 3-21), although evidence exists to suggest that hunting in the summit region was not a traditional cultural practice and did not begin until the late 19th century (McCoy and Nees 2009).

Existing roads and trails are used to access these culturally important areas (University of Hawaiʻi 2009, pp. 1, 5-6). Several trails traverse the Mauna Kea summit region. Traditional accounts suggest that some ancient trails were present in the summit regions. These trails are known to cultural practitioners and are not necessarily signed and marked. In some cases, it is unknown whether the current trails follow the same routes as the ancient trails, and, in some cases, it is known that current trails are on different alignments from ancient trails. Trails in the summit region include the following:

- The Humuʻula Trail is probably the best know trail, and, in ancient times, it apparently began in the Kalaieha area where the Humuʻula Sheep Station is located and extended past Hale Pōhaku to Lake Waiau. The trail initially appears on maps made in 1892. Today, the trail begins just above Hale Pōhaku, passes near Lake Waiau, and ends near the Batch Plant Staging Area. The trail originally went around the east side of Puʻu Keoneheheʻe, but, in the 1930s, the Civilian Conservation Corps (CCC) gave the trail a straighter course around the west side of the puʻu.

- The Umikoa Trail is not mentioned in early accounts, and it first appears in maps in the 1920s. The trail may well be an ancient trail, but the name appears to be modern and likely derived from the Umikoa Ranch. Horseback trips to Mauna Kea from the ranch took place in the early 1900s and perhaps earlier. The trail enters the Mauna Kea Science Reserve between Puʻu Makanaka and Puʻu Hoaka on the northeast slope, passes below and west of Puʻu Lilinoe, and intersects the Humuʻula Trail near Lake Waiau.

- A trail less well known to modern people, Waikiʻi-Puʻu Lāʻau-Waiau Trail, probably passed up the west slope of Mauna Kea and possibly through the vicinity of the LZs (Puʻu Lāʻau is on the western flank of Muana Kea, and Waikiʻi is farther west downslope toward Waikoloa and Waimea) (University of Hawaiʻi 2000b).

- The Makahalau Kemolo Waiau Trail led to Waiau from the northwest in ancient times.

With the construction of modern roads providing ready access to the summit area, trails are not believed to play a significant role in ongoing cultural practices. They are retained as historic properties, and remain important to modern cultural practitioners. Trails and corridors traversed significant portions of Hawaiʻi Island, connecting communities with each other and with physical and spiritual resource areas.

3.7.2.2 Mauna Kea Archaeological/Historic Resources. Several archaeological surveys and fieldwork have been conducted on Mauna Kea. The Mauna Kea CMP (University of Hawaiʻi 2009) summarizes investigations undertaken in the University of Hawaiʻi Management Area (see

Subsection 3.9.2 for a description of the University of Hawaiʻi area). Between 1975 and 2006, 223 historic properties were identified in the University of Hawaiʻi Management Area within 11 distinct site types. Site types include traditional cultural properties, shrines, burials, possible burials, stone tool quarry/workshop complexes, the adze quarry ritual center, isolated adze manufacturing workshops, isolated artifacts, stone marker/memorials, temporary shelters, historic campsites, and those of unknown function (University of Hawaiʻi 2009, pp. 5-19, 5-20).

To date, three TCPs have been designated on Mauna Kea and include the summit (Kukahauʻula) and Puʻu Lilinoe in the Mauna Kea Science Reserve and Lake Waiau in the Mauna Kea Ice Age NAR. In addition, a vast area on the summit is eligible for listing on the NRHP as a historic district. The Keanakakoʻi adze quarry is listed as a National Historic Landmark (University of Hawaiʻi 2009, p. 1), and it has been recommended that "the traditions, sites, practices, and continuing significance of Mauna Kea, both historically and today, make it eligible for nomination as a traditional cultural property under federal law and policies (USACE and COE 2009, p. 3-328). In addition, the State Historic Preservation Division (SHPD) has recommended that the entire region of Mauna Kea from 6000 feet to the summit be nominated to the State Register of Historic Places as a Traditional Cultural Property (Simonson & Hammatt 2010).

Results of field surveys undertaken at the three LZ locations on Mauna Kea are discussed below:

- LZ-4: A reconnaissance-level survey was conducted at LZ-4 on October 22, 2003. The results of this survey were negative. No archaeological sites were found in the area. However, a potential historic property (State of Hawaiʻi Site #50-10-22-24004) is located approximately 0.5 mile (1 kilometer) southwest of LZ-4. The site consists of a large basalt rock wall enclosure measuring 836 ft (255 m) N/S by 1,115 ft (340 m) E/W and 19.7 to 4.6 ft (0.60 to 1.40 m) high. It is believed to be a historic feature associated with steer or goat roundups (Godby and Head 2003).

  One small, single-course, diamond-shaped rock alignment feature was identified near LZ-4 and was termed Rock Alignment 1 during a survey conducted in February 2011. Rock Alignment 1 is located approximately 318 ft (97 m) south of LZ-4. This location is within the area of potential effect (APE), which is defined as 328-ft (100-m) from center point of each LZ. The feature is constructed of small and medium pieces of locally available rock with some cobble infilling. Rock Alignment 1 does not display formal construction characteristics, with the rocks simply sitting on top of the ground without being tightly placed or imbedded in the soil. Rock Alignment 1 is 5.35 by 3.64 by 0.69 ft (1.63 by 1.11 by 0.021 m) and is oriented roughly northwest-southeast (Crowell 2011a). This feature was not observed during the previous visits to LZ-4 by PTA Cultural Resources staff and therefore is probably of recent construction.

- LZ-5: A reconnaissance-level survey was conducted at LZ-5 on December 4, 2003. LZ-5 is located between LZ-4 and the large rock enclosure (Site #50-10-22-24004) described above. A thorough examination of the LZ area was conducted for archaeological resources with negative results (Godby and Head 2003).

  On February 24, 2011, a survey identified two stacked rock formations near LZ-5. These formations have been identified as Rock Mound 1 and Rock Mound 2 (Crowell 2011a).

  Rock Mound 1 is located between the southern edge of a large crater and the southern crest of the puʻu and overlooks the Saddle Region of Hawaiʻi Island. Rock Mound 1 is located approximately 472 ft (144 m) south-southwest of LZ-5 and is just outside of the APE. Rock Mound 1 is a pyramidal-shaped, stacked-rock mound constructed in five to seven courses of large- and medium-sized pieces of locally available rock, with smaller rock and cobble infill. The area around the feature appears to have been cleared, apparently for the construction of Rock Mound 1.The feature measures 8.7 by 5.74 by 4.1 ft (2.65 by 1.75 by 1.25 m) and is oriented roughly east-west. The feature is somewhat formally constructed with the rocks tightly placed and infilling with smaller rocks. Some of the rocks have tumbled from the top and sides of the feature and lie immediately adjacent at the base (Crowell 2011a).

Rock Mound 2 is located between the northern edge of a large crater and the northern crest of the puʻu. T-022411-02 is located within the APE, approximately 270 ft (82 m) east-southeast of LZ-5 and 594 ft (181 m) northeast of Rock Mound 1 at 235099E, 2194029N. The feature is a pyramidal-shaped, stacked-rock mound constructed in five to seven courses of large- and medium-sized pieces of locally available rock with some smaller rock infill but with less infilling than is present at Rock Mound 1. Additionally, Rock Mound 2 has a more rectangular and less pyramidal shape than Rock Mound 1 but is wider at the base than at the top. The feature displays somewhat formal construction characteristics, with tightly placed rocks and some evidence of a faced profile on the north side of the feature. The area around the feature shows evidence of clearing due to the construction of the mound. Rock Mound 2 measures approximately 8.4 by 5.48 by 3.67 ft (2.55 by 1.67 by 1.12 m) and is oriented roughly east-west. A few of the rocks have tumbled from the sides and top of the feature and lie immediately adjacent to the base (Crowell 2011a).

- LZ-6: A reconnaissance-level survey was conducted at LZ-6 on December 4, 2003. LZ-6 is located approximately 3,281 ft (1,000 m) east of LZ-5. A thorough examination was made of the proposed landing area with negative results (Godby and Head 2003).

  One stacked rock feature was identified during a February 2011 survey near LZ-6 and was termed Rock Mound 3. This feature was previously identified in the Godby and Head (2003) survey and described as a rock mound constructed with local cobbles and boulders with faced sides on the north and the east. The current survey identified Rock Mound 3 located within the APE, approximately 184 ft (56 m) east-southeast of LZ-6. The feature is a pyramidal-shaped, stacked-rock mound constructed in six to eight courses of large- and medium-sized pieces of locally available rock with smaller rock and cobble infill. Rock Mound 3 is fairly formally constructed with tightly placed rocks and infilling. The area around the feature was cleared during the construction of the mound. Rock Mound 3 is approximately 7 by 4.5 by 4.4 ft (2.13 by 1.37 by 1.35 m) and is oriented roughly north-south. Rock Mound 1 and Rock Mound 2 are clearly visible from Rock Mound 3 (Crowell 2011a).

Figure 3-15 shows the traditional cultural properties on Mauna Kea in relation to the three LZ locations and the flight corridor.

3.7.3 Saddle Region Cultural Aspects

Because of the spiritual and physical interconnectivity of Mauna Kea and Mauna Loa, a discussion of these areas would be incomplete without a brief description of the area between them, the Saddle Region.

The Saddle Region, home to PTA, connects Mauna Kea to Mauna Loa. Various trails connecting population and resource centers run through the area and have small rock structures associated with them, including rest shelters and cairns to mark the trails. This area is often over flown by civilian helicopters.

Nineteenth century documents reveal the presence of the ʻuaʻu (Hawaiian petrel), a nocturnal, pelagic seabird that nests on the ground, in the plateau region between Mauna Kea and Mauna Loa. Although recent studies at PTA have not been able to document ʻuaʻu, they have been found on the slopes of Mauna Loa. Historically, the ‘ua‘u chicks were considered a delicacy, were hunted, and, with few exceptions, were consumed only by chiefs. It appears that adult ‘ua‘u were hunted and eaten by travelers in the Saddle Region who were perhaps on their way to Mauna Kea or Mauna Loa (U.S. Army 2004b, p. 3-26). Hunting for ‘ua‘u and other birds continued from prehistoric times into the early 20th century (U.S. Army 2004b, p. 3-27).

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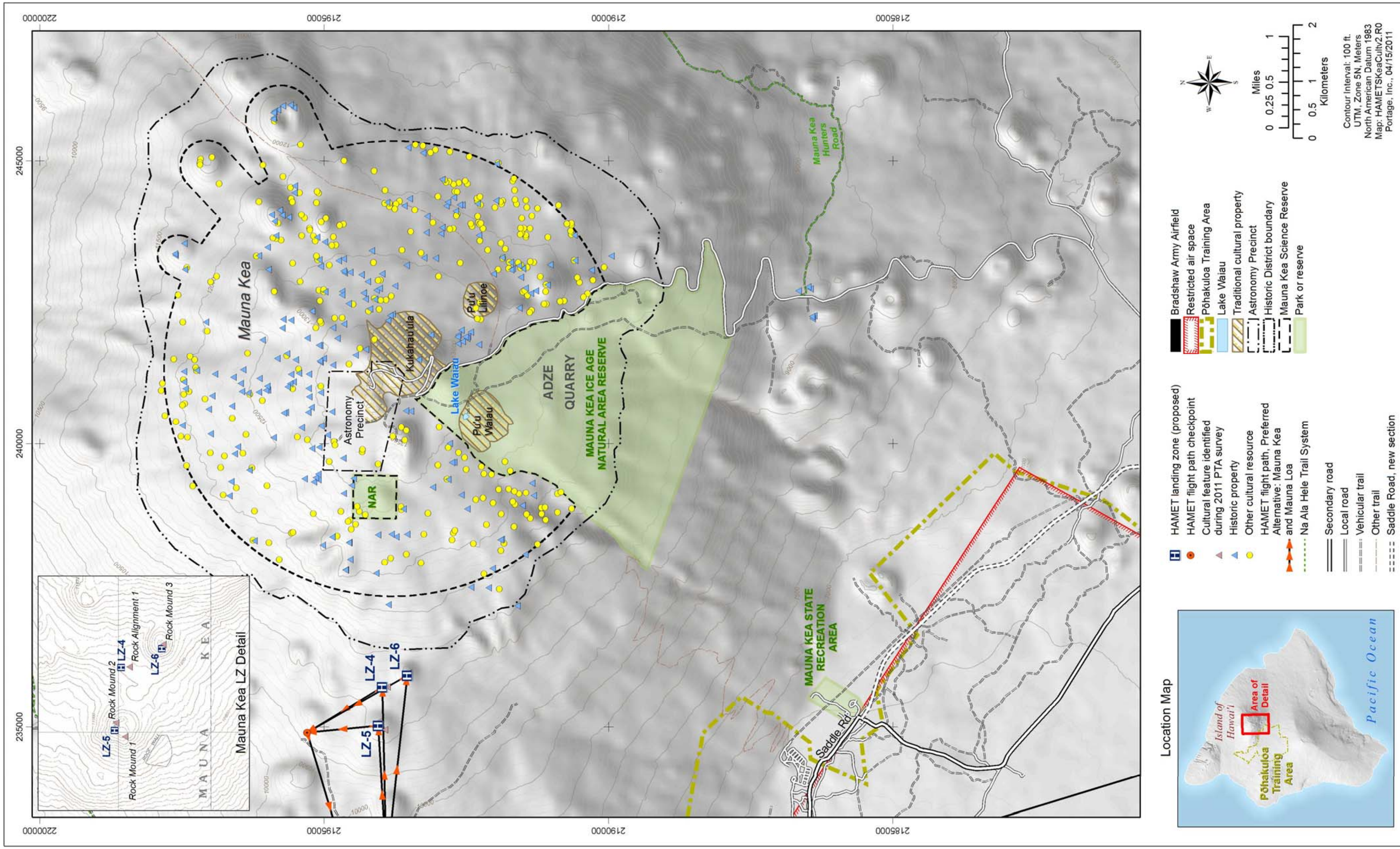

Figure 3-15. Map depicting the relationship between Mauna Kea LZs and flight paths to known traditional cultural properties.

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Numerous cultural-resource management investigations, including oral histories, archaeological field surveys, and historic building surveys, have been conducted in the Saddle Region, most for compliance purposes related to PTA. The Army manages more than 350 archaeological sites at PTA, including temporary habitation sites in lava tubes and on the surface of lava flows, trails, shrines, platforms, cairns, historic era ranching walls and fence lines, and other site types. Oral histories were gathered in 2002 by Social Research Pacific, and a field visit was made to *Ahu a'Umi heiau*, which is located west of PTA between Hualālai and Mauna Loa and served as a ritual site and possibly a locus of tribute collection. Recorded as early as 1853, *Ahu a 'Umi heiau* has been described as one of the most prominent of Hawaiian archaeological sites (Dye 2005, p. 16). Informants were also asked about possible burials, and the informants indicated some burials may exist in the vicinity of springs upslope from Bradshaw Army Airfield and Mauna Kea State Park (DOT 2010b).

Oral history subjects did report the continuation of bird hunting using old trails and modified lava blisters to encourage nesting in the region. Several major trails also linked population centers, and others likely led to procurement areas. In addition to prehistoric remnants, historic building surveys identified 138 PTA structures that are old enough to be considered for eligibility on the NRHP (U.S. Army 2004b, pp. 3-25, 3-28).

3.7.4 Mauna Loa Cultural Aspects

The following subsections describe the cultural aspects of Mauna Loa.

3.7.4.1 Mauna Loa Cultural Beliefs and Practices. Perhaps because it is an active volcano that erupted as recently as 1984, literature searches reveal much less cultural information about Mauna Loa than either Mauna Kea or the Saddle Region (Donham 2010). However, information that was discovered makes it apparent that Mauna Loa's prehistoric and historic resources are similar in type and density to those found on PTA and that Mauna Loa holds a place of cultural importance to Native Hawaiians that is no less significant than that of Mauna Kea. One oral history informant described the importance this way:

"Mauna Kea was always kūpuna [an elder, ancestor] to us. Mauna Kea and Mauna Loa, the tips, they were always kūpuna [elders, ancestors]. And there was no wanting to go on top. You know, just to know that they were there was just satisfying to us. And so it was kind of a hallowed place that you know is there, and you don't need to go there. You don't need to bother it. But it is there, and it exists. And it was always reassuring because it was the foundation for our island" (University of Hawai'i 2000b).

Hawaiian legends also describe Mauna Loa's importance in Native Hawaiian culture. They explain that the volcano goddess Pele was driven from her home by her angry older sister, Na-maka-o-kaha'i, because Pele had seduced her husband. Every time Pele would thrust her digging stick into the earth to dig a pit for a new home, Na-maka-o-kaha'i, goddess of water and the sea, would flood the pits. Pele eventually landed on the Big Island of Hawai'i, where she made Mauna Loa her new home. Literally meaning "long mountain" in the Hawaiian language, Mauna Loa was so tall that even Pele's sister could not send the ocean's waves high enough on Mauna Loa to drown Pele's fires. So Pele established her home on its slopes.

3.7.4.2 Mauna Loa Archaeological/Historic Resources. A 2005 historic-sites review and feasibility study conducted for a proposed Mauna Loa trail system revealed resources that are similar in association and nature to those found on Mauna Kea and within the Saddle Region. These resources include those related to canoe building and bird catching (such as caves, lava blisters, and overhangs), human burials, possible human burials, a vast network of trails, and several sites and structures associated with historic settlement, ranching, and other agricultural activities (Dye 2005, pp. 4–8). As with Mauna Kea, Mauna Loa's elevation and location made it an important spot for atmospheric and other scientific observations. The Mauna Loa Solar Observatory has long been prominent in observations of the sun, and the nearby National Oceanic and Atmospheric Administration (NOAA) MLO monitors the global atmosphere.

Results of field surveys undertaken at the three LZ locations on Mauna Loa are discussed below:

- LZ-1: A reconnaissance-level survey was conducted at LZ-1 (called LZ-3 in the survey clearance report) on May 20, 2009. LZ-1 is located to the east of LZ-2. A thorough examination of the LZ area was conducted for archaeological resources with negative results (Rumsey 2009). LZ-1 is a leveled area in ʻaʻā lava along another finger of the 1899 Mauna Loa lava flow. Pāhoehoe lava is present around the edges of the LZ. Several cavities were identified in this pāhoehoe during a February 2011 survey; these were investigated, but no cultural resources were identified. An area 328 ft (100 m) from the center of the LZ was surveyed, and no historic properties were identified within this area (Taomia 2011).

- LZ-2: A reconnaissance-level survey was conducted at LZ-2 on May 20, 2009. LZ-2 is located adjacent to a rough quarry road. A thorough examination of the LZ area was conducted for archaeological resources with negative results (Rumsey 2009). An additional survey was conducted in February 2011, and no historic properties were identified within 328 ft (100 m) of LZ-2 (Taomia 2011).

- LZ-3: A reconnaissance-level survey was conducted at LZ-3 (called LZ-1 in the survey clearance report) on May 20, 2009. LZ-3 is located directly adjacent to the north side of the Mauna Loa access road. A thorough examination of the LZ area was conducted for archaeological resources, and the results were negative. LZ-3 was again surveyed in February 2011. The LZ is in ʻaʻā from the 1899 Mauna Loa lava flow, and the remnants of a wind sock are present across the road from the LZ. No historic properties were identified within the 328-ft (100-m) survey area at this LZ (Taomia 2011).

Figure 3-16 shows the relationship between the Mauna Loa LZs and flight paths to known traditional cultural properties associated with Mauna Loa (i.e., those near to the proposed Mauna Loa trail system).

3.8 Socioeconomics and Environmental Justice

The socioeconomic indicators used to describe the affected environment for socioeconomic resources include population, economy, employment, and income. The population data include the number of residents in the area and recent changes in population growth. Data on employment, labor force, unemployment trends, income, and industrial earnings describe the economic health of a region. Income information is provided as an annual total by county and per capita. The ROI for socioeconomic impacts includes the county of Hawaiʻi, which is where the project is proposed to occur.

3.8.1 Socioeconomics

The County of Hawaiʻi is composed of nine districts with a total population of 148,677, as reported in the 2000 census. The three LZs located on Mauna Kea (LZs 4–6) are located within the District of Hamakua, and the three LZs located on Mauna Loa (LZs 1–3) are located within the District of North Hilo. Both of these districts are sparsely populated, with the 2000 census reporting populations of 6,108 (4%) and 1,720 (1%) and a population density of 10.5 and 4.6 persons per square mile (4.05 and 1.78 persons per square kilometer) for the Hamakua and North Hilo districts, respectively (County of

Hawai‘i 2010). The county of Hawai‘i has seen growth of 2.4% annually for the period between 1990 and 2000 (County of Hawai‘i 2010). During this same period, each of the districts of Hamakua and North

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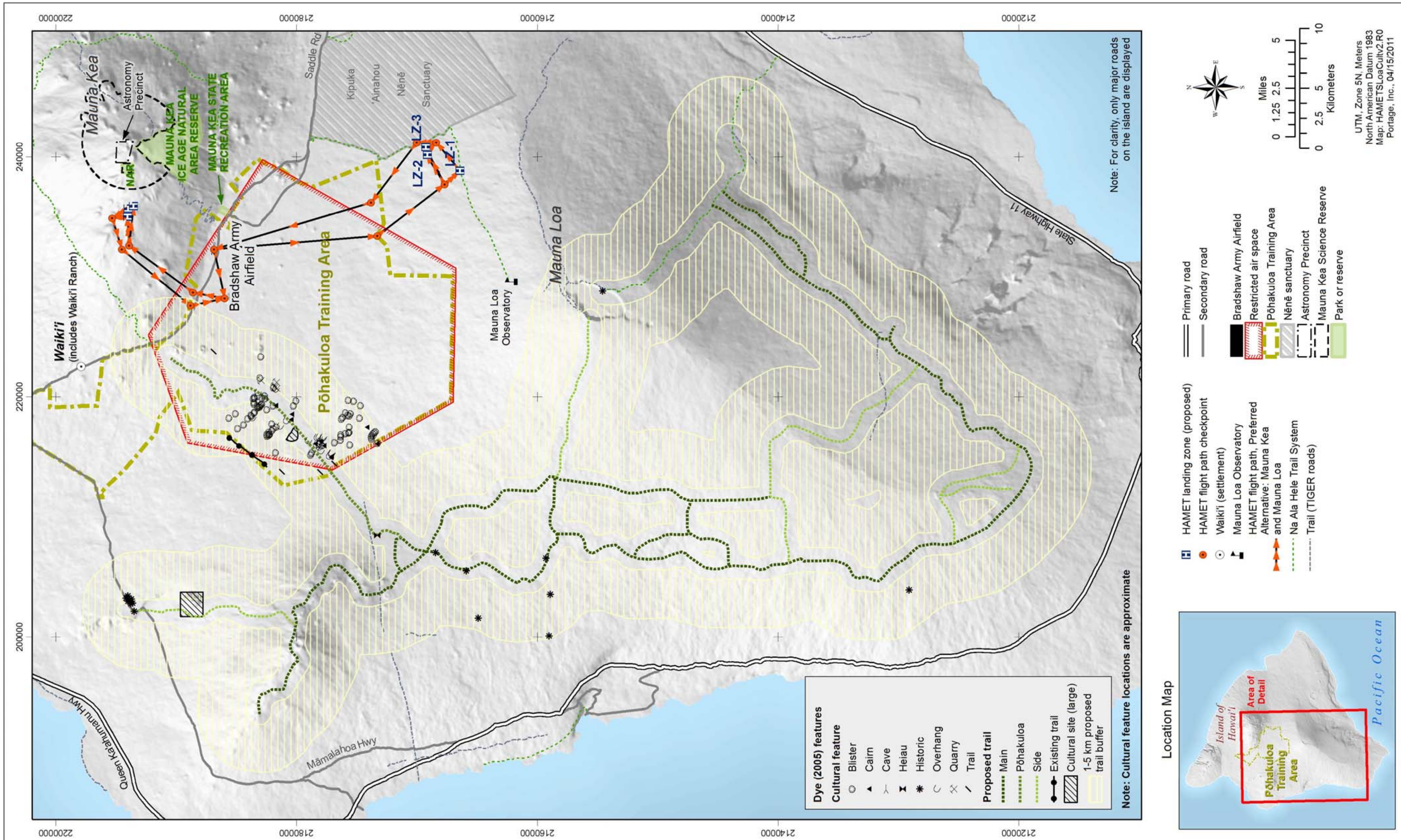

Figure 3-16. Map depicting the relationship between Mauna Loa LZs and flight paths to known cultural resources associated with Mauna Loa.

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Hilo grew by 1%. The growth rate for the county from 2000 to 2008 remained at approximately 2.3% and is projected to remain steady through 2020. Growth for Hamakua and North Hilo counties is projected to remain at approximately 1% (County of Hawaiʻi 2005).

The state government is the single largest employer in Hawaiʻi County, accounting for 8,240 (12%) jobs in 2008 followed by Hawaiʻi County itself with 2,705 (4%) and the federal government with 1,332 (2%) jobs (County of Hawaiʻi 2010). The next largest employer is the Hilton Waikoloa Village with 984 jobs, highlighting the importance of tourism to the county. Tourism accounts directly for approximately 12,500 (18.6%) jobs. Most of these jobs are centered primarily on the leeward (Kona) or western coast of the island in the North Kona and South Kohala districts. The county of Hawaiʻi had an unemployment rate of 10.1% in July 2010, lagging the overall state rate of 6.8% (Hawaiʻi Department of Labor 2010).

Within the Hamakua District, the main sources of income and employment are cattle, macadamia nuts, and various other crops. There are numerous cattle ranches and several different varieties of crops in the district. Of these, macadamia nuts are expected to continue to play an important role in the future of agricultural development. Other crops grown in this area are taro, watermelons, tomatoes, ginger, kava, coffee, and vegetables. Manufacturing within the district is limited to the processing of macadamia nuts and other agricultural products (County of Hawaiʻi 2010).

The astronomical facilities located atop Mauna Kea are also part of the Hamakua District. The facilities are located within the 11,228-acre (4,543-hectare) Mauna Kea Science Reserve, which includes those lands situated above the 12,000-ft (3,658-m) elevation, with the exception of areas within the Mauna Kea Ice Age NAR.

Mauna Kea is considered the world's premier site for ground-based astronomical observatories. Mauna Kea is home to 13 observatories and includes 12 of the world's most state-of-the-art telescopes. More major telescopes are located on Mauna Kea than on any other single mountain peak in the world. Mauna Kea is widely recognized as offering optimum conditions for optical, infrared, and millimeter/submillimeter measurements. In addition, the local availability of support technicians and personnel contribute to making Mauna Kea one of the finest astronomical sites in the world. These facilities have contributed more than $619 million in capital investments to the State of Hawaiʻi, contributed $72.4 million in annual operating costs (University of Hawaiʻi 2010), and generated approximately 270 permanent jobs (County of Hawaiʻi 2010). The newest planned addition is the Next Generation Large Telescope, which is currently planned for construction starting in 2011, with operations starting in 2018 at a capital cost that may exceed $1 billion. Its annual operating budget is estimated at $25.8 million, which includes $13 million in labor.

The North Hilo District is agriculturally oriented. On the arable lands of the lower elevations from Honohina-Ninole to ʻŌʻōkala, former sugarcane lands are being cultivated in smaller acreages with a diverse range of crops and are also planted in eucalyptus trees. Large tracts of land within the district are used for cattle grazing and logging of native and planted forests. Macadamia nuts, ginger, bananas, tropical foliage, orchids, tropical fruits, cacao, kava, assorted leafy vegetables, papaya, and taro are some of the other agricultural products grown in North Hilo.

There are no visitor accommodations in North Hilo. NOAA operates the MLO, a premier atmospheric research facility that has been continuously monitoring and collecting data related to atmospheric change since the 1950s.

Military presence within the county is represented by the U.S. Army, which operates a field training facility at PTA. With an area of 132,000 acres (52,800 hectares), PTA is the largest DoD installation anywhere in the Pacific.

3.8.2 Environmental Justice

On February 11, 1994, President Clinton issued "Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority and Low-Income Populations" (59 FR 32). It was designed to focus the attention of federal agencies on the human health and environmental conditions in minority and low-income communities. Environmental justice is analyzed to identify and address disproportionately high and adverse human health or environmental effects of federal agency programs, policies, and activities on minority and low-income populations and to identify alternatives that might mitigate these impacts. Data from the U.S. Department of Commerce 2000 Census of Population and Housing were used for this environmental justice analysis (U.S. Census Bureau 2010).

Minority populations included in the census are identified as Black or African American; American Indian and Alaska Native; Asian; Native Hawaiian and other Pacific Islander; Hispanic; of two or more races; and other. The majority of residents in the State of Hawaiʻi are of Native Hawaiian, Asian, and other Pacific Islander descent. These groups accounted for 51% of the total population of Hawaiʻi.

Poverty status, used to define low-income status, is reported as the number of persons with income below the poverty level. The Census Bureau bases the poverty status of families and individuals on 48 threshold variables, including income, family size, number of family members under the age of 18 and over 65 years of age, and amount of money spent on food.

For 2008, the Census Bureau defines the poverty level as an annual income of $10,991 or less for an individual, and an annual income of $21,834 or less for a family of four. The U.S. Census Bureau estimates indicate that nearly 13.3% of the population of Hawaiʻi County was below the poverty level of families in 2008 (U.S. Census Bureau 2010).

3.8.3 Protection of Children

"Executive Order 13045 – Protection of Children from Environmental Health Risks and Safety Risks" (62 FR 78) requires federal agencies, to the extent permitted by law and mission, to identify and assess environmental health and safety risks that might disproportionately affect children and ensure that the policies, programs, activities, and standards of federal agencies address disproportionate risks to children that result from environmental health or safety risks. Environmental health and safety risks primarily entail risks that are attributable to products or substances that the child is likely to come into contact with or to ingest. In 2000, 25.6% of the state's population was made up of children (under 18 years old), which is an increase of 10.9% from 1990. In 2008, 25% of the population of Hawaiʻi County was under the age of 18 (U.S. Census Bureau 2010).

3.9 Land Use

The total area of the island of Hawaiʻi is approximately 2.5 million acres or 4,028 square miles: 4,023 square miles of land and 4.4 square miles of inland water. All of these lands are divided into approximately 125,000 parcels (County of Hawaiʻi 2005).

The Proposed Action activities would be conducted on/over state lands and within the Hamakua and North Hilo land planning districts. Land use within these districts and around the area is described in this subsection.

3.9.1 Land Use and Zoning Districts

Hawaiʻi was the first of the 50 United States to have a state land use law and a state general plan. Hawaiʻi remains unique among the 50 states with respect to the extent of control that the state exercises in land use regulation. The *County of Hawaiʻi General Plan* (County of Hawaiʻi 2005), as amended, details the history and specifics of land use on the island. The County of Hawaiʻi has no land use control over federal property.

Figure 3-17 shows the overall land ownership in, and immediately surrounding, the Proposed Action area. Table 3-6 shows the breakdown of land (other than federal) within the Hamakua and North Hilo land planning districts.

Table 3-6. Land use by planning district.[a]

District	Agricultural (acre)	Conservation (acre)	Rural (acre)	Urban (acre)	Total (acre)
Hamakua	162,729	235,805	13	1,041	399,588
North Hilo	53,587	120,110	71	608	174,376
a. Table data from *County of Hawaiʻi General Plan* (County of Hawaiʻi 2005) for the year 2000.					

The County of Hawaiʻi zoning code is the legal method of land use designation and regulation. The zoning code is the county's main land use control and implements the *County of Hawaiʻi General Plan*. The code identifies the various types of zoning districts and the allowable uses for each district. Zoning maps establish the zoning for the island on a parcel-by-parcel basis. Rezoning is the primary method for changing the allowed uses of land. Rezoning must be consistent with the *County of Hawaiʻi General Plan*. Table 3-7 shows the zoning of nonfederal land in the Hamakua and North Hilo districts.

Table 3-7. Acres zoned by planning district.[a]

Zoning	North Hilo District (acre)	Hamakua District (acre)
Single Family	391	631
Multi-Family	0	4
Resort	0	42
Commercial	10	38
Industrial	38	15
Industrial Commercial Mixed	0	0
Family Agriculture	0	0
Residential Agriculture	55	0
Agriculture	61,954	165,076
Open	38	963
Unplanned	0	185
a. Table data from *County of Hawaiʻi General Plan* (County of Hawaiʻi 2005) for the year 2000.		

3.9.2 University of Hawai‘i Management Areas on Mauna Kea

This subsection provides an overview of the land use within University of Hawai‘i Management Areas, as taken from the Mauna Kea CMP (University of Hawai‘i 2009).

University of Hawai‘i Management Areas begin at approximately 9,200 ft (2,804 m) amsl on Mauna Kea and extend to the summit. There are three district areas within the University of Hawai‘i Management Area (Figure 3-18): the Mauna Kea Science Reserve (Science Reserve), the mid-level facilities at Hale Pōhaku, and the Summit Access Road. The University of Hawai‘i Management Areas are classified in the resource subzone of the state conservation district lands.

The Science Reserve is the largest of the three district areas (Figure 3-18). It was established in 1968 and originally encompassed approximately 13,321 acres (5,390 hectares). In 1998, 2,033 acres (823 hectares) were withdrawn from the Science Reserve as part of the Mauna Kea Ice Age NAR. Therefore, the Science Reserve now contains 11,288 acres (4,568 hectares) of state land above the 11,500-ft (3,505-m) elevation. Five hundred twenty-five of these acres (212 hectares) were designated in 2000 as an Astronomy Precinct, roads, and support infrastructure. The remaining 10,763 acres (4,356 hectares) in the Science Reserve are designated as a Natural/Cultural Preservation Area.

The Astronomy Precinct hosts the world’s largest astronomical observatory, with telescopes operated by astronomers from 11 countries. There are currently 13 working telescopes: nine of them are for optical and infrared astronomy, three of them are for submillimeter wavelength astronomy, and one is for radio astronomy. They include the largest optical/infrared telescopes in the world (the Keck telescopes), the largest dedicated infrared telescope (the United Kingdom Infrared Telescope), and the largest submillimeter telescope in the world (the James Kirk Maxwell Telescope). The westernmost antenna of the Very Long Baseline Array is situated at a lower altitude 2 miles (3.2 kilometers) from the summit.

The mid-level facilities at Hale Pōhaku encompass 19.3 acres (7.8 hectares) on the south slope of Mauna Kea. This area contains the Onizuka Center for International Astronomy, the Visitor Information Station, and the construction laborer camp, which has two old buildings and four modern cabins.

The Summit Access Road (John A. Burns Way) extends from Hale Pōhaku to the boundary of the University of Hawai‘i Management Areas at an elevation of approximately 11,500 ft (3,505 m). This area includes the road and a strip approximately 400 yd (366 m) wide on either side of the road but excludes the NAR.

3.9.3 Pōhakuloa Training Area

With 132,000 acres (52,800 hectares), PTA is the largest military training area in Hawai‘i, extending up the lower slopes of Mauna Kea to approximately 6,800 ft (2,073 m) amsl (Figure 3-19) (USAEC 2008). This area is within the general, limited, and resource subzones of the state-designated conservation district. A portion of the area is leased to the U.S. Army.

Land uses at PTA include the cantonment area, Bradshaw Army Airfield, maneuver training areas, drop zones, live-fire training ranges, artillery firing points, an ordnance impact area, and areas unsuitable for maneuver (USAEC and COE 2009). The cantonment area consists of 566 acres (229 hectares) with 154 buildings. The Bradshaw Army Airfield has a 3,969-ft (1,210-m) runway and offers helicopter access and, until recently, limited C-130 access. Approximately 56,661 acres (22,930 hectares) of land are suitable for field maneuvers. The ordnance area is approximately 51,000 acres (20,639 hectares).

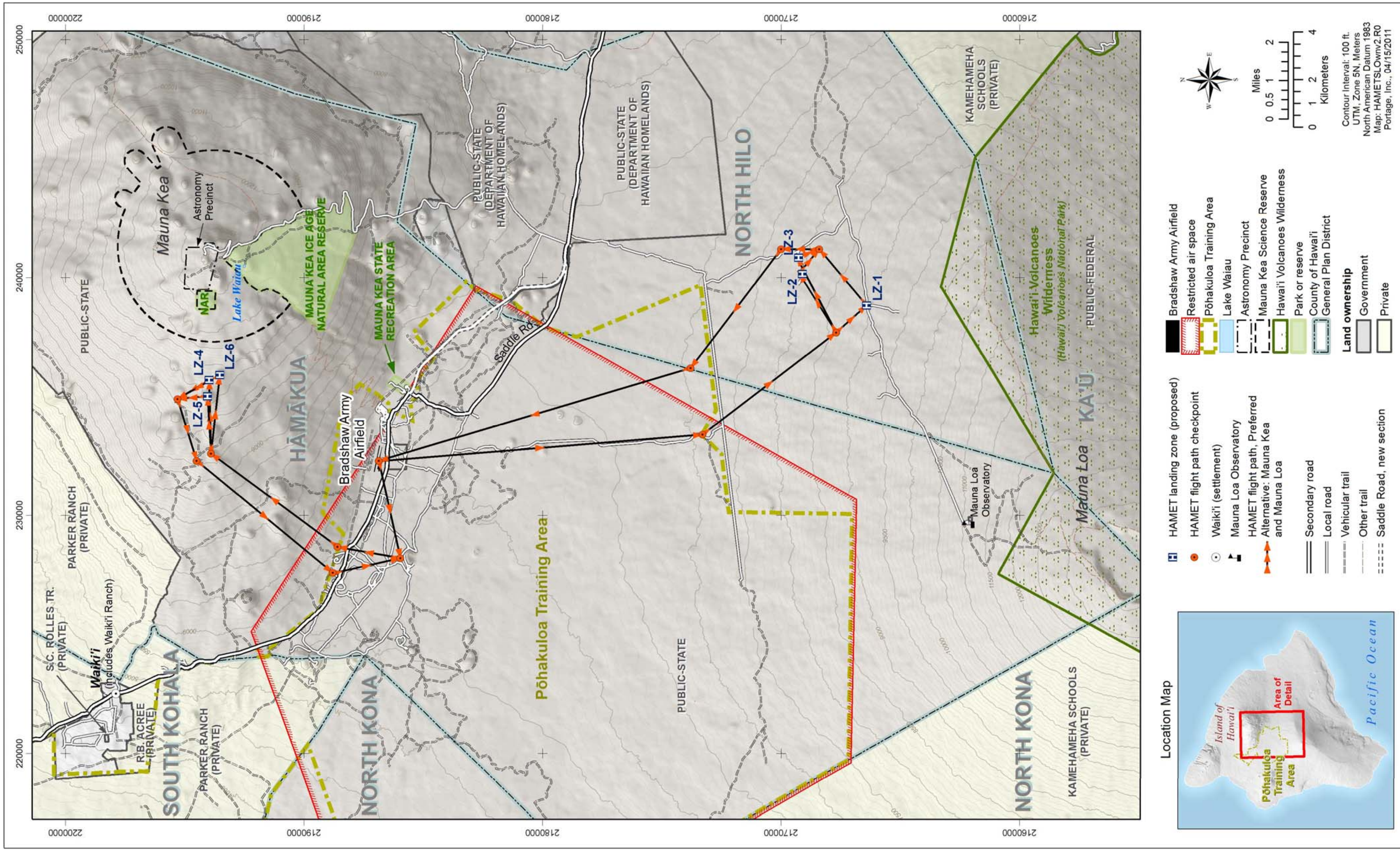

Figure 3-17. Land ownership.

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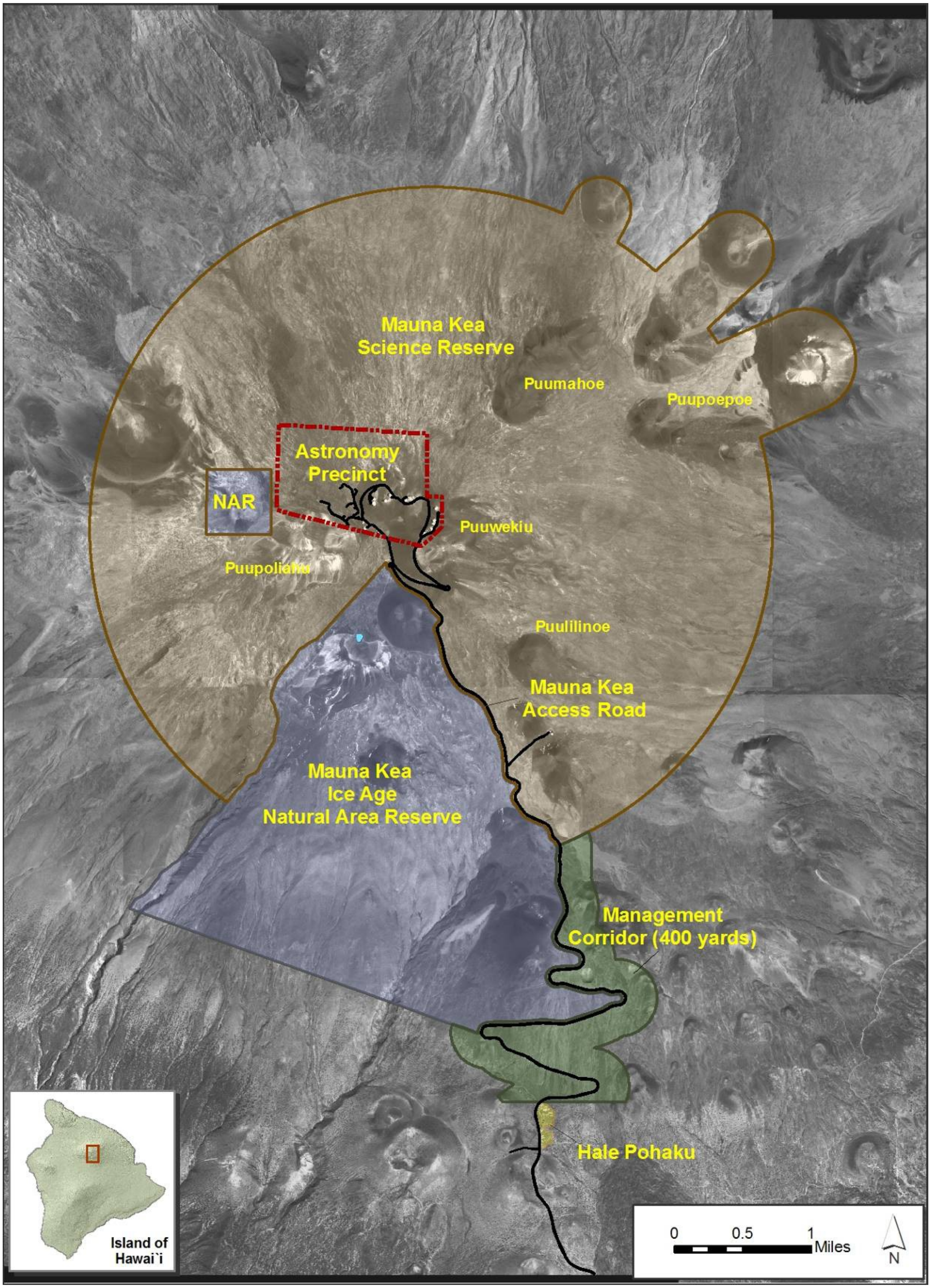

Figure 3-18. University of Hawai‘i Management Areas from University of Hawai‘i (2009).

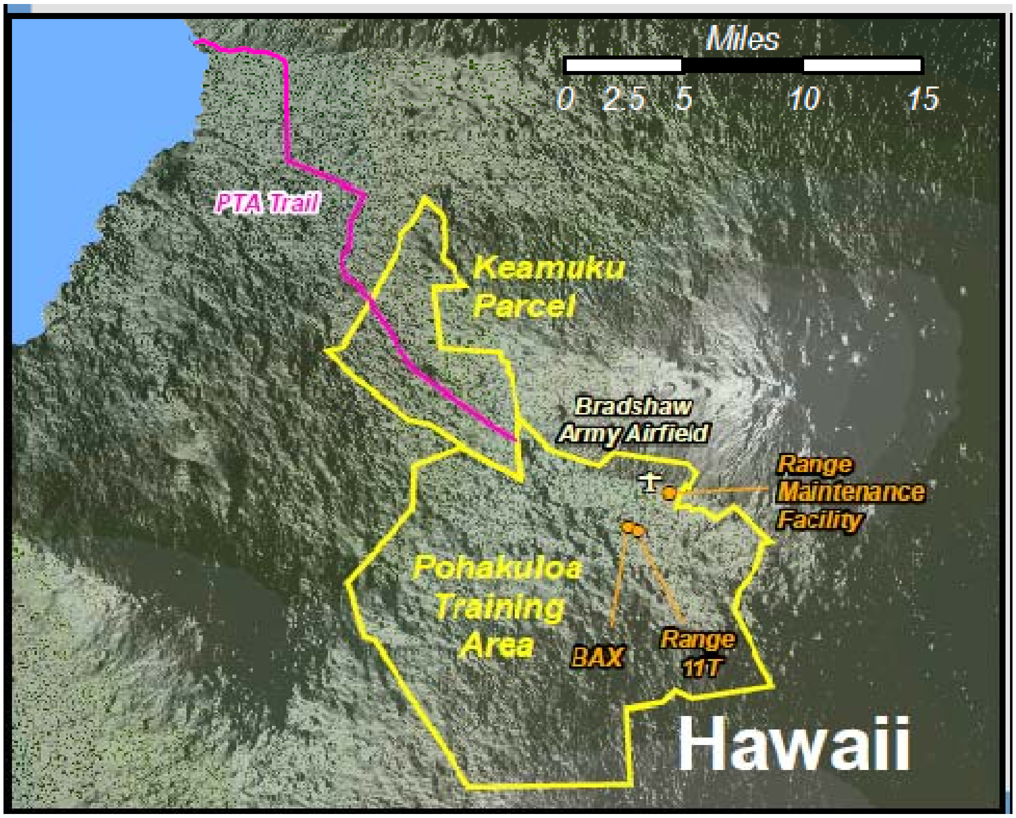

Figure 3-19. PTA and Keamuku Parcel from USAEC (2008).

Lands surrounding PTA are generally within the state-designated conservation district. Land uses in the areas include cattle grazing, game management, forest reserves, and undeveloped land (USAEC and COE 2009). Land to the northwest of PTA is agricultural, primarily for cattle grazing, and also provides limited hunting opportunities for big game species and game birds. Land to the north of PTA includes the Kaohe Game Management Area (GMA), Mauna Kea State Park, Mauna Kea Forest Reserve, and the Mauna Kea National Natural Landmark. Land to the east and south is included in the Mauna Loa Forest Reserve.

3.9.4 The Keamuku Parcel

The Keamuku Parcel (referred to as the West PTA Acquisition Area in the *Final Environmental Impact Statement, Permanent Stationing of the 2/25th Stryker Brigade Combat Team* [USAEC 2008]) was acquired in July 2006, lies at the western foot of Mauna Kea (Figure 3-19), consists of approximately 23,000 acres (9,300 hectares), and is currently used for military maneuver training, a quarry, and occasional grazing.

Land uses surrounding the Keamuku Parcel include cattle grazing, military training, agriculture, residential lots, and open space. The remaining surrounding lands are used for recreation and ranching or are undeveloped (USAEC and COE 2009).

3.9.5 Mauna Loa

Mauna Loa volcano covers approximately 2,035 square miles (5,270 square kilometers). The land around Mauna Loa is owned and managed by the NPS and the State of Hawaiʻi. Hawaiʻi Volcanoes

National Park covers the summit and southeast flank of the volcano. The Mauna Loa Forest Reserve is located on the northeast slope. The Kapapala Forest Reserve is located on the southeast slope. There is an observatory complex near the summit of Mauna Loa. This complex includes the Mauna Loa Solar Observatory and the MLO. In addition to the forest reserve areas, the area around Mauna Loa is primarily used for scientific research, public education, and outdoor recreational activity.

3.9.6 Regional Land Use

Areas outside the University of Hawaiʻi Management Areas include the Mauna Kea Ice Age NAR and the Mauna Kea Forest Reserve; both properties are managed by the DLNR. Other state- and federal-managed areas include Hakalau Forest National Wildlife Refuge and Hawaiian Home Lands.

The Mauna Kea Ice Age NAR was established in 1981 and has two parcels that are surrounded by the University of Hawaiʻi Management Areas. The NAR is under the jurisdiction of the DLNR Natural Area Resources Commission. A 143.5-acre (58.1-hectare) square parcel is located west of the summit area, around Puʻu Pohaku. The larger 3,750-acre (1,518-hectare), triangular-shaped parcel extends from an elevation of approximately 10,070–13,230 ft (3,069–4,032 m) at the upper tip of the parcel. There are several features within this parcel: The Mauna Kea adze quarry, Lake Waiau, and geomorphic features created by glaciers (moraines and glacial till).

The Mauna Kea Forest Reserve has 52,500 acres (21,246 hectares) that sit above 7,000 ft (2,134 m) amsl surrounding the University of Hawaiʻi Management Areas, Hale Pōhaku, and the Mauna Kea Ice Age NAR. The forest reserve is under the jurisdiction of the DLNR Division of Forestry and Wildlife.

The Hakalau Forest National Wildlife Refuge has two units: the 33,000-acre (13,355-hectare) Hakalau Forest Unit and the 5,300-acre (2,145-hectare) Kona Forest Unit. The Hakalua Forest Unit is on Mauna Kea, and the Kona Forest Unit is on Mauna Loa. The wildlife refuge was established to conserve endangered forest birds and their habitat.

The Hawaiian Home Lands area has 53,000 acres (21,448 hectares) at the lower elevations of Mauna Kea around Humuʻula Saddle that were designated by the Hawaiian Homes Commission Act of 1920 (42 Stat 108) to be made available for homesteads. Today, there is limited cattle ranching under a permit issued by the Department of Hawaiian Home Lands.

3.9.7 Administrative/Special Designations

The U.S. National Park Service National Landmarks Program designated Mauna Kea as a National Natural Landmark (NNL) in 1972 (NPS 2011). Established in 1962, the program aims to encourage and support voluntary preservation of sites that illustrate the geological and ecological history of the United States and to strengthen the public's appreciation of America's natural heritage. An NNL is a significant natural area that has been designated by the Secretary of the U.S. Department of the Interior. To be nationally significant, a site must be one of the best examples of a type of biotic community or geologic feature in its biophysiographic providence. The primary criteria for designation are that the area is of illustrative value and condition of the specific feature; secondary criteria include rarity, diversity, and value for science and education. Mauna Kea is listed as an NNL, because it is the highest insular mountain (rising to an elevation of 13,796 ft [4,200 m] above sea level) in the United States, containing the highest lake (Lake Waiau at 13,030 ft [3,972 m] above sea level) in the country and evidence of glaciations above 11,000 ft (3,353 m). Mauna Kea is also recognized as the "most majestic expression of shield volcanism in the Hawaiian Archipelago, if not the world" (NPS 2011).

3.10 Recreation

In general, most of the proposed project activities would be conducted on/over state lands. This subsection describes recreational land use.

Dispersed recreational activities may occur within the area. Data are limited to quantifiably describe which activities occur and the frequency of their occurrence; however, recreational activities generally include hiking, hunting, camping, and sightseeing. The LZs lie within areas used for recreation but are not destinations for recreational activities.

Hunting is a popular activity on the island of Hawaiʻi and near to the area where HAMET is proposed. Public hunting areas are those lands where the public may take game birds and mammals, including areas such as GMAs; forest reserves and surrendered lands; natural area reserves; restricted watersheds; cooperative GMAs; military training areas; unencumbered state lands; designated sanctuaries; and other lands designated by the DLNR (State of Hawaiʻi 1999a, 1999b). The area defined by the extent of the Preferred Alternative (i.e., HAMET flights) is over or near locations within the following DOFAW GMAs: Mauna Kea Forest Reserve and GMA; Mauna Loa Forest Reserve and GMA, including portions of the Kipuka ʻAinahou; PTA Cooperative GMA; Kaohe Horse Pasture GMA; PTA 21; and the Redleg portion of the PTA (State of Hawaiʻi 1999a, 1999b).

Hunted species in these areas include feral pig (*Sus scrofa*); axis deer (*Axis axis*); Columbian black-tailed deer (*Odocoileus hemionus columbianus*); feral goat (*Capra hircus*); wild sheep, including mouflon sheep (*Ovis musimon*), feral sheep (*Ovis aries*), and mouflon-feral hybrid sheep (*Ovis musimon* x *Ovis aries*); ring-necked pheasant (*Phasianus colchicus*); white-winged pheasant (*Phasianus colchicus principalis*); green pheasant (*Phasianus versicolor*); Kalij pheasant (*Lophura leucomelanos*); California quail (*Callipepla californica*); Gambel's quail (*Callipepla gambelii*); Japanese quail (*Coturnix japonica*); spotted dove (*Spilopelia chinensis*); barred dove (*Geopelia maugei*); mourning dove (*Zenaida macroura*); chestnut-bellied sandgrouse (*Pterocles exustus*); chukar (*Alectoris chukar*); gray francolin (*Francolinus pondicerianus*); black francolin (*Francolinus francolinus*); Erckel's francolin (*Francolinus erckelii*); wild turkey (*Meleagris gallopavo*); and other game mammals and birds as may be designated by the DOFAW (State of Hawaiʻi 1999a, 1999b).

Birds, as transient species on the island, are closely followed by hunters to the specific habitat in which they are plentiful, while game mammals tend to be less transient. All hunters are required to report their hunting results on standard field forms located at hunter check-in stations at the end of every hunt. Each individual hunter is responsible for obtaining and completing the required forms. These forms are indicative of successful hunts by hunters but not necessarily of total hunter numbers within a hunting area. Additionally, numbers may be higher in certain GMAs than others, seasonally or annually, based on movements of transient species and habitat conditions at the time of the hunt. Regardless, the number of forms collected at a hunter check-in station can give an indication of an area's overall usage, particularly if the data are routinely collected over an extended period.

3.10.1 Mauna Kea Recreation

Tourism and private recreational activities on Mauna Kea include hiking, biking, hunting, snow play, and sightseeing (University of Hawaiʻi 2009). These activities have increased over the past several decades due to better access and a greater number of organized commercial and educational tours. The Visitor Information Station of the Onizuka Center for International Astronomy (VIS), established in 1986 at Hale Pōhaku, serves to increase visitor knowledge. The VIS provides information on safety and hazards, astronomy, the observatories, and the natural and cultural resources of Mauna Kea, as well as providing restrooms, a gift shop, and an evening stargazing program.

While there is no official registration system to track users, in recent years OMKM has been keeping detailed records on the number of people visiting the VIS and the summit (University of Hawaiʻi 2009). In 2002, it was estimated that 105,000 visitors stopped at the VIS (University of Hawaiʻi 2009). The recorded total for all types of summit visitations by vehicles was 32,066 in 2006 and 32,017 in 2007 (University of Hawaiʻi 2009). Observatory vehicles and visiting four-wheel drive vehicles represent, by far, the largest percentage of total vehicles on the mountain, with just over 13,000 of the former and over 10,500 of the latter in 2007 (University of Hawaiʻi 2009). Ranger estimates indicate an average of about 30 noncommercial visitors a day to the summit, most of them staying less than 30 minutes (University of Hawaiʻi 2009). The majority of non-observatory traffic occurs in the afternoon.

Hiking is currently a popular day-use activity for visitors to Mauna Kea. The Mauna Kea Trail is 6 miles (9.6 kilometers) long, starting from the VIS, which is at 9,200 ft (2,804 m), and well marked. The trail loosely parallels a partially paved summit road and, from the Mauna Kea Ice Age NAR boundary at 13,200 ft (4,023 m) to the summit road's high point of 13,700 ft (4,176 m), actually follows the road. There are also several established (but unmarked) trails in the summit region and other trails at lower elevations. Rangers monitor the trails that lead to the most popular places of interest and work to curtail unwanted new trails by directing visitors to the established ones and covering over evidence of unwanted trails. New trails are mainly created when visitors or researchers opt to explore new terrain. Due to lack of signage and a maintained trail network, a faint trail used infrequently may be discovered by others and become more established and impacted. Trail maps are available at the VIS, and hikers are requested to register there and inform rangers of their travel plans. Ranger reports between 2001 and 2007 suggest that approximately 5,000 to 6,000 hikers visit the summit region every year (University of Hawaiʻi 2009). Figure 3-20 shows the Mauna Kea trail system and regional recreation areas.

Hunting occurs in many areas on Mauna Kea. Although hunters are known to start looking for animals at elevations as high as 12,000 ft (3,660 m), mammal hunting typically takes place at lower elevations on Mauna Kea in the DLNR Mauna Kea Forest Reserve, where the animals are more numerous (University of Hawaiʻi 2009). In 1979, a federal court ordered the eradication of sheep and goats from Mauna Kea as a result of a lawsuit filed to protect designated PCH, the māmane-naio forest. This goal was nearly achieved in 1981, but the animals are still present on the slopes of Mauna Kea, and hunting continues to be a popular recreational and subsistence activity with local residents. DLNR maintains an active control program for sheep, goats, and mouflon from the lower boundaries of the Mauna Kea Forest Reserve up into the Mauna Kea Science Reserve.

Skiing and snow play are a common winter pastimes on the Big Island when the conditions are conducive for these activities (University of Hawaiʻi 2009). Other than for plowing the roads (conducted by Mauna Kea Support Services) and directing parking, there is no logistical support for snow operations on the summit, and it is difficult to control use and access. During periods of heavy snow, rangers keep the road closed at Hale Pōhaku until they receive confirmation that conditions are safe for visitors to proceed up the mountain. Sometimes people wait overnight in their cars for the opportunity to drive up and see/collect snow (University of Hawaiʻi 2009). Located directly east of the Caltech Submillimeter Observatory, Poi Bowl is the primary area used for snow play—in part because it is accessible by road at both the top and bottom of the run. Because there are no designated trails or ski lifts, visitors often hike off-trail to reach the ski runs, sometimes traveling across open cinder between the snow-covered areas. Vehicle and visitor traffic to the summit may be particularly high on snow days, especially when they fall on weekends. Many people (especially locals) visit the mountain only when there is snow. As many as 600 vehicles were recorded traveling to the summit on one heavy snow day, and each of these was likely carrying several passengers (University of Hawaiʻi 2009). On New Year's Day 2004, after a period of particularly heavy snowfall, rangers estimated there were 1,400 vehicles on the summit (University of Hawaiʻi 2009), and during the 19 days documented by OMKM rangers as snow days in 2007, a total of 2,547 vehicles were recorded on the mountain (University of Hawaiʻi 2009).

3.10.2 Mauna Loa Recreation

A proposed trail system would encircle Mauna Loa at its mid-elevations and would be accessible from the Māmalahoa Highway and Saddle Road at several locations. The total length of the trail system would exceed 350 miles (563 kilometers). The Mauna Loa Trail System is proposed to cross or pass adjacent to both public and private lands. The corridor within which the Mauna Kea Trail System is proposed includes only lands within agricultural and conservation zones (Nature Conservancy of Hawaiʻi 2005).

The Mauna Loa Trail System, as proposed, would incorporate four well-known Hawaiʻi trails (ʻAinapō Road, ʻAinapō Trail, Mauna Loa Observatory Road, and Puʻu ʻŌʻō Trail) and would link directly with two others (Puʻu Lāʻau and Puʻu Huluhulu) (Nature Conservancy of Hawaiʻi 2005). Figure 3-20 shows the Mauna Loa proposed trail system and regional recreation areas. Key regional areas near the Proposed Action are discussed in the following subsection.

3.10.3 Regional Recreation

Recreation at PTA includes archery, and hunting on designated training areas, which the Army coordinates with the state (USAEC and COE 2009). Recreation opportunities exist in areas surrounding the Keamuku Parcel as well (USAEC and COE 2009).

Hawaiʻi Volcanoes National Park encompasses a large area of the Big Island (see Figure 3-20). The northern border of Volcanoes National Park lies approximately 2 miles (3,200 m) from Mauna Loa LZ-1. The park displays the results of 70 million years of volcanism, migration, and evolution (NPS 2011). The park highlights two of the world's most active volcanoes and offers insights on the birth of the Hawaiian Islands and views of dramatic volcanic landscapes. Recreation within the park includes biking, camping, hiking, lava viewing, lodging, and drivable tours (NPS 2011). Statistics from the NPS show 1,304,667 visitors used the Hawaiʻi Volcanoes National Park in 2010 (NPS 2011).

The U.S. Congress designated the Hawaiʻi Volcanoes Wilderness in 1978, and it now has a total of 130,790 acres (University of Montana 2011). The northwestern extension of the park includes Mauna Loa and is designated wilderness (Figure 3-20). In the southwestern portion of the park, a large chunk of wilderness includes several miles of coastline, and a small portion southeast of the visitor center is the ʻOlaʻa Forest, which is separate from and just north of the park.

The wilderness trail system within Hawaiʻi Volcanoes National Park provides the backcountry hiker with a diverse array of experiences, from barren lava to dense forest and steep alpine slopes (Nature Conservancy of Hawaiʻi 2005). Several trails run from 4–16 miles (6–26 kilometers). The longest, at 19 miles (31 kilometers), is the Mauna Loa Summit trail. It is, by far, the most challenging trail as a result of elevation gain (more than 7,000 ft [2,134 m]) and rapidly changing weather. Two cabins near the summit of Mauna Loa provide shelter on a first-come basis. The summit can also be reached by the Mauna Loa Weather Observatory road. The 2004 visitors report indicated that 2.6 million visitors entered the park, and 5,070 overnight backcountry permits were issued (Nature Conservancy of Hawaiʻi 2005).

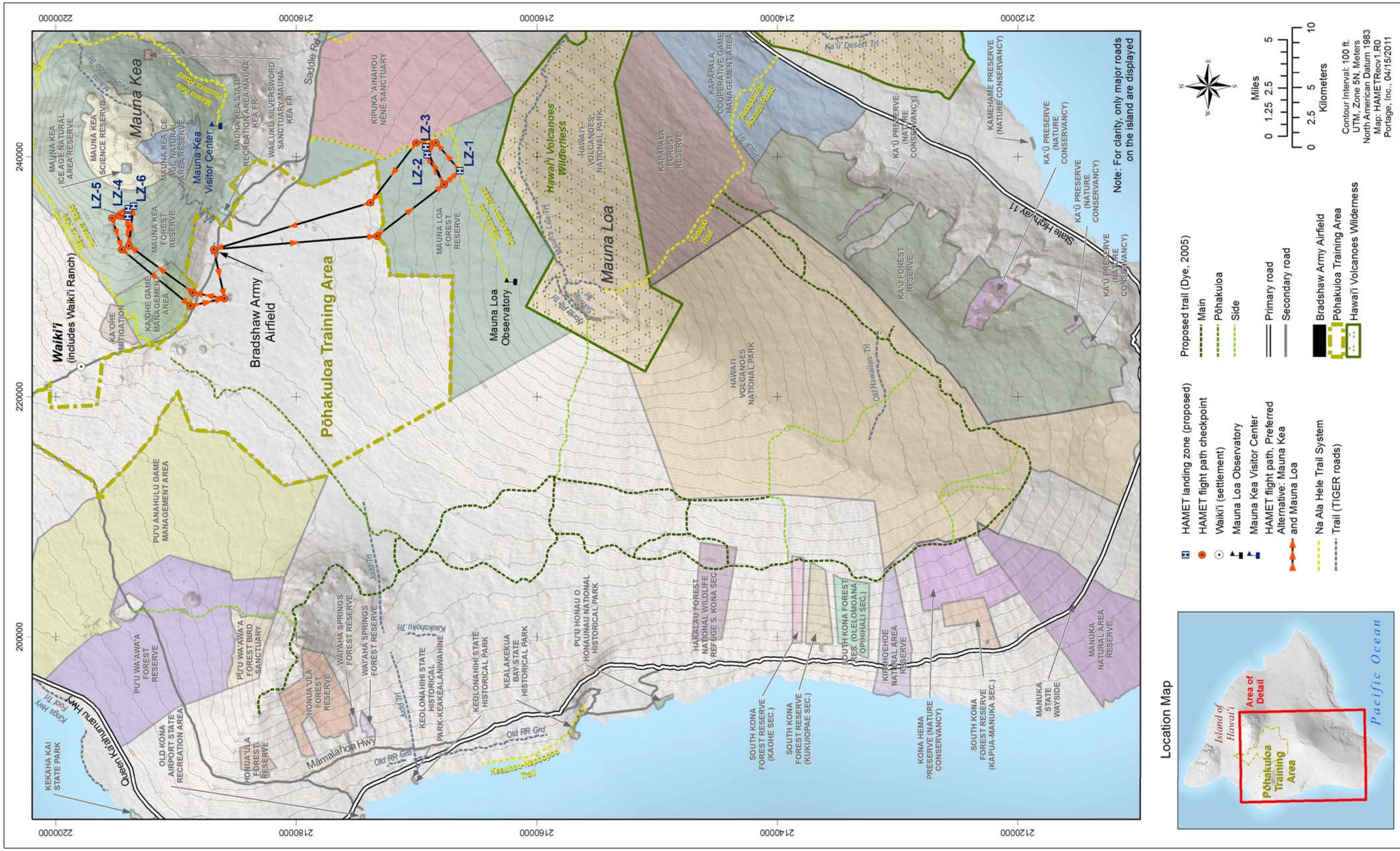

Figure 3-20. Mauna Kea trail system and regional recreation areas.

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3.11 Noise

Noise is generally unwanted sound. It can interfere with communications or other human activity, may be intense enough to cause hearing damage, or may be otherwise annoying. Human responses to noise vary, depending on the type and characteristics of the noise, distance between the source and receptor, receptor sensitivity, and time of day.

The typical human response to noise is annoyance, a response that is complex and displays wide variability for any given noise level. Although individual annoyance is sometimes measured in the laboratory, field evaluations of community annoyance are most useful for predicting the consequences of actions involving various noise sources, including various aircraft. A person's expectation of appropriate sound levels associated with an activity has a direct bearing on the level of annoyance. Effects from noise may include communication interference, sleep disturbance, disruption of one's peace of mind, enjoyment of one's property, and the enjoyment of solitude. The consequences of noise-induced annoyance are personal irritation that is often expressed as complaints to the installation or authorities. The five factors identified as indicators for estimating community-complaint reaction to noise are the following:

- Type of noise
- Amount of repetition
- Type of neighborhood
- Time of day
- Amount of previous exposure (USAEC and COE 2009).

3.11.1 Noise Standards and Guidelines

Noise is regulated under various federal and state guidelines. The federal government is required to set and enforce uniform noise-control standards for aircraft and airports, interstate motor carriers and railroads, workplace activities, trucks, motorcycles, and portable air compressors as well as for federally assisted housing projects located in noise-exposed areas. Among the laws governing these requirements are the Noise Control Act of 1972 (42 USC 65 § 4901), the Aviation Safety and Noise Abatement Act of 1979 (49 USC 475 § 47501), and the Control and Abatement of Aircraft Noise and Sonic Boom Act of 1968 (49 USC 447 § 44715). According to the FAA's 2000 Aviation Noise Abatement Policy (49 USC 401 § 40101), "[N]oise relief continues to be a shared responsibility… The FAA and the aviation industry have the primary responsibility to address aircraft source noise… Airport proprietors, state and local governments, and citizens have the primary responsibility to address airport noise compatibility planning and local land use planning and zone."

The EPA is the agency in charge of enforcing the Noise Control Act. The EPA recommends using the day-night average sound level (DNL) for environmental noise to quantify the intrusiveness of nighttime noise.

The DoD began developing noise evaluation programs in the early 1970s. Initial program development involved the Air Installation Compatible Use Zone program for military airfields. Early application of that program emphasized Air Force and Navy airfields. The Army implemented the program by addressing both airfield noise issues and other major noise sources, such as weapons testing programs and firing ranges. Joint Air Force, Army, and Navy planning guidelines use annual average DNL values to categorize noise exposure conditions on military installations.

The Army uses three noise zones referred to as Land Use Planning Zones (LUPZs). These LUPZs are outlined in Army Regulation 200-1 (U.S. Army 2007a) and are intended to minimize the impact of environmental noise on the public without impairing the mission of the installation. Under Army policy:

- Zone I is compatible with noise-sensitive land use (residences, schools, medical facilities, cultural activities)
- Zone II should generally be limited to industrial activities (such as manufacturing, transportation, and resource protection)
- Zone III is incompatible with noise-sensitive land use.

In addition to federal regulations, the State of Hawai'i has adopted statewide noise regulations. The standards outlined in Title 11 of Chapter 46 of the Hawai'i Administrative Rules (State of Hawai'i 1996) apply to fixed stationary noise sources, agricultural equipment, and construction equipment. However, the alternatives under proposed training activities being assessed in this report do not involve introduction of, or modifications to, stationary sources; therefore, the State of Hawai'i Administrative Rules noise standards do not apply to these activities. The State of Hawai'i Department of Transportation Airports Division outlines noise abatement areas for each island in the *Hawai'i Airports and Flying Safety Guide 2010–2011* (DOT 2010a). These guidelines apply to all aviation activities in Hawai'i, including proposed HAMET activities. Figure 3-21 shows designated noise abatement areas on the island of Hawai'i. Proposed HAMET flight paths do not infringe on any voluntary noise abatement areas or recommended avoidance areas.

The U.S. Army Public Health Command has developed the *U.S. Army Hawai'i Statewide Operational Noise Management Plan* (SONMP) (U.S. Army 2010c) to provide guidelines to foster positive relations between the Army and the public. The SONMP uses the LUPZs to provide more detailed information to surrounding communities on potential effects of increased noise resulting from Army operations. In addition to the three zones listed in Table 3-8, the Hawai'i SONMP includes an informal land use planning zone, which is at the lower boundary of Zone I. This additional zone is intended to account for seasonable variability in increased operations that may dilute noise impacts averaged over a 1-year period.

3.11.2 Existing Conditions

Bradshaw Army Airfield and PTA lie in the saddle between Mauna Kea and Mauna Loa. The existing noise conditions and noise abatement procedures for Bradshaw Army Airfield and PTA are outlined in the U.S. Army Hawaiian SONMP. The current number of military aircraft using established flight corridors near Bradshaw Army Airfield and PTA do not generate ground noise contours, because both are limited use with regard to aircraft (U.S. Army 2010c).

Noise conditions at PTA vary depending on location and time of day. The main source of noise at PTA is small-arms and large-caliber weapons firing, which occurs throughout the year, as well as aircraft and vehicles (USAEC and COE 2009). Currently, existing noise contours as a result of small-arms and large-caliber weapons firing are shown in Subsection 11.4 of the Hawai'i SONMP (U.S. Army 2010c). Zone III noise contours extend slightly north of the PTA boundary approximately 650 ft (200 m) onto forest reserve land. Zone II noise contours also extent onto forest reserve land north of PTA, but all land uses within the contour are compatible with Zone II land uses. These noise contours represent a cumulative effect of all firing activities at PTA and therefore represent worst-case noise levels. When firing activities are not occurring, ambient noise levels may vary from 40 A-weighted decibels (dBA)

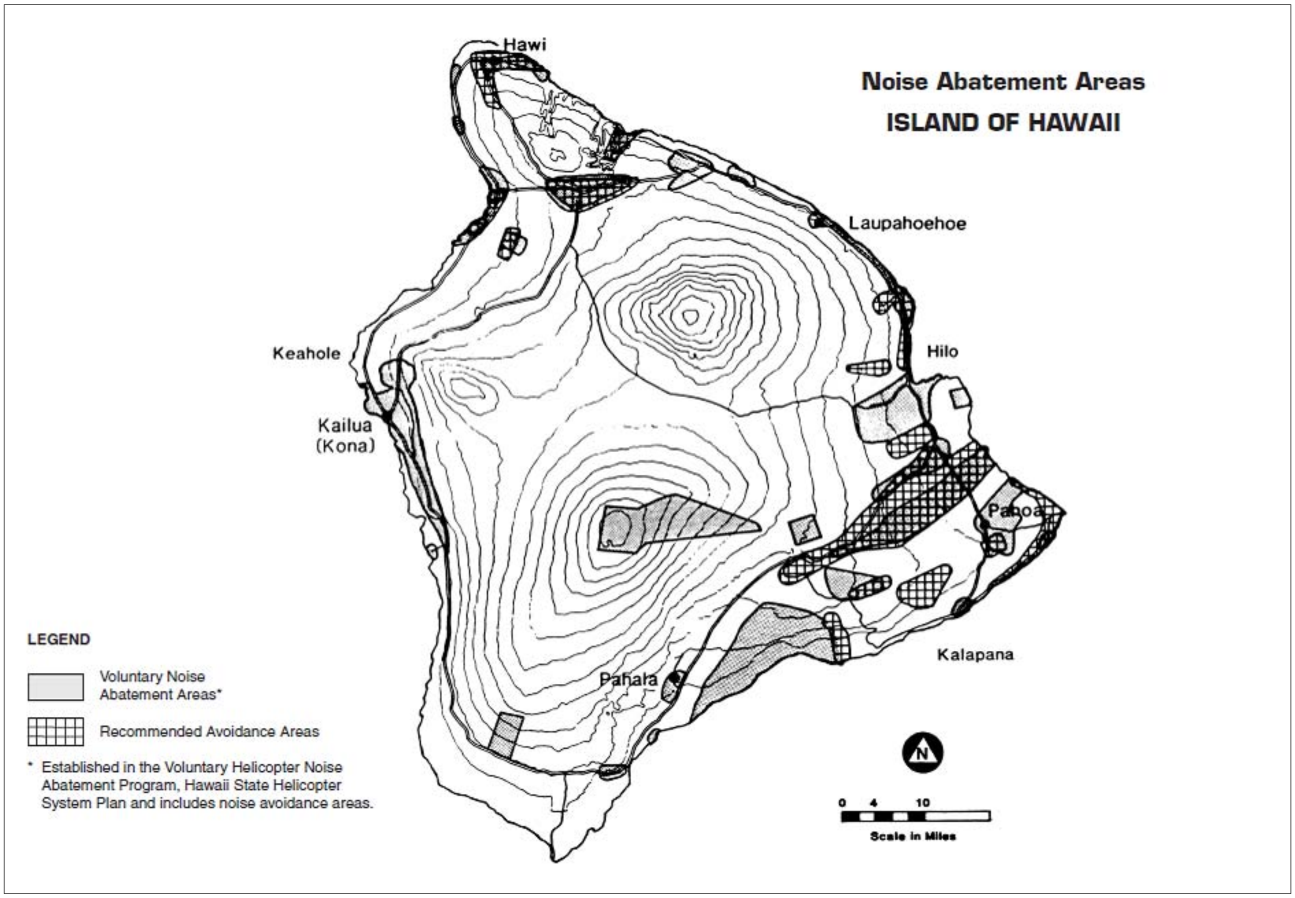

Figure 3-21. Island of Hawai‘i Noise Abatement Areas from DOT (2010a).

Table 3-8. Army land use planning guidelines.[a]

Noise Zone	Aviation ADNL (dBA)	Impulsive CDNL (dBC)	Small Arms PK 15 (met)
Land Use Planning	60–65	57–62	Not applicable
I	Less than 65	Less than 62	Less than 87
II	65–75	62–70	87–104
III	Greater than 75	Greater than 70	Greater than 104

a. Source: U.S. Army (2010c).
ADNL = A-weighted day-night average sound level.
CDNL = C-weighted day-night level.
dBA = A-weighted decibel.
dBC = C-weighted decibel.

during quiet nighttime hours to 70 dBA during windy daytime hours or when traffic is present on Saddle Road (U.S. Army 2010c).

The main source of noise at Bradshaw Army Airfield is aircraft, although the airfield only averages one flight per day for each of the aircraft utilizing it. These aircraft include rotary wing AH-64, CH-47, OH-58, UH-60, and Dauphin as well as fixed-wing C-12 and C-130 (U.S. Army 2010c). As previously stated, the low number of flights at Bradshaw Army Airfield does not generate DNL noise contours.

3.11.2.1 Mauna Kea. The three high-altitude LZs on Mauna Kea are located within in the Mauna Kea Forest Reserve. Therefore, existing noise levels at the LZs are relatively low. Ambient noise sources consist of birds, insects, and wind. Noise sources that generate noise above background levels are generally associated with recreational use of the Mauna Kea State Recreation Area, Mauna Kea Ice Age NAR, and Mauna Kea summit region. These sources include tourists, vehicular traffic, observatory operations and users, and cultural practitioners. In addition, commercial helicopter flights operate in the area at lower elevations as part of scenic tours, which may also contribute to noise levels above background.

3.11.2.2 Mauna Loa. Similar to the Mauna Kea LZs, the three high-altitude LZs on Mauna Loa are located within the Mauna Loa Forest Reserve, and existing noise levels at the LZs are low. Ambient noise sources consist of birds, insects, and wind. Noise sources that generate noise above background levels are generally associated with recreational use of the Hawaiʻi Volcanoes National Park. These sources include tourists and vehicular traffic.

3.12 Visual and Aesthetic Resources

The visual character of an area is defined in terms of four primary components: water, landform, vegetation, and cultural modifications. These components are characterized or perceived in terms of the design elements' form, line, color, texture, and scale. Visual components also may be described as being distinct (unique or special), average (common or not unique), or minimal (a liability) elements of the visual field and in terms of the degree to which they are visible to surrounding viewers (e.g., foreground, middle ground, and background) (USAEC 2008).

The visual quality of an area is defined in terms of the visual character and the degree to which these features combine to create a landscape that has the following qualities: vividness (memorable quality), intactness (visual integrity of environment), and unity (compositional quality). An area of high visual quality usually possesses all three of these characteristics.

The visual quality of an area also is defined in terms of the visual sensitivity within the view shed of the Proposed Action. Locations of visual sensitivity are defined in general terms as areas where high concentrations of people may be present or areas that are readily accessible to large numbers of people. They are further defined in terms of several site-specific factors, including the following:

- Areas of high scenic quality (i.e., designated scenic corridors or locations)
- Recreation areas characterized by high numbers of users with sensitivity to visual features
- Quality (i.e., parks, preserves, and private recreation areas)
- Important historic or archaeological locations.

The natural beauty of the island of Hawai‘i includes not just lush tropical forests, waterfalls, and sandy beaches framed by turquoise waters but also active and dormant volcanoes and towering mountains.

3.12.1 Region of Influence

The *County of Hawai‘i General Plan* (County of Hawai‘i 2005) is a statement of development objectives, standards, and principles with respect to the most desirable use of land within the county (County of Hawai‘i 2005). The long-range goals with respect to the natural beauty of the island of Hawai‘i include the following:

- Protect, preserve, and enhance the quality of areas endowed with natural beauty, including the quality of coastal scenic resources
- Protect scenic vistas and view planes from becoming obstructed
- Maximize opportunities for current and future generations to appreciate and enjoy natural and scenic beauty.

The proposed HAMET LZs and PTA lie within the Hamakua and North Hilo planning districts described in the *County of Hawai‘i General Plan* (County of Hawai‘i 2005). Specific standards provide guidelines for designating sites and vistas of extraordinary natural beauty that must be protected, including the following types of features:

- Distinctive and identifiable landforms distinguished as landmarks, such as Mauna Kea
- Coastline areas of striking contrast
- Vistas of distinctive features
- Natural or native vegetation that makes a particular area attractive (USAEC and COE 2009).

3.12.2 Landscape Description

The landscape of the region from PTA to the proposed LZs is characterized by panoramic views of the broad open area between Mauna Kea and Mauna Loa. The gently sloping form and smooth line of Mauna Kea to the north and Mauna Loa to the south are dominant background features of the visual landscape. Terrain in the PTA area is gently sloping and open, periodically interrupted by remnant volcanic cones (pu‘u). Lava flows create dark, visually receding areas throughout PTA.

Vegetation generally consists of grasses and shrubs that tend to be sparse and low in height. Observatories are on Mauna Loa and Mauna Kea to the south and northeast of PTA. There are few human-made features in the area except roads and support facilities within the training area and structures, roads, and an airfield within the cantonment area of PTA. The cantonment area is a visually distinct element of the landscape. Visible cultural features include walls, platforms, and many rock shelters.

The extremely uniform vegetation and topography result in middle-ground and background views of PTA and the proposed LZs that lack visual complexity but that are dramatic in their expansiveness. The panoramic views, the integrated visual space, and the unity of the natural features give this area a high overall visual quality, despite the uniformity of the landscape.

The *County of Hawai'i General Plan* identifies areas of unique natural beauty that are a principle asset of the island, and the plan encourages programs for their conservation, preservation, and integration with other elements. Within the Hamakua and North Hilo planning districts in which the Proposed Action would take place, the general plan lists the Mauna Kea State Park (and area) as an example of natural beauty sites the plan protects (County of Hawai'i 2005).

Within this visual landscape, aviation training currently occurs within PTA, and commercial and private aircraft operate outside of PTA. The latter topics are discussed in Subsection 3.14, Traffic and Circulation. A view plane analysis is presented in Subsection 4.12, Visual and Aesthetic Resources.

3.13 Human Health and Safety Hazards

The six LZs proposed for HAMET have similar environmental features and would have similar operations conducted on them under all alternatives. There is no distinction between LZs from a human-health and safety-hazards perspective.

Existing hazards that could threaten human health and safety within the proposed LZs range from limited to nonexistent and are based on human presence within an LZ. In other words, there are no human health and safety hazards unless a human is present at the LZ. As presented in Subsection 2.7.2, Features Common to Alternatives 1, 2, and 3, the LZs have been used for previous HAMETs (U.S. Army 2003a; U.S. Army 2004a; U.S. Army 2005a). No incidents involving human health and safety occurred during previous uses, and no structures or other features that would pose a human health and safety hazard were placed during previous operations (U.S. Army 2003b; U.S. Army 2004a; U.S. Army 2005a). The primary human health and safety concerns of HAMET and human presence include LZ safety, hazardous material, and wildfire.

The Army has procedures in place to investigate and plan for possible hazards. As part of flight operations, a risk assessment is completed by a commanding officer and addresses general and specific hazards for each flight mission. Pilots are briefed on the risk assessment, hazards, mitigative actions, and emergency procedures during preflight briefings prior to the start of each training mission (Mansoor 2011a).

3.13.1 Landing Zone Safety

Health and safety hazards associated with the LZs proposed for high-altitude training activities are based on human activities proposed at each location. These hazards include the following:

- High elevation
- Risk of wildfire
- High wind
- Extreme temperature
- Night/low visibility.

3.13.2 Hazardous Material

The U.S. Department of Transportation defines a hazardous material as a substance or material that the Secretary of Transportation has designated as capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and that has been designated as hazardous under Section 5103 of the Federal Hazardous Materials Transportation Law (49 USC 51 § 5101 et seq.). The term "hazardous material" includes hazardous substances, hazardous wastes, marine pollutants, elevated-temperature materials, materials designated as hazardous in the Hazardous Materials Table, and materials that meet the defining criteria for hazard classes and divisions in 49 USC 51 § 5101 et seq. Hazardous-material and waste management continues to follow Army, federal, and state regulations to prevent impacts on human health or the environment.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 103 § 9601 et seq.) defines as hazardous any substance that, due to its quantity, concentration, or physical and chemical characteristics, poses a potential hazard to human health and safety or to the environment. CERCLA has created national policies and procedures to identify and remediate sites contaminated by hazardous substances. There have been no hazardous substances identified at the proposed LZ locations.

3.13.3 Wildfires

Fire in the area of PTA has been limited to volcanically started fires, occasional lightning ignitions, and human error such as catalytic converters (i.e., vehicle exhaust systems) and discarded cigarettes (USAEC and COE 2009).

Tracer ammunition (which is not used in HAMET) is by far the largest cause of fires within PTA. Based on fire records, the number of fires per month peaks from March to July. However, PTA has a mosaic of dry habitats that is relatively dry throughout the year. Additionally, the amount of precipitation received during the winter is not sufficient to change the probability of fire by any significant amount. Also, based on the fire history of PTA, the data show that the western and the northern sections of PTA potentially face the greatest threat of wildfire (USAEC and COE 2009). Therefore, the main cause of monthly variation in the data is probably the frequency and intensity of use by the military and not due to environmental or climatic conditions.

Since July 1990, more than 8,000 acres (3,237 hectares) at PTA have been recorded as burned. Of these, more than 7,700 acres (3,116 hectares) or 91% of all acres burned were from fires caused by lightning, arson, or carelessly discarded cigarettes, and the largest of these started off Army lands and later burned onto PTA (USACE and COE 2009). In 1994, for example, a wildfire that began off-post destroyed 118 individuals of *Tetramolopium arenarium* ssp. *Arenarium*, eliminating approximately one-third of the total population. In addition to the 8,000 acres (3,237 hectares) of previous burns, a fire of unknown ignition origin occurred immediately adjacent to PTA within the PCH during August 2010 and burned 1,387 acres (561 hectares) of habitat (see Figure 3-12).

Invading nonnative species can pose a threat to native plant communities in burned areas. Many invasive plant species (e.g., fountain grass) are fire tolerant and can rapidly spread, outcompeting the native vegetation and threatening the ecosystem functionality as well as creating the potential to impede training activities. Once a fire has occurred and the native habitat has been burned, there is the potential for subsequent invasion of nonnative plant species (particularly fountain grass). These species may increase competition with native plants and, depending on the species, may result in an increased or decreased fire-prone landscape.

All six LZs are either devoid of plant life or so sparsely vegetated that the risk of fire is minimal. In the unlikely event of a fire, wildland fire crews from the 25th CAB and PTA would respond in accordance with current agreements between the Army and local emergency management agencies. The response plans would be conducted using current, approved emergency response procedures.

3.13.4 Wildfire Management

The integrated wildland fire management plan (IWFMP) for PTA was developed to establish specific guidance, procedures, and protocols for managing wildfires on PTA (CEMML and U.S. Army 2003). The IWFMP addresses environmental conditions and fire effects in Hawai‘i, fire prevention, pre-fire suppression, fire suppression, post-fire actions, and fire management areas. Fire prevention includes planning, managing fuels, using prescribed fire, planning water resources, and conducting firefighter training.

Records and reports, reviews and formal investigations, and analysis make up post-fire actions. These require the Wildland Fire Program manager to maintain a wildland fire incident report for all wildland fires on Army lands. The IWFMP discusses fire management areas and describes baseline site characteristics, wildland fire fuel types, previous fires, biological and cultural resources protection, and the firebreak system. The locations of water storage resources and other firefighting resources are described in the IWFMP. The appendices to the IWFMP address standard operating procedures.

Vegetation management is a tool used to prevent the spread of a fire by creating firebreaks and to control the abundance of highly flammable plants so that fires cannot easily ignite. Conducting prescribed burns is one form of vegetation management; mowing and applying herbicides are others. The Army uses vegetation management techniques at PTA. In the event of a fire at PTA, affected activities (e.g., training) are stopped immediately, and appropriate actions are undertaken to control/extinguish the fire (USAEC and COE 2009).

Standard operating procedures provide specific requirements that delineate the responsibilities of the Army, Federal Fire Department, Range Control personnel, and military training units in preventing and suppressing fires on Army lands (CEMML and U.S. Army 2003). In addition to addressing the environmental setting in the standing operating procedures, site-specific guidance is provided for fire prevention (including drought management), fire-suppression actions, and post-fire actions.

According to the IWFMP, in the recent past, the entire Hawaiian ecosystem has experienced an increase in wildfire frequency. Causes for the increase in fire frequency include the spread and intensification of alien grasses. In 1991, the Army began to reduce the frequency of fires on Army land with the application of a fire-prevention and prescribed-burn program. During a typical training exercise, unit leaders receive briefings from Range Division staff on the locations of fire hazards and fire-prevention measures and procedures. Unit leaders brief every soldier in the unit on the importance of preventing wildland fires. In the event of fire at any location, the unit takes all appropriate actions to put out the fire (USAEC and COE 2009).

3.14 Traffic and Circulation

3.14.1 Land-Based Traffic

Traffic and circulation refers to the movement of vehicles and pedestrians along and adjacent to roadways. Major roads are under the jurisdiction of the state through the Hawai‘i Department of Transportation; other streets and roads are under the jurisdiction of the counties. Roadways range from multi-lane road networks with asphalt surfaces to unpaved plantation roads. Roads and paths leading to the LZs are non-maintained, single-lane roads built on crushed lava. These roads are accessible only with high-clearance, four-wheel-drive vehicles due to the remote location, extreme elevation changes, and harsh operating conditions. While these roads are open to the public, they are not used heavily. The following types of land-based activities may take place:

- Hiking
- Camping
- Mountain bike riding
- All-terrain vehicle riding
- Horseback riding
- Dog training.

These activities are unlikely to be conducted near the proposed LZs as a result of high elevation and undesirable terrain.

3.14.2 Aerial Traffic

Approximately 60 commercial helicopter flights per day (approximately 22,200 flights per year) fly over the PCH just to the north of PTA (Munger 2010b). Commercial vendors include, but are not limited to, Paradise/Tropical Helicopter, Sunshine Helicopters, and Blue Hawaiian Helicopters, all of which are based out of Hilo. Flights usually originate from the west side of Hawaiʻi and fly along the south slope of Mauna Kea directly above the PCH to reach various parts of the island as part of scenic tours.

3.15 Public Services and Utilities

The LZs are proposed in remote locations on Mauna Kea and Mauna Loa. The LZs on Mauna Kea are only accessible by a four-wheel-drive vehicle trail. The LZs on Mauna Loa are accessible by an access road that is open to the public. There are no public services or utilities in the general area. In the event that police, fire, or emergency-medical services are needed, they are available from PTA. HAMET flights would be based from Bradshaw Army Airfield at PTA. Public services and utilities at, and affecting, PTA are presented in this subsection.

3.15.1 Police

Army staff provides all police services on PTA. Units that come to PTA for training may bring military police of their own, depending on the size of the unit and other circumstances. The PTA police facility is located in the cantonment and is open 24 hours per day, 7 days per week. Saddle Road, a public highway, is patrolled by Hawaiʻi County police, but PTA military police are available for support when necessary. Lands leased by the Army are not patrolled on a regular basis, but military police respond to calls in coordination with county police. PTA military police coordinate extensively with county police on a regular basis (USAEC and COE 2009).

3.15.2 Fire

Fire-response services are provided by Army staff based at PTA. There is one fire station located at Bradshaw Army Airfield, with a staff of six (including two emergency medical technicians sharing duty around the clock). Available equipment includes two brush trucks (wildland rigs), a tanker, a crash rig, and an ambulance (USAEC and COE 2009). The Army is required to follow established standard operating procedures for wildfire situations (CEMML and U.S. Army 2003).

3.15.3 Emergency Medical Services

Emergency-medical services are provided by Army staff based at PTA. Serious medical emergencies rely on medical helicopter transport to Hilo, which is about 10 minutes away by air. PTA emergency staff respond to accidents on the roughly 25 miles (40.2 kilometers) of Saddle Road that pass through PTA, and, at the border of the installation, the injured are transferred to the care of the City of Hilo and County of Hawaiʻi (USAEC and COE 2009).

3.15.4 Potable Water

The water supply to PTA is now hauled by tanker trucks from the town of Waimea, where it is purchased. Excess demand can be met by the City of Hilo. Each truck has a capacity of 5,000 gal (18,927 L), and up to 14 truckloads per day were required when the camp was at full capacity. Two pump stations transport the hauled water to two 670,000-gal (2,553,226-L) storage reservoirs, where it is treated with powdered chlorine and sent to three 10,000-gal (37,854-L) distribution reservoirs. Water from these reservoirs supplies PTA, Bradshaw Army Airfield, and fire reserves. Water consumption on PTA ranges from 10,000 gal (37,854 L) per day to 250,000 gal (946,353 L) per day, depending on camp occupancy; average consumption is 100,000 gal (378,541 L) per day (USAEC and COE 2009).

Hōkūpani Spring, Waihū Spring, and Liloe Spring previously supplied water to PTA. Spring water is captured by two 2-in. (5-cm) pipes running from the springs, through water catchments, and down to the base camp. The annual production of water supplied by the springs ranges from 20,000 gal (75,708 L) to 40,000 gal (151,417 L) per day. Historically, however, the spring produces a range of 0 to 80,000 gal (302,833 L) per day. This water was stored in a 670,000-gal (2,553,226-L) tank and treated in a slow sand filter treatment plant installed in 1996. The treated water was then conveyed to the two storage reservoirs for chlorination. The slow sand filter ceased to function, and use of spring water was discontinued. The state ranger facility has the rights to the first 8,000 gal (30,283 L) of water from the springs. The Army has the rights to the next 6,000 gal (22,712 L), and the remainder of the water is divided equally between the two agencies (USAEC and COE 2009).

3.15.5 Wastewater

Wastewater discharges at PTA derive from domestic wastewater generated by mess halls, latrines, and other administrative operations. Most of the flows from each of these facilities are disposed of in adjacent cesspools. Some facilities are grouped to one cesspool, and wastewater from grouped facilities is collected and transported through 4-in. (10-cm) sewer lines to a cesspool for disposal. Three latrine/shower facilities (T-87, T- 290, and T-121) recycle water used in the showers and sinks for use in the latrines. The wastewater from the latrines is then discharged to a septic tank and is finally disposed of in a seepage pit or leach field (USAEC and COE 2009).

3.15.6 Solid Waste Management

PTA generates an estimated 296 tons (269 metric tons) of industrial solid waste annually based on the waste and recycling streams generated during the third quarter of 2002 (USAEC and COE 2009).

3.15.7 Telephone

Telecommunications from the area between Mauna Kea and Mauna Loa are transmitted to Hilo through the Humuʻula microwave station. Overhead trunk lines extend from this station to PTA, and distribution lines are located in the base camp, cantonment area, and Bradshaw Army Airfield. The trunk and distribution lines are owned by GTE Hawaiian Telephone, Inc. (USAEC and COE 2009).

3.15.8 Electricity

HELCO supplies electric power to PTA through a single 12.47-kV delivery point from a HELCO-owned substation located outside the northeast fence of the cantonment area. The components of this system include metering equipment, 29 transformers, 20 miles (32.2 kilometers) of overhead lines, and 755 poles. Demand for electric power varies throughout the year, depending on troop population in the base camp. Usage varies from about 1,600 kilowatt hours per day (kWh/day) to 7,100 kWh/day; average consumption is approximately 4,553 kWh/day (USAEC and COE 2009).

3.15.9 Wildfire Response at PTA

As part of its stated objectives, the IWFMP provides the necessary firefighting capabilities for firefighter and public safety (CEMML and U.S. Army 2003). The IWFMP incorporates public health and environmental quality considerations into its fire management planning and execution and, where practical, provides protection for the natural and cultural resources. By following the guidelines set forth in the IWFMP and associated standard operating procedures, the Army can reduce wildfires and provide for the protection of public services and utilities. In the event of a fire, wildland fire management on Army-controlled lands is conducted in accordance with the NHPA and the ESA (U.S. Army 2004a).

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4. ENVIRONMENTAL CONSEQUENCES

This section presents a summary of the potential environmental impacts from the Action Alternatives and the No Action Alternative. The methodology and assumptions used for impact analysis and a discussion of factors used to determine the significance of direct and/or indirect impacts are also provided. Direct impacts are those impacts that are caused by the Action Alternatives and occur at the same time and place as the action. Indirect impacts are those impacts that occur later in time or are farther removed in distance from the action itself. The terms "impact" and "effect" are used synonymously throughout this section.

To determine whether an impact is significant, CEQ regulations require the consideration of context and intensity of potential impacts. Context normally refers to the setting, whether local or regional, and intensity describes the severity of the impact.

Summary tables provide an overview of impacts by resource and by alternative. These tables show the highest level of impact for each resource by issue area. Text supporting these conclusions is presented, and mitigation measures are listed for significant impacts and less-than-significant impacts, where mitigation is possible.

For this analysis, impacts are defined in the following categories: significant (S), significant but can be mitigated to less than significant (S/MI), less than significant (<SI), and no impact (NI). The results of the impact analysis of the Action Alternatives are included within each VEC discussion, and a summary table of overall impacts is presented in Table 6-1 of Section 6, Conclusions.

Mitigation is the reduction or elimination of the severity of an impact. The intention of mitigation is to reduce the effects of an action on the environment. CEQ defines mitigation as (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action; (3) rectifying the impact by repairing, rehabilitating, or restoring the environment; (4) reducing or eliminating an impact over time by using preservation and maintenance operations; and (5) compensating for an impact by replacing or providing substitute resources or environments (40 CFR 1508.20). Therefore, as with alternatives, mitigation measures would only be proposed if they would be technically feasible and if they would allow the proposed project to meet the purpose and need.

Unless otherwise indicated, data used in developing the impact analysis for the Action Alternatives relied on, and reference, existing environmental documents, field surveys, and other studies developed as part of past or concurrent projects associated with HAMET, PTA, and the lands and resources in the affected environment area.

An initial evaluation of the potential impacts associated with the Action Alternatives indicated that several of the VECs described in Section 3 were found to have few or no impacts resulting from implementing the Proposed Action. Those VECs include climate; air quality; geology and topography; soils; water resources; biological resources; cultural resources; socioeconomics and environmental justice; land use; recreation; noise; visual and aesthetic resources; human health and safety; traffic and circulation; and public services and utilities. The impacts are discussed in detail in the following subsections.

4.1 Impacts from No Action Alternative

The impact analysis of the No Action Alternative for all VECs resulted in the following findings:

- Impacts to climate and air quality are not anticipated under the No Action Alternative. The alternative does not change current climate or air quality conditions.

- Impacts to geology, soils, and water resources are not anticipated under the No Action Alternative. The alternative does not alter the current physical state of the environment.

- Impacts to biological or cultural resources are not anticipated under the No Action Alternative. The alternative does not alter the current state of these resources, which are described in Section 3.

- Impacts to sociological resources, economic resources, environmental justice, and environmental health effects on children are not anticipated under the No Action Alternative. The alternative does not alter the current state of the current conditions described in Section 3.

- Impacts to land use are not anticipated under the No Action Alternative. The alternative does not curtail the range of beneficial uses of the environment or conflict with existing or planned land uses. The alternative does not result in any substantial secondary impacts, such as population changes or effects on public facilities. The alternative also does not affect any special land use designations.

- Impacts to recreation are not anticipated under the No Action Alternative. The alternative does not curtail the range of recreational uses of the environment, affect scenic vistas or view planes, disrupt recreational use of land-based resources, interfere with the public's right of access, prevent a peak season, or discourage existing recreational activities.

- Impacts to noise or to visual and aesthetic resources are not anticipated under the No Action Alternative. Noise levels, visual character, visual quality, and sensitivity levels would remain as described in Section 3.

- Impacts to human health and safety, traffic and circulation, public services, and utilities are not anticipated under the No Action Alternative. These VECs would remain as described in Section 3.

The No Action Alternative would result in no changes in the existing environment. The No Action Alternative would leave the DoD stationed in Hawaiʻi at a disadvantage with few ways to mimic the type of environment the unit will experience in Afghanistan.

4.2 Climate

4.2.1 Impact Methodology

Climate impacts from the Action Alternatives have been evaluated. The identification of project impacts relied on the use of available observations and professional judgment to make reasonable inferences about the potential impacts of the project, given the interpretation of the local and regional climates provided in Section 3.

4.2.2 Factors Considered for Impact Analysis

An action would be considered to have a significant impact on climate if it would alter a local or regional climatological condition (i.e., average temperature, rainfall, or wind pattern).

4.2.3 Summary of Impacts

No impacts to local or regional climate are expected as a result of Alternatives 1–3 (Table 4-1). The climate at the proposed LZs, and the island of Hawai‘i overall, would remain cool and tropical (upper montane to alpine), with no impacts on average temperatures, rainfall, or wind patterns.

Table 4-1. Summary of potential impacts to climate.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Climate change (temperature, winds, precipitation)	NI	NI	NI	NI

S = Significant.
S/MI = Significant but can be mitigated to less than significant.
<SI = Less than significant.
NI = No impact.

4.3 Air Quality

Evaluating impacts on air quality, as well as other VECs, required an understanding of a mechanism of physical disturbance associated with helicopter rotor wash. Rotor wash is a term used to define a “wave” of air created by the rotor disc of a helicopter. As shown in Figure 4-1, this wave is created by the downward thrust of air that produces lift. The wave extends out in a 360-degree pattern from the center of mass of the helicopter, which is usually the rotor mast (DOT 2000). High-speed rotor wash can be produced up to approximately three times the diameter of the rotor disc (U.S. Army 2007b).

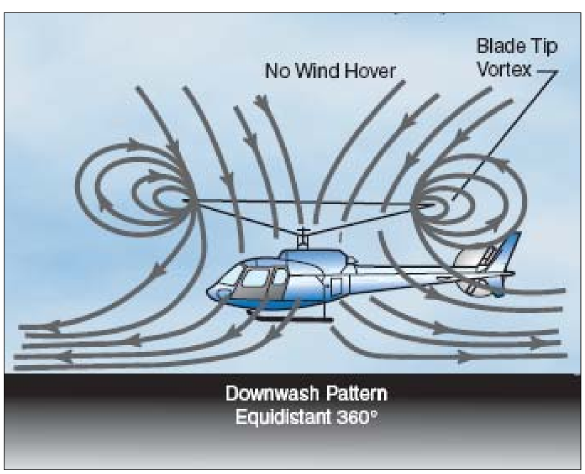

Figure 4-1. Rotor wash shown as “downwash” from DOT 2000.

Within a specific height from the ground, related to the helicopter's rotor blade diameter, rotor wash intensity may be sufficient to displace dust, dirt, rocks, or other loose materials. Rotor wash intensity tends to decrease as the distance from the helicopter increases. The intensity of rotor wash on the localized area is directly related to many factors, including helicopter weight, disc area of the helicopter being used, and the height of the helicopter from the ground. For example, a heavier helicopter, such as the Chinook, requires more lift than a Black Hawk and produces rotor wash across a wider area than the lighter Black Hawk would generate in the same area. Similarly, the Chinook's rotor wash, generated by a 60-ft (18-m) diameter rotor, begins to affect a localized environment when the pilot lowers the helicopter to approximately 90 ft (27 m) AGL (Figure 4-2). The Black Hawk, which is lighter and has a smaller rotor diameter at 53 ft (16 m), begins to affect a localized environment when the pilot lowers it to 79 ft (24 m) AGL.

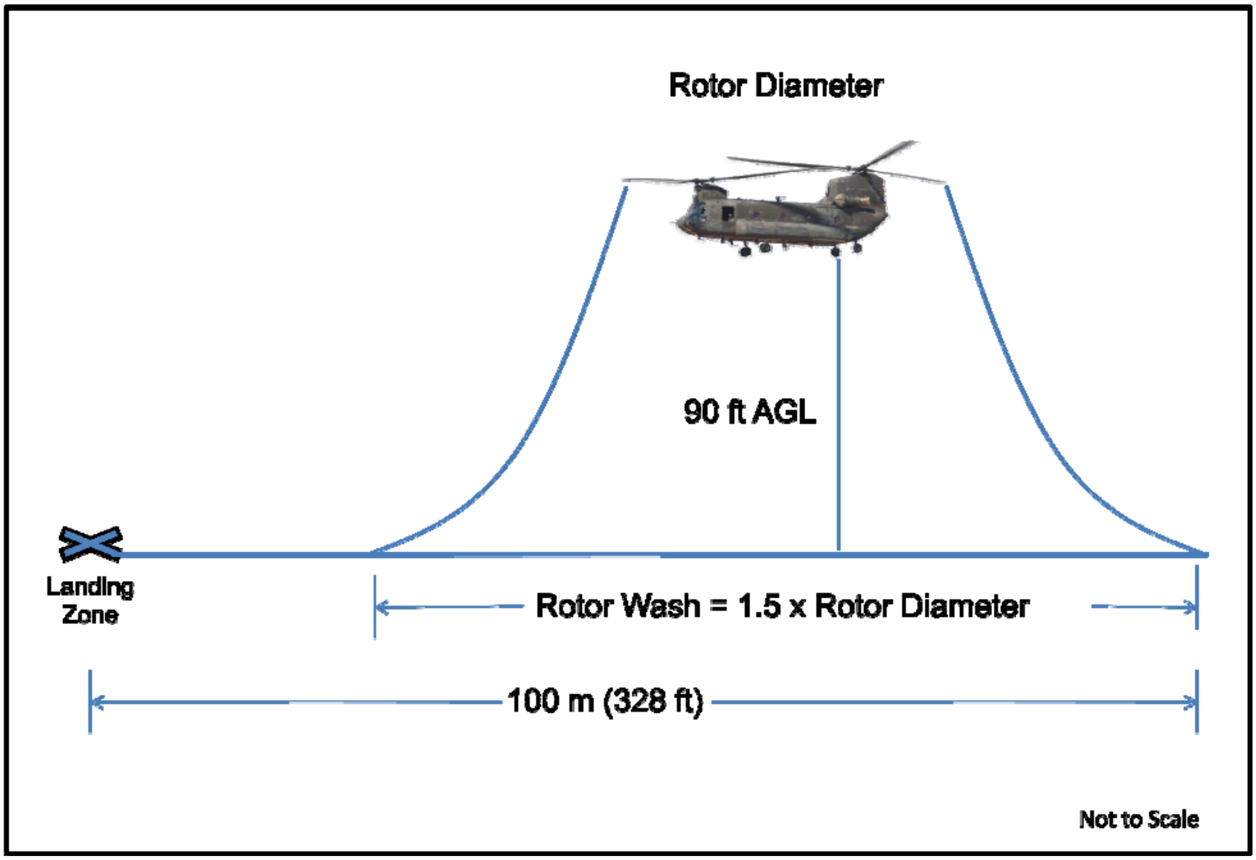

Figure 4-2. Rotor wash impact area.

For the air quality analysis, it was determined that the rotor wash from the Chinook and Black Hawk, at 90 ft (27 m) AGL, impact an area of 180 ft (55 m) and 159 ft (48 m), respectively. For purposes of a conservative analysis, the area of impact analyzed was 100 m (328 ft) from the center point of the LZ, or roughly twice as large as the typical rotor-wash area. Figure 4-3 is a photo of a Black Hawk that is hovering 12 in. (30 cm) from the ground on LZ-5 during the March 2011 data-collection training period. The photo shows no dust visible.

Figure 4-3. A Black Hawk helicopter (photographed from a separate helicopter at an angle) hovers above LZ-5 during the March 2011 data collection training period.

4.3.1 Impact Methodology

Air quality impacts from the Action Alternatives have been evaluated. Emission sources associated with Alternatives 1–3 include military helicopter engines and fugitive dust from helicopter landings and take-offs. The analysis was performed assuming a conservative flight frequency of 60 flights per day.

Particulate matter emissions analyses prepared for this EA are presented as PM_{10} estimates, because that is the most appropriate size fraction to address fugitive dust issues. PM_{10} estimates presented for military helicopter engine emissions can be interpreted as also being a conservative estimate of $PM_{2.5}$ emissions. Visible dust is a clear indication of airborne PM_{10} concentrations that are typically in the range of several micrograms per cubic meter. PM_{10} emissions are important, because the PM_{10} size fraction represents airborne particles small enough to be inhaled into the lower respiratory tract, where they can have adverse health effects. PM_{10} modeling was performed to better evaluate the potential for violations of the federal PM_{10} standards due to fugitive dust emissions associated with helicopter use. The modeling analyses used the EPA AP-42 emission calculation (EPA 1995) and *Fugitive Dust Handbook* from the Western Regional Air Partnership (WRAP 2004). The particle size category used was for undisturbed soils to determine particle settling and deposition. Meteorological conditions assumed in the modeling analysis included Class B (stable) and C (slightly unstable) for daytime operation with an average speed of 15.4 ft (4.7 m) per second from the NNW and D (neutral) and Class E (mild temperature inversion) for nighttime operations with an average wind speed of 16.7 ft (5.1 m) per second from the SSE. The dispersion modeling results obtained for evaluating helicopter maneuver exercises on a 1.2-acre

(5,046 m^2) section of undisturbed soil were used to extrapolate potential PM_{10} concentrations from wind erosion due to landings and take-offs from the LZ's conditions.

4.3.2 Factors Considered for Impact Analysis

Major factors considered in determining whether a project alternative would have a significant impact on air quality include the following:

- The amount of net increase in annual emissions of criteria pollutants on a given island. The 100 tons (90.7 metric tons) per year Clean Air Act conformity de minimums threshold does not apply to Hawaiʻi, because it is an attainment area, but the threshold was used nonetheless as a basis of comparison in analyzing air quality impacts.

- Whether or not dispersion modeling analyses indicated a potential for violation of federal and state PM_{10} or $PM_{2.5}$ standards at off-post locations.

- Whether or not dispersion modeling analyses indicated a potential for violation of federal and state carbon monoxide, nitrogen oxide, and sulfur dioxide standards at off-post locations.

4.3.3 Summary of Impacts

Potential impacts to air quality are discussed in following subsections and summarized in Table 4-2.

4.3.3.1 PM_{10} Emissions. Because each LZ was considered a separate point source and the soil characteristics at both Mauna Loa and Mauna Kea are similar, fugitive dust emissions would have the same relative impacts for all three of the Action Alternatives. Based on modeling, the impact of fugitive dust from helicopter activity on either Mauna Loa or Mauna Kea LZ areas would be less than significant. This is based on each LZ being treated as a separate area source and assuming one landing per episode. Using these assumptions, the maximum concentration at 1,093 yd (1,000 m) away from the center of the LZ(s) is less than 17.98 $\mu g/m^3$, which is below the state and EPA emission standard of 150 $\mu g/m^3$ per 24 hours of exposure to the general public (see Table 3-1). Consequently, PM_{10} emissions would be a less-than-significant impact for all Action Alternatives.

4.3.3.2 Pollutant Emissions from Helicopter Engine Use. Because the number of missions would be the same for Alternatives 1, 2, and 3, pollutant emissions would be the same for each option. The total tons per year for regulated pollutants are based on the average emissions from the proposed helicopters in use. Using emissions presented in Table 4.4.2 of the *Final Environmental Impact Statement, Military Training Activities at Mākua Military Reservation, Hawaiʻi* provides a realistic estimate of the regulated pollutants released from HAMET (USAEC and COE 2009).

The pollutant with the highest estimated annual net increase in emissions would be carbon monoxide followed by nitrogen oxides, which would increase by 3.85 tons (3.45 metric tons) per year for all missions combined.

Table 4-2. Summary of potential impacts to air quality.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
PM_{10} emissions	<SI	<SI	<SI	NI
Pollutant emissions	<SI	<SI	<SI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

4.4 Geology, Soils, and Topography

4.4.1 Impact Methodology

Geologic impacts include all of the effects that result from the interaction between the project and the geologic environment. For example, project impacts may include changes in erosion rates or changes in the level of exposure of people and structures to earthquakes or unstable slopes.

The identification of project impacts relied heavily on the use of available geologic studies, reports, observations, and professional judgment to make reasonable inferences about the potential impacts of the project, given the interpretation of the geologic setting provided in Section 3.

4.4.2 Factors Considered for Determining Significance of Impacts

Factors considered in determining whether an alternative would have a significant geologic impact include the extent or degree to which its implementation would:

- Result in substantial soil loss (e.g., through increased erosion) or terrain modification (e.g., altering drainage patterns through large-scale excavation, filling, or leveling)
- Result in soil or sediment contamination exceeding regulatory standards or other applicable or relevant human health or environmental effects thresholds
- Increase the exposure of people or structures to geologic hazards (e.g., ground shaking, liquefaction, volcanism, slope failure, expansive soils, hazardous constituents of soils) that could result in injury, acute or chronic health problems, loss of life, or major economic loss
- Adversely alter existing geologic conditions or processes such that the existing or potential benefits of the geologic resources are reduced (e.g., construction of a jetty that would interfere with sand-transport processes and beach formation or would increase shore erosion)
- Permanently damage or alter a unique or recognized geologic feature or landmark.

4.4.3 Summary of Impacts

The impacts on geology, soils, and topography from implementing each of the Action Alternatives are discussed in following subsections and summarized in Table 4-3.

Table 4-3. Summary of potential impacts to geology, soils, and topography.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Results in substantial soil loss (e.g., through increased erosion) or terrain modification (e.g., altering drainage patterns through large-scale excavation, filling, or leveling)	NI	NI	NI	NI
Results in soil or sediment contamination exceeding regulatory standards or other applicable or relevant human health or environmental effects thresholds	NI	NI	NI	NI
Adversely alters existing geologic conditions or processes such that the existing or potential benefits of the geologic resource are reduced	NI	NI	NI	NI
Soil dispersion from helicopter-generated winds; soil compaction from helicopters landing on the soil	<SI	<SI	<SI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

4.4.3.1 Alternative 1 – Mauna Kea and Mauna Loa. The three LZs (4, 5, and 6) on Mauna Kea exist on soils composed of cinder (Figure 3-7). LZ-4 lies in the vicinity of neighboring very stony soil. One potential for impact to these LZs would be from the helicopters disturbing the soil (i.e., blowing the soil). However, both of these soil types are very resilient to wind forces, because their larger grain sizes make it difficult to disturb by wind. Subsection 4.3.3.1 quantifies the amount of soil that would be dispersed is less than 17.98 $\mu g/m^3$ at 1,093 yd (1,000 m) away from the center of the LZ(s). Therefore, this impact is considered less than significant.

Another potential for impact would be the helicopter landing on the soil. The weight of the helicopter may compact or crush any soil or gravel underneath, but the potential impact is considered less than significant.

The three LZs (1, 2, and 3) on Mauna Loa exist on soils composed of ‘a‘ā lava flows (see Figure 3-7). Nearby soils are composed of cinder. The potential impacts are the same as those listed for Mauna Kea above.

The LZs to be used by each alternative already exist; no further major ground-disturbing activities or alterations are planned. There would be no impact to geology or topography, because no further construction to the LZs is required. This also means there would be no impact to any geologic landmarks. The impact to soils from this alternative is considered less than significant.

4.4.3.2 Alternative 2 – Mauna Kea. As described in Subsection 4.4.3.1, there would be no impact to geology or topography for Alternative 2; the impact to soils from this alternative is considered less than significant.

4.4.3.3 Alternative 3 – Mauna Loa. As described in Subsection 4.4.3.1, there would be no impact to geology or topography for Alternative 3; the impact to soils from this alternative is considered less than significant.

4.5 Water Resources

This subsection evaluates impacts on water resources, as described in Section 3.

4.5.1 Impact Methodology

The impact analysis in this subsection is a discussion of the effects of No Action and the Action Alternatives. The nature of existing conditions on the island of Hawaiʻi is interpreted from available literature.

4.5.2 Factors Considered for Determining Significance of Impacts

An Action Alternative’s impact on water resources is considered to be significant if the alternative would do any of the following:

- Degrade water quality in a manner that would reduce the existing or future beneficial uses of the water
- Substantially increase risks associated with human health or environmental hazards
- Reduce the availability of, or accessibility to, one or more of the beneficial uses of a water resource
- Alter water movement patterns in a manner that would adversely affect the uses of the water within or outside the ROI
- Be out of compliance with existing or proposed water quality standards or require an exemption from permit requirements in order for the project to proceed.

The regulatory standards against which impacts to water resources are evaluated include, but are not limited to, the following:

- Federal and state primary and secondary drinking water standards
- EPA Region 9 tap water preliminary remediation goals
- Point and nonpoint source discharge permit requirements under the Clean Water Act
- State and local plans and policies protecting surface water and groundwater resources.

4.5.3 Summary of Impacts

The potential impacts to water quality are discussed in following subsections and summarized in Table 4-4.

No impacts to surface water are expected as a result of the Alternative Actions, because there are no perennial streams or other surface water resources that could potentially be affected.

The only potential impact to groundwater would be through the contamination of an aquifer. If an emergency (i.e., mechanical failure resulting in a crash) were to result in a spill, it would likely be uncontainable due to the high permeability and percolation rates through the porous lava rock. Therefore, it would be likely for a spill to percolate through the lava rock and possibly contaminate an aquifer below. However, the groundwater level is near sea level and is, therefore, very far below the ground surface where high-altitude training would occur. Additionally, Army helicopters have self-sealing primary and auxiliary fuel systems for rotary winged aircraft to reduce the possibility of leakage, fire and explosion during impact. Therefore, the potential for the Action Alternatives to degrade water quality is less than significant.

Table 4-4. Summary of potential impacts to water quality.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Degrades water quality in a manner that would reduce the existing or future beneficial uses of the water	<SI	<SI	<SI	NI
Substantially increases risks associated with human health or environmental hazards	NI	NI	NI	NI
Reduces the availability of, or accessibility to, one or more of the beneficial uses of a water resource	NI	NI	NI	NI
Alters water movement patterns in a manner that would adversely affect the uses of the water within or outside the ROI	NI	NI	NI	NI
Is out of compliance with existing or proposed water quality standards or requires an exemption from permit requirements in order for the project to proceed	NI	NI	NI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

Implementation of any of the Action Alternatives requires no earth moving or land disturbance. Therefore, there is no potential to reduce the availability of, or accessibility to, any water resources, nor are any water movement patterns impacted.

Water quality would not be disturbed by implementing the Action Alternatives, because there are no discharges of wastewater required. Therefore, no permitting is required for point-source or nonpoint-source discharging under the Clean Water Act.

4.6 Biological Resources

Potential impacts to endangered and threatened species, sensitive species, and other vegetation and wildlife species, and to their respective habitats within and near the proposed alternative flight paths and LZs (i.e., the species' region of influence - ROI), were assessed by examining the planned activities in conjunction with past and present Section 7 ESA consultations, biological surveys, and relevant literature. All actions that could affect biological resources will be determined to be significant if that action substantially affects rare, threatened, or endangered species or their habitat.

4.6.1 Impact Methodology

Generally speaking, the impacts to the biological resources may be short or long term, direct, or indirect. Direct impacts on biological resources result when those resources are altered, destroyed, or removed during the project (USAEC and COE 2009). Examples of direct impacts include injury or mortality from aircraft collisions. Indirect impacts occur when project-related activities result in environmental changes that can influence the survival, distribution, or abundance of a species (USAEC and COE 2009). Examples of indirect impacts include the long-term effects of noise.

4.6.2 Factors Considered for Impact Analysis

The significance of all potential impacts, as defined by NEPA, to biological species (vegetation and wildlife) is based on the following:

- Importance or value of the resource affected
- Occurrence of a resource in the region
- Sensitivity of a resource to the potential impact
- Anticipated severity of the potential impact
- Anticipated duration of the potential impact.

When evaluating the potential impacts to biological resources, the sensitivity of the vegetation or wildlife is taken into account. Sensitive species are considered significant, while common species are considered significant if they are sensitive to modification. The determination of a potential impact's significance on common species depends on habitat quality, population size, and the extent of the anticipated impact.

Evaluating the significant environmental consequences for each alternative includes examining how the degree of the potential impact would affect the vegetation and wildlife. For each alternative, the impact on the vegetation and wildlife resources is considered using the following factors:

- Whether or not the impact would cause the injury or mortality that would result in a “take” under the ESA for an identified threatened or endangered species.

- Whether or not the impact would reduce the population of a sensitive species. A reduced population is defined as a reduction in numbers; alteration in behavior, reproduction, or survival; introductions of new species; or loss or disturbance of habitat.

- Whether or not the impact would have an adverse effect on the species habitat, such as a critical habitat.

Information on sensitive species is based on existing data from biological assessments, surveys, and previous EAs. A list of sensitive species that potentially occur is provided in Table 3-5. There are sensitive species that have been known to occur and that can potentially be affected by the HAMET operations: four federal- and state-listed endangered plant species and seven federal- and state-listed wildlife species. Detailed descriptions of the potentially impacted species are found in Subsection 3.6.

Section 7 of the ESA calls for interagency cooperation to conserve federally listed species and designated critical habitat. A Section 7 consultation requires that cooperating federal agencies determine whether or not a proposed action may affect listed species or critical habitat. Critical habitats are designated for sensitive species and require specific management practices. As previously discussed, the PCH has been designated for the listed palila bird, as described in Subsection 3.6. The critical habitat consists of māmane and naio forest with native shrubs and grasses and some invasive weed species. The military has established conservation measures to lessen the impacts to the palila and its habitat while operating over the PCH, and these conservation measures are in compliance with the *Revised Recovery Plan for Hawaiian Forest Birds* in that the measures limit impacts that alter bird behavior (Peshut 2011; USFWS 2006).

4.6.3 Summary of Impacts

The following subsections summarize the potential impacts to endangered and threatened species, sensitive species, and other vegetation and wildlife species.

4.6.3.1 Endangered and Threatened Species. Potential impacts to endangered and threatened species from Alternatives 1–3 are described below.

4.6.3.1.1 Alternative 1 – Mauna Kea and Mauna Loa. Alternative 1 consists of using the LZs on Mauna Kea and Mauna Loa and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation.

Impacts to Endangered and Threatened Species. In general, wildland fire is a devastating threat to endangered and threatened species, because it can cause mortality and habitat loss (USAEC and COE 2009). However, measures have been established at PTA to reduce the potential for fires and to respond to those that do occur. Not only is a potential wildland fire remote because there is sparse vegetation but also because of the unlikely event of a crash with fire (Lugo 2010). Therefore, the impact on endangered and threatened species experiencing habitat loss and mortality from a wildland fire is less than significant (Peshut 2011).

The introduction of nonnative vegetation and wildlife species can have a direct and indirect impact on biological species and their habitats, because nonnative species may remove nutrient sources, prey on native species, and carry disease (USAEC and COE 2009). Potential impacts of nonnative species from planned operations include the transportation of nonnative species to the LZs from the PTA and O‘ahu.

The transportation of nonnative species was determined to be a less-than-significant impact because of a mitigation measure that calls for inspecting and cleaning the aircraft as required, if invasive species are identified. This measure is intended to limit the probability of transport of nonnative species to the LZs (USAEC and COE 2009; Mansoor 2011b).

Noise in the form of rotor wash from helicopter operations could potentially impact endangered and threatened wildlife species. The noise from helicopter training is a potential distraction to wildlife and may cause them to flee the area, interrupting life-cycle activities and modifying behavior. However, in most cases of disturbance from noise, wildlife will avoid the disturbance and then return to normal when the disturbance is over, and, after repeated disturbances, wildlife become habituated to frequent noise (Whittaker and Knight 1998). It is unlikely that wildlife species will be attracted to the noise. According to the DoD operational noise manual (U.S. Army 2005b), the specific reaction to noise is dependent on the species, and the reaction of a specific species can only be known after subsequent studies. Although results from studies cannot be applied across species, studies have demonstrated that birds can become habituated and can co-exist with loud noises (U.S. Army 2011; Delaney et al. 2000; Pater et al. 2009). Furthermore, published scientific literature on the effects of noise on bird species has indicated that they are more affected by ground-based noise, such as hiking and hunting, than air-based noise (Delaney et al. 2000). Surveys in March 2011 to identify potential wildlife species that could be impacted by noise from helicopters were conducted within the area formed by a 2,000-ft (610-m) radius from the center of the LZ based on the 80-dBA buffer. Detailed results and methods can be found in the memorandum for record (Peshut and Schnell 2011a, 2011b). The potential impacts of noise to the endangered and threatened wildlife species were determined to be insignificant because the noise generated by HAMET operations at LZs will be intermittent and of short duration (generally less than 10 minutes), because noise > 100 dB is expected to occur within approximately 150 feet of the aircraft, and because the presence of species within the ROI during HAMET operations is expected to be extremely rare (Peshut and Doratt 2011a; Peshut and Schnell 2011a, 2011b).

Collisions of endangered and threatened species with the helicopters constitute a potential impact that could cause injury or mortality to those species. Bird strikes are a possibility. Scientific literature has indicated that most bird strikes happen near runways where birds tend to migrate to avoid predators and because airports present roosting and feeding areas (Burger 1983). The military records have indicated that there has only been one strike with a helicopter since 2002 (U.S. Army 2011b). On Mauna Kea and Mauna Loa. many of the wildlife species' ranges are not located within the helicopter flight paths, but bird and bat species have been known to cross into the specified areas. In addition, the 2,000-ft (610-m) AGL is outside of the flight paths of many birds and bats. It has been noted from viewing birds from helicopters in flight that birds will change their flight paths to avoid the helicopters (Peshut 2011). Within the proposed flight paths and LZs, the potential impact of collisions between helicopters and endangered and threatened bird species is considered to be extremely low and thus considered a less-than-significant impact. This is because of the locations of known bird habitats, behavior of bird species in response to noise, the planned flying altitudes of the helicopters over habitats, and established flight procedures to prevent collisions (USAEC and COE 2009).

The impact of wind and dust on threatened and endangered species is insignificant because of the scattered nature of the vegetation over barren rock and the small amount of available particulate matter at LZs.

Hawaiian Hoary Bat: During these surveys, potential Hawaiian hoary bat habitat (roosting and foraging) sites were not observed (Peshut and Doratt 2011a). Noise from the helicopters could potentially disturb the Hawaiian hoary bat. However, studies on bats have indicated that bat physiology provides several mechanisms to protect their auditory systems from environmental sounds, therefore reducing the impact of noise (Delaney 2002). In addition, noise is anticipated to have no impact on the life-cycle activities of the Hawaiian hoary bat, because roosting and rearing of their young occurs within forested areas, and all LZs are essentially devoid of vegetation that would attract bats as suitable habitat (Peshut and Doratt 2011a).

Hawaiian Petrel. There are no identified active petrel breeding colonies within 2000 feet of the Mauna Kea and Mauna Loa LZs (Peshut and Schnell 2011a, 2011b). There are several conservation actions in place to manage current populations. These actions include protecting suitable habitat, controlling nonnative predatory species, determining the distribution of the populations, controlling direct mortalities, and minimizing the effects of artificial lighting (USFWS 1983). Surveys for petrels were conducted at all LZs in March and June 2011. No nesting colonies were identified, and no petrel presence was observed.(Peshut and Schnell 2011a, 2011b). Although petrels are known to transit the saddle region between the sea and nesting colonies in Hawaii Volcanoes National Park,the density of petrels in the saddle region is expected to be extremely low, based on earlier surveys. It is highly improbable that peterels would transit the summit region of Mauna Kea in favor of the lower elevations of the saddle region. The Hawaiian petrel is not expected to be affected by the Proposed Action, because birds, if disturbed, tend to temporarily leave an area when a noise event is experienced and return after the noise dissipates.

Palila. The potential impacts on the palila from planned operations include the impact of the noise from engines and rotor wash. No other direct or indirect impacts are likely to affect the palila due to the birds' range and habitat. Mitigation measures are in place to lessen the impact of the noise by maintaining an altitude of at least 2,000 ft (610 m) AGL while flying outside of the PTA and at locations near the designated LZs, as described in Subsection 2.7.

Mitigation. To reduce the impact of invasive species, measures are in place to inspect and clean equipment and helicopters if necessary to avoid the transportation of nonnative species (USAEC and COE 2009). Conservation measures to minimize the impacts of noise on endangered and threatened species include having an established flying altitude of at least 2,000 ft (610 m) AGL outside the PTA and at locations near the designated LZs. The military has an ongoing bird/aircraft strike hazard program to reduce bird/aircraft collisions, and this program would minimize the potential of collisions with endangered and threatened species (USAEC and COE 2009).

4.6.3.1.2 Alternative 2 – Mauna Kea. Alternative 2 consists of using the three LZs (4, 5, and 6) and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation. Potential impacts to endangered and threatened species are the same as those listed under Alternative 1.

Mitigation efforts for Alternative 2 should be the same conservation practices as discussed for Alternative 1.

4.6.3.1.3 Alternative 3 – Mauna Loa. Alternative 3 consists of using the three LZs (1, 2, and 3) and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation. Potential impacts to endangered and threatened species are the same as those listed under Alternative 1.

Mitigation efforts for Alternative 3 should be the same conservation practices as discussed above.

4.6.3.1.4 Conclusion. As determined by the individual analyses of fire, invasive species, noise, and collisions, the overall impact of Alternatives 1–3 to endangered and threatened species would be less than significant. Conservation measures previously described would lessen the impacts of invasive species, noise, and collisions. Impacts to endangered and threatened species are summarized in Table 4-5.

4.6.3.2 Sensitive Species. Potential impacts to sensitive species from Alternatives 1–3 are described below.

4.6.3.2.1 Alternative 1 – Mauna Kea and Mauna Loa. Alternative 1 consists of using the LZs on Mauna Kea and Mauna Loa and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation.

Table 4-5. Summary of potential impacts to threatened and endangered species.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Impacts to endangered and threatened species from helicopter-caused fire	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from nonnative species	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from noise	<SI	<SI	<SI	NI
Impacts of endangered and threatened species from aircraft collisions	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from wind from helicopters	NI	NI	NI	NI
S = Significant. S/MI = Significant but can be mitigated to less than significant. <SI = Less than significant. NI = No impact.				

Impacts to Sensitive Species. In general, wildland fire is a devastating threat to sensitive species, because fire can cause mortality and habitat loss (USAEC and COE 2009). However, not only is a potential wildland fire remote because there is sparse vegetation but also because of the unlikely event of a crash and/or the remoteness of a crash with fire (Lugo 2010). Therefore, the potential impact of sensitive species experiencing habitat loss and mortality from a wildland fire is low and thus insignificant (Peshut 2011).

The introduction of nonnative vegetation and wildlife species can have a direct and indirect impact on biological species and their habitats, because nonnative species may remove nutrient sources, prey on native species, and carry disease (USAEC and COE 2009). Potential impacts of nonnative species from planned operations include the transportation of nonnative species to the LZs from the PTA and O‘ahu. The potential for transportation of nonnative species is low and a less-than-significant impact, because of a mitigation measure that requires cleaning the aircraft. This measure would minimize the transport of nonnative species to the LZs (USAEC and COE 2009; Mansoor 2011b).

Noise in the form of rotor wash from helicopter operations potentially could impact sensitive species. The noise from helicopter training is a potential distraction to wildlife and may cause them to flee the area, interrupting life-cycle activities and modifying behavior. However, in most cases of disturbance from noise, wildlife will avoid the disturbance and then return to normal when it is over, and after repeated disturbances, wildlife become habituated to frequent noise (Whittaker and Knight 1998). It is unlikely that wildlife species will be attracted to the noise. According to the DoD operational noise manual (U.S. Army 2005b), the specific reaction to noise is dependent on the species, and the reaction of a specific species can only be known after subsequent studies. Although results from studies cannot be applied across species, studies have demonstrated that birds can become habituated and can co-exist with loud noises (U.S. Army 2011b; Delaney et al. 2000; Pater et al. 2009). Furthermore, published academic literature on the effects of noise on bird species has indicated that they are more affected by ground-based noise, such as hiking and hunting, than air-based noise (Delaney et al. 2000). Noise has no impact on vegetation species. Surveys in March 2011 to identify potential wildlife species that could be impacted by noise from helicopters were conducted within the area formed by a 2,000-ft (610-m) radius from the center of the LZ based on the 80-dBA buffer. Detailed results and methods can be found in the memorandum for record (U.S. Army 2011b). The potential impacts of noise to the sensitive wildlife species within the area were determined to be insignificant due to established measures to minimize the effects of noise and due to the nature of the species habitat and range (Peshut 2011).

Collisions of sensitive bird species with the helicopters constitute a potential impact that could cause injury or mortality to those species. Bird strikes are a possibility. Academic literature has indicated that most bird strikes happen near runways where birds tend to migrate to avoid predators and because airports present roosting and feeding areas (Burger 1983). The military records have indicated that there has only been one strike with a helicopter since 2002 (U.S Army 2011a). Many of the wildlife species' ranges are not located within the helicopter flight paths, but bird and bat species have been known to cross into the specified areas. In addition, the 2,000-ft (610-m) AGL is outside of the flight paths of many birds. In addition, it has been noted from viewing birds from helicopters in flight that birds will change their flight paths to avoid the helicopters (Peshut 2011). Within the proposed flight paths and LZs, the potential impact of collisions between helicopters and sensitive species is low and thus considered a less-than-significant impact. This is because of the locations of known bird habitats, behavior of bird species in response to noise, the planned flying altitudes of the helicopters over habitats, and established flight procedures to prevent collisions (USAEC and COE 2009).

The impact of wind and dust on sensitive species is insignificant because of the scattered nature of the vegetation over barren rock and the small amount of available particulate matter.

Nēnē. The March 2011 presence surveys did not detect any nēnē or evidence of the nēnē, but it is not unreasonable to assume that the nēnē would use suitable habitat near the Mauna Loa LZs (Peshut and Schnell 2011a). The nēnē is not expected to be affected by the planned operations because of the known response of the nēnē to noise and aircraft. In addition, helicopters are permitted to fly under 500 ft (152 m) AGL while doing maneuvers on PTA (at PTA Range 1) when nēnē are in proximity (U.S. Army 2011b).

Mitigation. To reduce the impact of invasive species, measures are in place to clean equipment and helicopters to avoid the transportation of nonnative species (USAEC and COE 2009).

4.6.3.2.2 Alternative 2 – Mauna Kea. Alternative 2 consists of using the three LZs (4, 5, and 6) and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation. Potential impacts to sensitive species are the same as those listed under Alternative 1.

Mitigation efforts for Alternative 2 should be the same conservation practices as discussed for Alternative 1.

4.6.3.2.3 Alternative 3 – Mauna Loa. Alternative 3 consists of using the three LZs (1, 2, and 3) and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation. Potential impacts to sensitive species are the same as those listed under Alternative 1.

Mitigation efforts for Alternative 3 should be the same conservation practices as discussed for Alternative 1.

4.6.3.2.4 Conclusion. As determined by the individual analyses of fire, invasive species, noise, and collisions, the overall impact of Alternatives 1–3 to sensitive species would be less than significant. Conservation measures described previously would lessen the impacts of invasive species and noise. Impacts to sensitive species are summarized in Table 4-6.

Table 4-6. Summary of potential impacts to sensitive species.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Impacts to sensitive species from helicopter-caused fire	NI	NI	NI	NI
Impacts to sensitive species from nonnative species	<SI	<SI	<SI	NI
Impacts to sensitive species from noise	<SI	<SI	<SI	NI
Impacts of sensitive species from aircraft collisions	<SI	<SI	<SI	NI
Impacts to sensitive species from wind from helicopters	NI	NI	NI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

4.6.3.3 Other Vegetation and Wildlife Species. The potential impacts to other vegetation and wildlife species from Alternatives 1–3 are described below.

4.6.3.3.1 Alternative 1 – Mauna Kea and Mauna Loa. Alternative 1 consists of using the LZs on Mauna Kea and Mauna Loa and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation.

Impacts to Vegetation and Wildlife Species. In general, wildland fire is a devastating threat to vegetation and wildlife species, because fire can cause mortality and habitat loss (USAEC and COE

2009). However, not only is a potential wildland fire remote because there is sparse vegetation but also because of the unlikely event of a crash and/or the remoteness of a crash with fire (Lugo 2010). Therefore, the potential impact on vegetation and wildlife species experiencing habitat loss and mortality from a wildland fire is less than significant (Peshut 2011).

The introduction of nonnative vegetation and wildlife species can have a direct and indirect impact on biological species and their habitats because nonnative species may remove nutrient sources, prey on native species, and carry disease (USAEC and COE 2009). Potential impacts of nonnative species from planned operations include the transportation of nonnative species to the LZs from the PTA and O‘ahu. The potential for transportation of nonnative species is low, and a less-than-significant impact, because of a mitigation measure that requires cleaning the aircraft. This measure would minimize the transport of nonnative species to the LZs (USAEC and COE 2009; Mansoor 2011b).

Noise from the helicopter operations potentially could impact wildlife species. The noise from helicopter training is a potential distraction to wildlife and may cause wildlife to flee the area, interrupting life-cycle activities and modifying behavior. However, in most cases of disturbance from noise, wildlife activities return to normal when the disturbance is over, and wildlife often adapt to the frequent noise. According to the DoD operational noise manual (U.S. Army 2005b), the specific reaction to noise is dependent on the species, and the reaction of a specific species can only be known after subsequent studies. Noise has no impact on vegetation species.

Surveys in March 2011 to identify potential wildlife species that could be impacted by noise from helicopters were conducted within the area formed by a 2,000-ft (610-m) radius from the center of the LZ based on the 80-dBA buffer. Detailed results and methods can be found in the memorandum for record (U.S. Army 2011b). The potential impacts of noise to wildlife species within the area were determined to be insignificant due to established measures to minimize the effects of noise and due to the nature of the species habitat and range (Peshut 2011).

Collisions of bird species and helicopters constitute a potential impact that could cause injury or mortality to those species. Within the proposed flight paths and LZs, the potential impact of collisions between helicopters and birds is low and thus considered a less-than-significant impact. This is because of the known habitats and responses of bird species, the planned flying altitudes of the helicopters over habitats, and established procedures to prevent collisions (USAEC and COE 2009). In addition, it has been noted from viewing birds from helicopters in flight that birds will change their flight paths to avoid the helicopters (Peshut 2011).

The impact of wind and dust on vegetation and wildlife species is insignificant because of the scattered nature of the vegetation over barren rock and the small amount of available particulate matter.

Mitigation. To reduce the impact of invasive species, measures are in place to clean equipment and helicopters to avoid the transportation of nonnative species (USAEC and COE 2009). The military has an ongoing bird/aircraft strike hazard program to reduce bird/aircraft collisions, and this program would minimize the impact of collisions with wildlife species (USAEC and COE 2009).

4.6.3.3.2 Alternative 2 – Mauna Kea. Alternative 2 consists of using the three LZs (4, 5, and 6) and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation. Potential impacts to vegetation and wildlife species are the same as those listed under Alternative 1.

Mitigation efforts for Alternative 2 should be the same conservation practices as previously discussed.

4.6.3.3.3 Alternative 3 – Mauna Loa. Alternative 3 consists of using the three LZs (1, 2, and 3) and the designated flight paths from Bradshaw Army Airfield with a 2,000-ft (610-m) AGL flying elevation. Potential impacts to vegetation and wildlife species are the same as those listed under Alternative 1.

Mitigation efforts for Alternative 2 should be the same conservation practices as discussed for Alternative 1.

4.6.3.3.4 Conclusion. As determined by the individual analyses of fire, invasive species, noise, and collisions, the overall impact of Alternatives 1–3 to would be less than significant. Conservation measures previously described would lessen the impacts of invasive species, noise, and collisions. Impacts to vegetation and wildlife species are summarized in Table 4-7.

Table 4-7. Summary of potential impacts to other vegetation and wildlife species.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Impacts to other vegetation and wildlife species from helicopter-caused fire	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from nonnative species	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from noise	<SI	<SI	<SI	NI
Impacts of other vegetation and wildlife species from aircraft collisions	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from wind from helicopters	NI	NI	NI	NI

S = Significant.
S/MI = Significant but can be mitigated to less than significant.
<SI = Less than significant.
NI = No impact.

4.6.4 Section 7 Consultation

Based on field surveys, a survey of the relevant scientific literature, supporting documents, and the conclusions presented in this EA, the Army has determined that the HAMET operations would have no effect on federally listed species or federally designated critical habitat. This determination is documented in Appendix B. This EA and supporting documents satisfy Army responsibilities under Section 7(c) of the ESA (16 USC 35 § 1531 et seq.) at this time. The Army will continue to remain aware of any change in the status of these species or critical habitat and will be prepared to reevaluate potential project impacts if necessary.

4.7 Cultural Resources / Cultural Impact Assessment

The U.S. Army is committed to the management of Hawaiian cultural resources through an active cultural resource management program. Through this program, the Army has identified, evaluated, monitored, and protected more than 350 cultural resources on Army lands in Hawaiʻi (U.S. Army 2004b, p. 3-70). Cultural resources within the ROI include cultural beliefs and practices and properties that are listed on, or are eligible for, the NRHP. The conclusions in this subsection are based on the information presented in Section 3 and on the existence, extent, and type of cultural resources within the 328-ft (100-m) APE of each LZ.

4.7.1 Impact Methodology

A literature search was conducted to gather information on cultural resources in the APE, namely the three LZs on Mauna Kea, the three LZs on Mauna Loa and 100 m from the center of each LZ. The search was conducted to determine direct, indirect, and cumulative impacts on cultural resources within the APE.

Maps, cultural resource reports, resource management plans, and past environmental documents have been examined to identify cultural resources in the APE. In addition, the Hawaiʻi State Historic Preservation Division was contacted to provide cultural resource surveys and survey results within the APE. The latter contact resulted in the identification of no new resources. In February 2011, a survey was conducted of the LZs and the area within 328 ft (100 m) of the center of each zone. However, given the large number and various types of cultural resources in University of Hawaiʻi Management Areas on Mauna Kea that are located near the LZs and on Mauna Loa, and the mountains' sacredness to Native Hawaiians, it is assumed that cultural resources, both tangible and intangible, are similar in type, importance, quantity, and variety to those that have already been identified near and within the APE. See Subsection 3.7 for more details on known and assumed cultural resources.

4.7.2 Factors Considered for Impact Analysis

Several federal laws and regulations guide the protection of cultural resources, primary among them is the NHPA (16 USC 1A § 470 et seq.), specifically Section 106. Section 106 of the NHPA requires that all federal agencies consider the impact of their actions on properties that are on, or eligible for listing on, the NRHP. Called historic properties, they would potentially include some of those that are significant for their importance to Native Hawaiian groups. An undertaking would have an effect on a historic property when that undertaking may alter the characteristics that make the property eligible for inclusion on the NRHP. Two determinations of effect can be made: (1) no historic properties affected, meaning there are either no historic properties within the ROI or there are historic properties but they would not be affected by the undertaking, or (2) historic properties affected, meaning that historic properties exist within the ROI and may be affected by the undertaking. If the latter determination is made, it is then required to determine whether the effect would be adverse. Adverse impacts include the following:

- Physical destruction, damage, or alteration of all or part of the property
- Isolation of the property or alteration of the character of the property's setting when that character contributes to the property's qualifications for the NRHP
- Introduction of visual, audible, or atmospheric elements that are out of character with the property, or changes that may alter its setting

- Neglect of a property, resulting in its deterioration or destruction
- Transfer, lease, or sale of a property without adequate provisions to protect its historic integrity.

Native Hawaiian cultural resources include cultural practices and beliefs, sacred sites, burials, and cultural items. Although they may not be eligible under NRHP criteria, they may be protected under the American Indian Religious Freedom Act (42 USC §§ 1996a, 1996b), ARPA (16 USC 1B § 470aa et seq.), or Native American Graves Protection and Repatriation Act (25 USC 32 § 3001 et seq.). Factors considered in determining whether an alternative would have a significant impact on cultural resources include the extent or degree that its implementation would result in the following:

- An adverse effect on a historic property, as defined under Section 106 of the NHPA and its implementing regulations, 36 CFR § 800
- A violation of provisions in the American Indian Religious Freedom Act, ARPA, or Native American Graves Protection and Repatriation Act.

NHPA and NEPA compliance differences, public concerns must also be considered. Opinions differ on the use of Mauna Kea for nontraditional activities such as the Proposed Action. Broadly, the public is divided into two groups, those who believe traditional and contemporary activities can co-exist and those who believe that "any disturbance of Mauna Kea by someone other than a Native Hawaiian is significant and unmitigatible…" (University of Hawaiʻi 2010, p. S-12). Additionally, Native Hawaiians have expressed concern over access to traditional and religious sites for ceremonial purposes, access for hunting and gathering, access to trails and known travel corridors, protection and preservation of archaeological and traditional sites, interpretation of significance based on Native Hawaiian tradition and the knowledge of community elders, community involvement in managing cultural resources on Army land, and compliance with federal and state laws and regulations concerning cultural-resources protection (USAEC 2008) and religious practices (University of Hawaiʻi 2009, p. 1-1). Some Native Hawaiians have also expressed concern with the cumulative impacts associated with various and multiple activities from a wide range of groups (University of Hawaiʻi 2009).

4.7.3 Consultation

In compliance with the NHPA, the Department of the Army consulted the Hawaiʻi SHPD on the Proposed Action. A letter initiating Section 106 consultation, dated October 20, 2010, was sent on October 25 to the SHPO at the Kapolei Office to request concurrence with a no-historic-properties-affected determination (Appendix B). This initiated the 30-day consult period. The Army also sent letters requesting review and comments to other consulting parties, including the NPS, Office of Hawaiian Affairs, Hawaiʻi Island Council of Hawaiian Civic Clubs, Hui Malama I Na Kupuna O Hawaʻi Nei, and the Hawaii Island Burial Council. NPS responded by expressing concern regarding traditional practitioner access and disturbance from HAMET activities (Appendix B). These latter concerns are addressed in Subsection 4.7.6.

The Proposed Action was also presented to the PTA Cultural Advisory Committee at the November 2010 meeting. No serious concerns were raised at that time. In January 2011, SHPD provided a memo in response to the EA that also covered Section 106 concerns. The Army responded with a letter dated April 15, 2011.

The Office of Mauna Kea Management and its advisory council, Kahu Ku Mauna, expressed concerns about the Proposed Action and its impacts on cultural resources and cultural practices. On February 25, 2011, Kahu Ku Mauna joined the PTA Cultural Advisory Committee for a meeting. The meeting provided a good opportunity for discussion. Lieutenant Colonel Robinson of the CAB attended and provided an overview of the training. The entire group was then invited to view a static display of helicopters and talk with crew members and instructors. Members of the PTA CAC requested a special meeting on March 11, 2011, to discuss the concerns raised particularly by OMKM and Kahu Ku Mauna, to be followed by another meeting with Kahu Ku Mauna. Lieutenant Colonel Niles assured members of Kahu Ku Mauna that their concerns would be addressed in the revised EA. Lieutenant Colonel Niles provided a digital copy of the EA comments to members of the PTA CAC. The meeting was held on March 11, 2011, at which steps being taken to address the concerns that had been raised were discussed. A follow-up meeting was held with Kahu Ku Mauna on May 11, 2011. In addition, PTA representatives met with Kealoha Pisciotta, representing Mauna Kea Anaina Hou on May 25, 2011 to discuss the proposed project and concerns regarding Mauna Kea.

4.7.4 Summary of Impacts

Potential impacts to cultural resources are summarized in Table 4-8 beginning with those related to cultural resources and followed by those related to cultural beliefs and practices.

4.7.5 Summary of Direct Impacts to Cultural Resources

A survey conducted in February 2011 of the LZs and the area within 328 ft (100 m) of the center of each zone did not discover any cultural resources directly within the LZs. Under the Action Alternatives, no landings would be planned or permitted outside of existing LZs. HAMET personnel would be provided with exact locations of all LZs to avoid the possibility of inadvertent landings that could alter or destroy known cultural resources or areas of cultural importance. No direct impacts would occur from project activities.

The February 2011 survey identified three potential cultural resources within the 328-ft (100-m) APE at the LZs. One potentially historic rock formation was located within the APE of LZ-5, and one within the APE of LZ-6. These rock formations could potentially see increased wind as a result of rotor wash from a landing helicopter. It should be noted that a rock outline located within the APE of LZ-4 was not observed during previous surveys, was constructed between 2003 and 2011, and is therefore not an historic property.

To assess the potential impact to the rock mounds near the LZs, a monitoring study was conducted between March 24, 2011, and April 4, 2011 (Crowell 2001b and c). The purpose of the monitoring was to ascertain whether HAMET has the potential to affect the rock mounds. An initial assessment of the state of the rock mounds was performed on March 24, 2011, with follow-up monitoring of the rock mounds on April 2, 2011, at the conclusion of the CAB training. The initial and the final monitoring included visual inspection of each rock mound and the immediate vicinity around each mound. Locations of photographs from the February survey were identified, and new photographs were taken from those locations to document any potential effects to the mounds. Additional photographs were taken of the remaining profiles of each rock mound in order to more fully document the mounds and to provide additional baseline data from which monitoring of potential effects may be performed. Each of the mounds was again monitored on April 2, 2011, when no additional tumbled rocks or collapse of the mounds were observed and the mounds appeared to be intact with no adverse effects from HAMET (Crowell 20011c).

Table 4-8. Summary of potential impacts to cultural resources.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Cultural resources – inadvertent landings resulting in the physical destruction, damage, or alteration of all or part of the property	NI	NI	NI	NI
Beliefs/practices – access restrictions that could isolate the property or alter the character of the property's setting when that character contributes to the property's qualifications for the NRHP	<SI	<SI	<SI	NI
Beliefs/practices – introduction of visual, audible, or atmospheric elements due to the presence of military aircraft that could impact the quality or frequency of cultural practices and beliefs. For some Native Hawaiians, any flights in the vicinity of Mauna Kea or Mauna Loa will be perceived as causing significant impacts. However, alternative design features and mitigations lessen the level of significance.	<SI	<SI	<SI	NI

Table 4-8. (continued).

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Beliefs/practices – introduction of visual, audible, or atmospheric elements due to the presence of military aircraft that could impact the quality or frequency of cultural practices and beliefs. Native Hawaiians who believe that cultural practices can exist along side secular activities will see that compliance with regulations and careful planning and implementation can ensure less-than-significant impacts to the culturally significant lands.	<SI	<SI	<SI	NI
S = Significant. S/MI = Significant but can be mitigated to less than significant. <SI = Less than significant. NI = No impact.				

4.7.5.1 Alternative 1 – Mauna Kea and Mauna Loa. Alternative 1 proposes using the LZs on Mauna Kea and Mauna Loa, the flight corridor over the PCH, and the projected flight path from Bradshaw Army Airfield to the LZs for helicopter training. The following determinations are made with a general knowledge that cultural resources and culturally important areas exist outside of the LZs and within the ROI, and the assumption that flight paths may cross over all or part of them:

- Mauna Loa LZ-1: Field survey determined that no cultural resources would be directly affected within the LZ.
- Mauna Loa LZ-2: Field survey determined that no cultural resources would be directly affected within the LZ.
- Mauna Loa LZ-3: Field survey determined that no cultural resources would be directly affected within the LZ (Appendix B).
- Mauna Kea LZ-4: Field survey determined that no cultural resources would be directly affected within the LZ (Appendix B). A potential historic property (State of Hawaiʻi Site #50-10-22-24004) located approximately 0.5 mile (1 kilometer) southwest of LZ-4 would be avoided and, therefore, would not be directly affected (Godby and Head 2003).
- Mauna Kea LZ-5: Field survey determined that no cultural resources would be directly affected within the LZ (Appendix B). The rock enclosure (Site #50-10-22-24004) described above that lies just to the southwest of LZ-5 would be avoided and, therefore, would not be directly affected (Godby and Head 2003). Of the two rock mounds identified during the February 2011 PTA survey, one is located within the 328-ft (100-m) APE. As stated in Subsection 4.7.5, these rock mounds will not be impacted by increased winds due to rotor wash from landing HAMET helicopters.

- Mauna Kea LZ-6: Archaeological survey determined that no cultural resources would be directly affected within the LZ (Appendix B). A potential historic property (State of Hawaiʻi Site #50-10-22-24004) located approximately 0.5 mile (1 kilometer) west of LZ-6 would be avoided and, therefore, would not be directly affected (Godby and Head 2003). One rock mound has been identified within the 328-ft (100-m) APE. As stated in Subsection 4.7.5, these rock mounds will not be impacted by increased winds due to rotor wash from landing HAMET helicopters.

- Flight paths: The Mauna Kea LZs are located in the *lana* or least restricted and sacred area of the mountain. Additionally, flight paths would be planned to avoid the majority of known cultural resources. No direct impacts to cultural resources or culturally important areas would result from the use of flight paths over this area (see Subsection 4.7.6 for indirect impact discussion). The training would be infrequent and temporary.

4.7.5.2 Alternative 2 – Mauna Kea. See Subsection 4.7.5.1 for LZs 4–6 and the flight corridor. No historic properties were identified at any of the three Mauna Kea LZs. The flight corridor is a consideration under this alternative; however, the LZs are located in the *lana* or least restricted and sacred area on the mountain. Additionally, flight paths would be planned to avoid the majority of cultural resources and areas identified as culturally significant.

4.7.5.3 Alternative 3 – Mauna Loa. See Subsection 4.7.5.1 for LZs 1–3. No archaeological resources were identified at any of the three Mauna Loa LZs. The flight path would not be a consideration under this alternative.

4.7.6 Summary of Indirect Impacts

Indirect and cumulative impacts may occur for all alternatives except the No Action Alternative. Indirect and cumulative impacts to the quality and frequency of cultural beliefs and practices could occur from access restrictions by practitioners to culturally important resources. However, access would not be restricted in areas that are flown over and would only be restricted near LZs where and when training activities would be planned. In addition, indirect and cumulative impacts may occur from the introduction of audible and visual elements by military aircraft. Introduction of such elements could result in the alteration of the character of all or part of historic properties and/or culturally important properties, including the potentially NRHP-eligible Mauna Kea TCP.

Indirect and cumulative impacts are rendered less than significant through the following:

- Flights would avoid known cultural resources. Air routes have been adjusted to approach from the west and to remain 2 miles (3.2 kilometers) away from the National Historic Landmark and the traditional cultural properties. Noise modeling showed insignificant impacts. Modeling results are presented in Subsection 4.11. Modeling results indicate that areas surrounding the flight path will be at or below Zone I levels (less than 65dB). As defined by the Army 220-1 Regulations (U.S. Army 2007a), Zone I levels are compatible with activities such as residences, schools, medical facilities, and cultural activities.

- As detailed in Subsection 4.11, cultural practitioners may experience and perceive noise as a distraction/annoyance under all Action Alternatives. However, the extent and magnitude of the distraction would be dependent on the distance the practitioner is from the noise source (HAMET flight) at any point in time during HAMET flights. Modeled average noise levels were compatible with current recreational land uses, as outlined in Army Regulation 200-1 (U.S. Army 2007a). In addition to modeled noise levels, a noise level study was conducted during training activities in March and April 2011. The results are discussed further in Subsection 4.11. In keeping with these results, noise from HAMET flights would be expected to be of short duration and should not obstruct or curtail practitioner activities Potential impacts to practitioners would be mitigated through public notification of the HAMET schedule. With mitigation, the potential impacts to practitioners would be minimized to levels that are less than significant.

- Surveys of LZs revealed no historic properties to alter or destroy

- Cultural awareness training will be completed by all HAMET personnel, with particular emphasis on intangible resources and their importance to Native Hawaiians.

- The training will be of short duration and sporadic and temporary by its nature. There is no modification to the existing landscape of Mauna Kea or Mauna Loa. Therefore the project will not change the inherent qualities of the mountains that make them significant cultural places for Native Hawaiians.

As discussed in Section 4.12, cultural practitioners at Lake Waiau and the Mauna Kea summit would not be impacted visually under any of the Action Alternatives. At other locations, practitioners may see helicopters in the area depending on the alternative chosen and where the cultural practitioner is located at the time. However, HAMET flights would be of short duration and would not result in obstructing the cultural practitioners' views or practices.

For some Native Hawaiians, any flights in the vicinity of Mauna Kea or Mauna Loa will be perceived as causing significant impacts; however, those Native Hawaiians who believe that cultural practices can exist along side with secular activities will see that compliance with regulations and careful planning and implementation can ensure less-than-significant impacts to the culturally significant lands. Alternative design features have been developed to ensure that the cultural impacts will be less than significant. The project has been designed such that access to culturally significant areas will not be restricted at any point during the project, and no flights will occur during cultural holidays, as defined in Section 2. Mitigation efforts to ensure that impacts are less than significant include providing cultural awareness training for all HAMET personnel, with particular emphasis on intangible resources and their importance to Native Hawaiians.

4.8 Socioeconomics and Environmental Justice

4.8.1 Methodology

Socioeconomics includes sociological and economic conditions such as demographics, regional employment and economic activity, housing, schools, medical facilities, shops and services, and recreation facilities. The project would result in a significant impact if it substantially affects the economic or social welfare of the community or state. Therefore, a significant socioeconomic impact would occur if the project adversely affected the revenue, employment, or overall economic conditions of the island community or the state as a whole.

Environmental justice focuses on the distribution of race and poverty status in areas potentially affected by implementation of a Proposed Action. "Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 32) directs each federal agency to identify and address any disproportionately adverse environmental effects of its activities on minority and low-income populations. The impact analysis presents projected conditions under the Action Alternatives, including the No Action Alternative. Potential disproportionate effects on low-income or minority populations and the potential for increased adverse health effects on children are also assessed to identify environmental justice effects. "Executive Order 13045 – Protection of Children from Environmental Health Risks and Safety Risks" (62 FR 78) requires federal agencies to assess activities that have disproportionate environmental health effects on children.

4.8.2 Factors Considered for Impact Analysis

Factors considered in determining whether an alternative would have a significant impact on socioeconomics and environmental justice include the extent or degree to which its implementation would:

- Affect the unemployment rate for the county
- Change total income
- Change business volume
- Affect the local housing market and vacancy rates, particularly with respect to the availability of affordable housing
- Change any social, economic, physical, environmental, or health conditions in such a way as to disproportionately affect any particular low-income or minority group; or disproportionately endanger children.

4.8.3 Summary of Impacts

The impact analysis presents projected conditions under the Action Alternatives, including the No Action Alternative. Potential disproportionate effects on low-income or minority populations and the potential for increased adverse health effects on children are also assessed to identify environmental justice effects.

The impact analysis identifies and describes the potential project impacts on the ROI population, employment, income, business volume, and schools. The potential socioeconomics and environmental justice impacts are presented in the following subsections and summarized in Table 4-9.

4.8.4 Alternative 1 – Mauna Kea and Mauna Loa

Implementation of Alternative 1 would not affect any of the sociological and economic conditions. Implementation of Alternative 1 would also not affect children, because there are no schools or permanent family housing facilities in the area. Implementation of Alternative 1 would not change conditions associated with environmental justice.

4.8.5 Alternative 2 – Mauna Kea

The conditions associated with Alternative 2 are the same as stated above; there would be no impact to sociological, economic, environmental justice, or environmental health effects on children for this alternative.

4.8.6 Alternative 3 – Mauna Loa

The conditions associated with Alternative 3 are the same as stated above; there would be no impact to sociological, economic, environmental justice, or environmental health effects on children for this alternative.

Table 4-9. Summary of potential impacts to socioeconomics and environmental justice.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Economic development	NI	NI	NI	NI
Protection of children	NI	NI	NI	NI
Environmental justice	NI	NI	NI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

4.9 Land Use

4.9.1 Impact Methodology

This subsection evaluates impacts on land use, as described in Section 3. Land use includes activities that are being carried out on the land in and around the ROI and the designation of land as determined in local, state, and federal land use policies. This subsection also describes the methods and significance criteria used to assess the level of impact and then describes the impacts from the Action Alternatives.

Impacts on land use were assessed based on the consistency of project activities with state and local plans and on compatibility with land uses in and near to the ROI.

4.9.2 Factors Considered for Determining Significance of Impacts

An action would be considered to have a significant impact on land use if it would do any of the following:

- Curtails the range of beneficial uses of the environment
- Involves substantial secondary impacts, such as population changes or effects on public facilities
- Conflicts with existing or planned land uses on or around the site
- Conflicts, or is incompatible, with the objectives, policies, or guidance of state and local land use plans
- Conflicts, or is incompatible, with administrative or special designations.

4.9.3 Summary of Impacts

The Proposed Action does not involve acquiring land or rezoning land for use, and, as such, the Proposed Action and the use of the LZs would not result in any changes of current or planned land uses or zonings as delineated by the *County of Hawai‘i General Plan* (County of Hawai‘i 2005). For the same reasons, HAMET use of the LZs would not curtail the range of beneficial uses of the environment; would not result in substantial secondary impacts, such as increases or decreases in population changes or effects upon public facilities; and would not be in conflict with the objectives, policies, or guidance of state and local land use plans.

As discussed in Section 3, general features for which an NNL designation is considered for an area include rarity, diversity, and value for science and education. The specific features for which Mauna Kea was designated as an NNL include:

- Being the highest insular mountain (rising to an elevation of 13,796 ft [4,200 m] above sea level) in the United States
- Having the highest lake (Lake Waiau at 13,030 ft [3,971 m] above sea level) in the country
- Possessing evidence of glaciations above the 11,000-ft (3,353-m) level.

Mauna Kea is one of the best examples of a type of biotic community or geologic feature in its biophysiographic providence. HAMET activities would not compromise or disturb the illustrative value or condition of the features for which Mauna Kea was designated NNL status. Thus, the Proposed Action does not impact any of the criteria with regard to Mauna Kea's NNL designation, and implementing HAMET would have no impact on NNL designation. The potential impacts to land use are shown in Table 4-10.

Table 4-10. Summary of potential impacts to land use

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Curtails the range of beneficial uses of the environment	NI	NI	NI	NI
Involves substantial secondary impacts, such as population changes or effects on public facilities	NI	NI	NI	NI
Conflicts with existing or planned land uses on or around the site	NI	NI	NI	NI
Conflicts, or is incompatible, with the objectives, policies, or guidance of state and local land use plans	NI	NI	NI	NI
Conflicts, or is incompatible with, special land use designations (i.e., NNL status for Mauna Kea)	NI	NI	NI	NI
S = Significant. S/MI = Significant but can be mitigated to less than significant. <SI = Less than significant. NI = No impact.				

4.10 Recreation

This subsection evaluates impacts on recreational use, as described in Section 3. Recreational use includes activities that are being carried out on the land in the Proposed Action area. This subsection also describes the methods and significance criteria used to assess the level of impact on recreational use and then describes the impacts from the Action Alternatives.

4.10.1 Impact Methodology

Impacts on recreational resources were assessed by determining the types of recreational uses in and around the ROI and then determining the sensitivity of those uses to the short- and long-term project effects, such as noise and visual disturbance and access and recreational restrictions.

4.10.2 Factors Considered for Determining Significance of Impacts

An action would be considered to have a significant impact on recreation if it would do any of the following:

- Curtails the range of recreational uses of the environment
- Substantially affects scenic vistas and view planes
- Disrupts recreational use of land-based resources, such as parks or recreational paths, or interferes with the public's right of access
- Prevents long-term recreational use or use during a peak season or impedes or discourages existing recreational activities.

4.10.3 Summary of Impacts

Recreational activities occur in the areas described in Section 3. Dispersed recreational activities may occur near or at the LZs; however, the LZs are not normally destinations for recreational activities. While HAMET use of LZs would not be compatible with concurrent recreational uses of an LZ, HAMET use of the LZs would not curtail the range of recreational uses of the surrounding areas that currently occur. As detailed in Section 3.11, Noise, recreationists may experience and perceive noise as a distraction/annoyance under all Action Alternatives. However, the extent and magnitude of the distraction would be dependent on the distance the recreationist is from the noise source (HAMET flight) at any point in time during HAMET flights. Modeled average noise levels were found to be compatible with current recreational land uses as outlined in Army Regulation 200-1 (U.S. Army 2007a). In addition to modeled noise levels, a noise level study was conducted during training activities in March and April 2011 and is discussed further in Subsection 4.11. In keeping with these results, noise from HAMET flights would be expected to be of short duration and should not obstruct or curtail recreation activities. Recreational trails or activities in the ROI would not be closed or modified as a result of noise introduced through implementation of any of the Action Alternatives. Additionally, the public right of access to any recreation areas would not be modified. Thus, it is not anticipated that any of the Action Alternatives would significantly impact or result in the cessation of any recreational activities or access to them, including Mauna Loa Observatory Access Road, Saddle Road, and Mauna Kea Summit Access Road. The helicopter overflights may also introduce aesthetic disturbances that may be perceived as a distraction by people in the immediate area. As discussed in the view plane analysis in Section 4.12, Visual and Aesthetic Resources, recreationists at Lake Waiau and the Mauna Kea summit would not be impacted visually under any of the Action Alternatives. At other locations, recreationists may see helicopters in the area depending on the alternative chosen and where the recreationist is located at the time. However, HAMET flights would be of short duration and would not result in obstructing recreationists' views.

Potential impacts to recreation would be mitigated through public notification of the HAMET training schedule. With mitigation, the potential impacts to recreation, shown in Table 4-11, would be minimized to levels that are less than significant.

Table 4-11. Summary of potential impacts to recreational use.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Curtails the range of recreational uses of the environment	NI	NI	NI	NI
Substantially affects scenic vistas and view planes	<SI	<SI	<SI	NI
Disrupts recreational use of land-based resources, such as parks or recreational paths, or interferes with the public's right of access	<SI	<SI	<SI	NI
Prevents long-term recreational use or use during a peak season or impedes or discourages existing recreational activities	<SI	<SI	<SI	NI

S = Significant.
S/MI = Significant but can be mitigated to less than significant.
<SI = Less than significant.
NI = No impact.

4.11 Noise

Noise associated with proposed training operations has the potential to impact various land uses and wildlife in the ROI. Modeled average noise levels (DNLs) and maximum noise levels were used in accordance with Army Regulation 200-1 (U.S. Army 2007a) to assess effects of helicopter noise on land uses and wildlife in the area. The conclusions in this subsection are based on the information presented in Section 3, noise modeling results, and maximum noise levels.

4.11.1 Impact Methodology

Noise emissions from helicopter training operations associated with the Action Alternatives on current land uses have been evaluated using the DoD's NoiseMap noise model. NoiseMap uses aircraft-specific sound hemispheres generated from flyover measurement studies in conjunction with acoustical research conducted by the Air Force Research Laboratory's Aural Displays and Bioacoustics Branch to model noise due to helicopter operations (U.S. Army 2010d).

Modeling was performed assuming a conservative flight frequency of 60 flights per day during both daytime (0700 to 2200 hours) and nighttime hours (2200 to 0700 hours), 45 days per year, by the CH-47 Chinook. The CH-47 Chinook was used for both modeling purposes and maximum noise levels, because it is the loudest helicopter in terms of maximum decibel levels of the helicopters to be used for training activities and therefore represents a worst-case scenario.

Noise monitoring was performed during the March 2011 data collection and training period conducted at the three Mauna Kea LZs in March and April 2011. Noise measurements were collected at areas of concern to assess baseline noise levels associated HAMET activities. Sound-level meters were placed at each of the following locations:

1. Under the flight path in the PCH

2. Under the flight path in the PCH farther northeast and upslope on Mauna Kea

3. Near the Na Ala Hele trails within the PCH and northwest of the LZs

4. Near the summit of Puʻu Poliʻahu (Mauna Kea)

5. Near the boundary of the Ice Age NAR

6. Near Lake Waiau.

These sample locations are shown on Figure 4-4. The sound-level meters at each location collected average, maximum, and minimum noise levels continuously during the 2-week training period. Results of this sampling effort are discussed in the following subsections.

4.11.1.1 Noise Measurements and Effects. Noise is expressed and analyzed as follows:

- Units of measurement. The unit of measurement used in sound measurement is the decibel (dB), which is usually reported on an A-weighted (dBA), a C-weighted (dBC), or a linear (dBL) scale. The A-weighted scale most closely represents the response of the human ear to sound. The term “noise level” is used interchangeably with “sound level.”

- Common metrics. Two noise metrics commonly used to assess impacts of noise are the day-night average sound level (DNL) and the maximum sound level (L_{max}).

  – *DNL.* Most federal community noise guidelines in the United States are based on the DNL (Berger et al. 2003). The DNL represents energy-averaged sound levels measured by summation and averaging of sound exposure level values during a 24-hour period. A penalty of 10 dB is assigned to noise events occurring between 10 p.m. and 7 a.m. to compensate for generally lower background noise levels and increased annoyance associated with events occurring at night. For this assessment, modeling parameters included a daytime flight frequency of 42 flights and a nighttime flight frequency of 18 flights. The DoD, FAA, and Department of Housing and Urban Development use a DNL of 65 dBA as their regulatory goal in assessing acceptable noise levels in and near residential areas (Berger et al. 2003). For assessing long-term average sound levels near airports with frequently occurring sound events, the DNL is usually calculated using a 365-day year averaging period. However, use of the 365-day averaging period in areas where sound events are intermittent may dilute the DNL (Berger et al. 2003). To account for seasonal variation in noise levels resulting from intermittent training operations, the

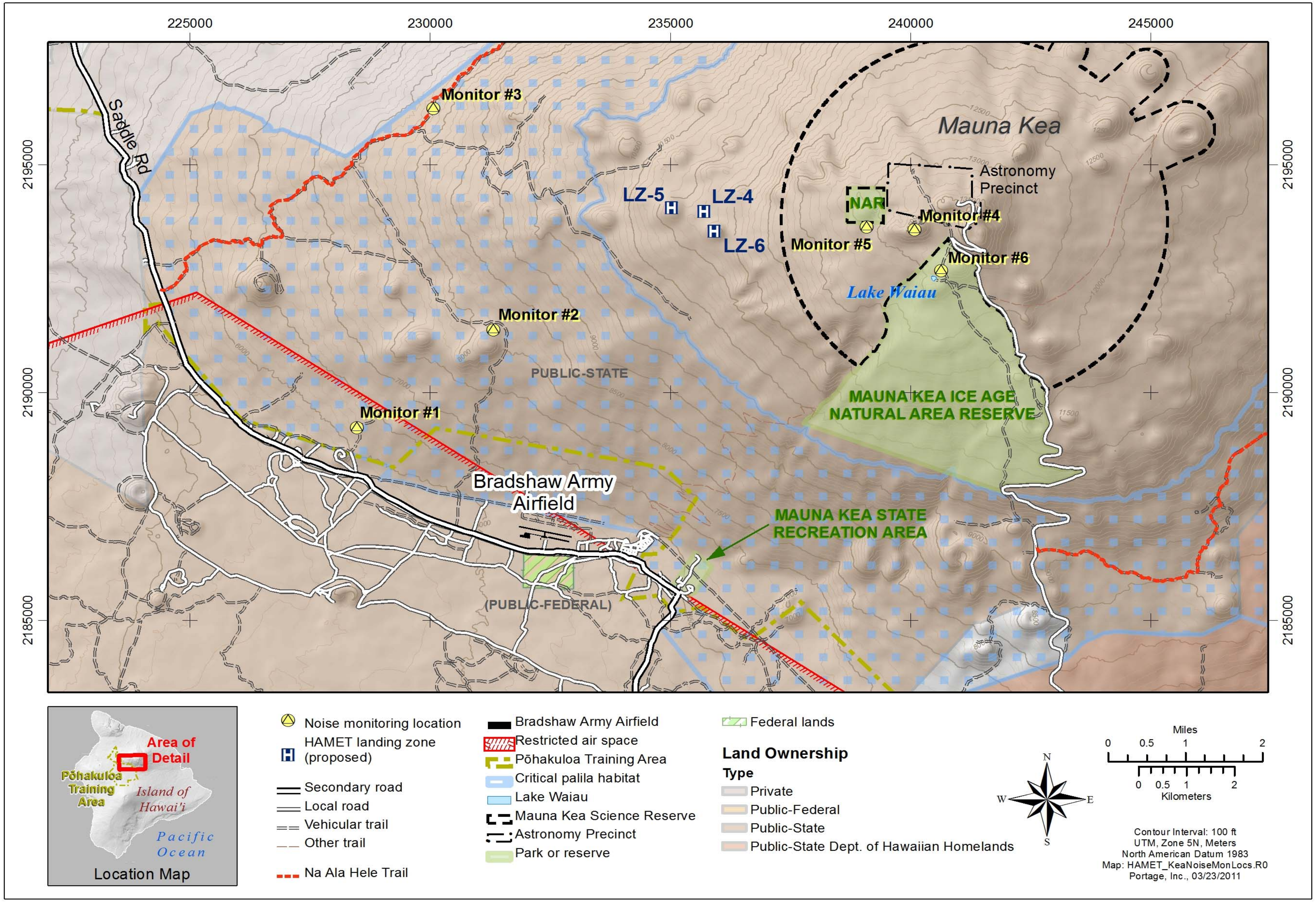

Figure 4-4. Noise monitoring sample locations for March – April 2011 sampling effort.

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Army may use shorter averaging periods to more accurately represent average noise levels (U.S. Army 2005b). An averaging period of 45 days was used in this EA to calculate DNLs resulting from HAMET operations and corresponds to the actual proposed number of flying days per year.

– L_{max}. The maximum sound level of a noise source is useful in anticipating impacts on wildlife. Maximum sound levels are used in conjunction with the proximity and duration of the noise source to examine potential effects on wildlife (NoiseQuest 2011).

- Metric noise from transportation sources. Noise from transportation sources, such as vehicles and aircraft, and from continuous sources, such as generators, is assessed using the A-weighted DNL (ADNL). The ADNL significantly reduces the measured pressure level for low-frequency sounds while slightly increasing the measured pressure level for some high-frequency sounds.

The maximum noise levels for military helicopters to be used for HAMET are listed in Table 4-12. The CH-47 Chinook is the loudest of these helicopters.

Table 4-12. Maximum sound level by aircraft (dBA).[a]

Slant Distance (ft)[b]	CH-47 (Chinook)	UH-60 (Black Hawk)
200 (60 m)	98	91
500 (152.4 m)	89	83
1,000 (304.8 m)	83	76
2,000 (609.6 m)	77	69

a. Source: U.S. Army (2010c).

b. The slant distance is the distance between the helicopter and a lateral point on the ground.

These levels can be compared to the percentage of the population likely to be annoyed by particular noise levels to determine potential annoyance due to helicopter operations (Table 4-13). Annoyance associated with transient noise sources such as helicopters is dependent on both the noise level and duration. The annoyance levels in Table 4-13 were developed using respondents exposed to more than 50 flights per day; therefore, annoyance levels due to HAMET operations may vary based on the actual number of flights per day (U.S. Army 2010c).

Table 4-13. Population annoyance percentages due to aircraft noise.

Maximum Noise Level (dBA)	Percentage Highly Annoyed
70	5
75	13
80	20
85	28
90	35

a. Source: U.S. Army (2010c).

Chapter 14 of Army Regulation 200-1 (U.S. Army 2007a) states the primary means of assessing military noise should be to use DoD noise assessment software and the primary metric should be the DNL. In accordance with this regulation, NoiseMap noise modeling software was used in assessing noise impacts from proposed HAMET activities. NoiseMap is the official DoD computer model for assessing fixed-wing and rotorcraft noise. The program uses aircraft-specific acoustical data in conjunction with topography, atmospheric data, flight frequency, time of day, flight track, and flight profile information to develop DNL ground noise contours. The farthest extent for each ground noise contour represents an accurate picture of the potential noise impact on current land uses in the ROI.

Army Regulation 200-1 (U.S. Army 2007a) also specifies that potential impacts of noise on wildlife shall be assessed through studies "…on individual species' response or a surrogate response to noise." In accordance with this approach, published studies on wildlife responses to helicopter noise were utilized in assessing potential effects on wildlife due to training operations.

4.11.1.2 Additional Parameters. In addition, the parameters listed below were used in each flight path during noise modeling.

- The minimum flight altitude for all HAMET helicopter operations is 2,000 ft (610 m) AGL when departing from PTA and enroute to the release point (RP). At the RP, aircrews begin descending directly to one of the three LZs on either Mauna Kea or Mauna Loa. Flights around the LZ area will be conducted at 500 ft (152 m) AGL, and, once a final approach is established, a controlled descent will be made to the designated LZ.

- Upon departure from each LZ, the aircrew will climb to a minimum altitude of 2,000 ft (610 m) AGL prior to reaching the outbound checkpoint and will remain at or above this altitude until back inside the PTA property line.

- Inside the PTA property line, helicopter aircrews will maintain altitudes of 500 ft (152 m) AGL or less unless otherwise approved in accordance with PTA standard operating procedures (U.S. Army 2008).

Modeled DNL noise contours were aligned with current recreational and cultural land use locations. The resulting land use and associated DNL were then compared to the LUPZs discussed in Subsection 3.11.1 to determine the impact of training operations on current land uses. Figures 4-5 and 4-6 show modeled noise contours in relation to recreational areas, and Figures 4-7 through 4-9 show contours in relation to cultural areas.

Maximum noise levels were compared to current wildlife habitat locations to determine noise levels wildlife may be exposed to during training activities. Figure 4-9 shows flight path locations in relation to PCH, the Kipuka ʻAinahou Nēnē Sanctuary, and ʻakiapolaʻau and ʻio habitats. The duration of maximum noise levels was also considered, because this affects wildlife responses (NoiseQuest 2011).

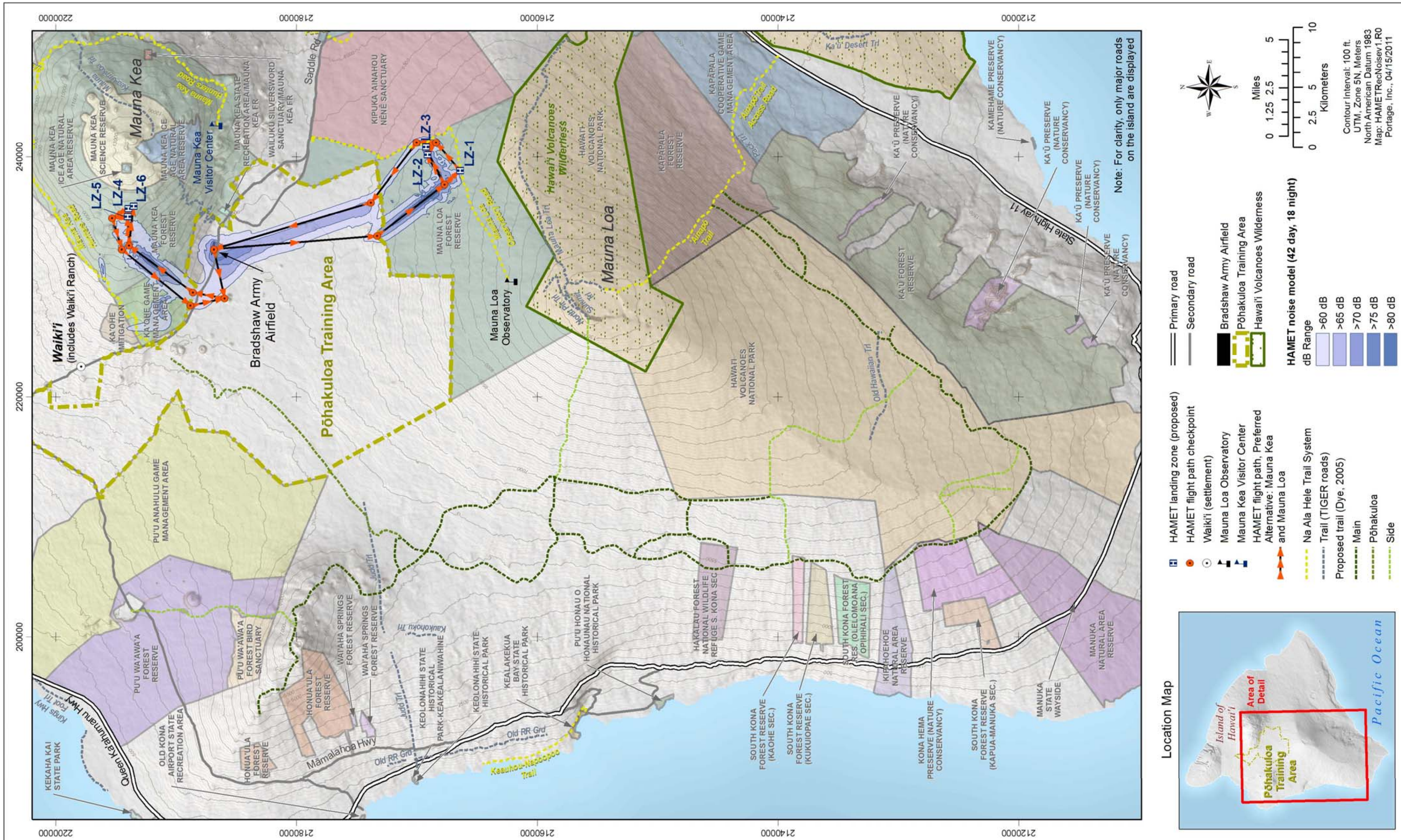

Figure 4-5. Modeled DNL noise contours in relation to recreational resources within and surrounding the Proposed Action/Alternatives area.

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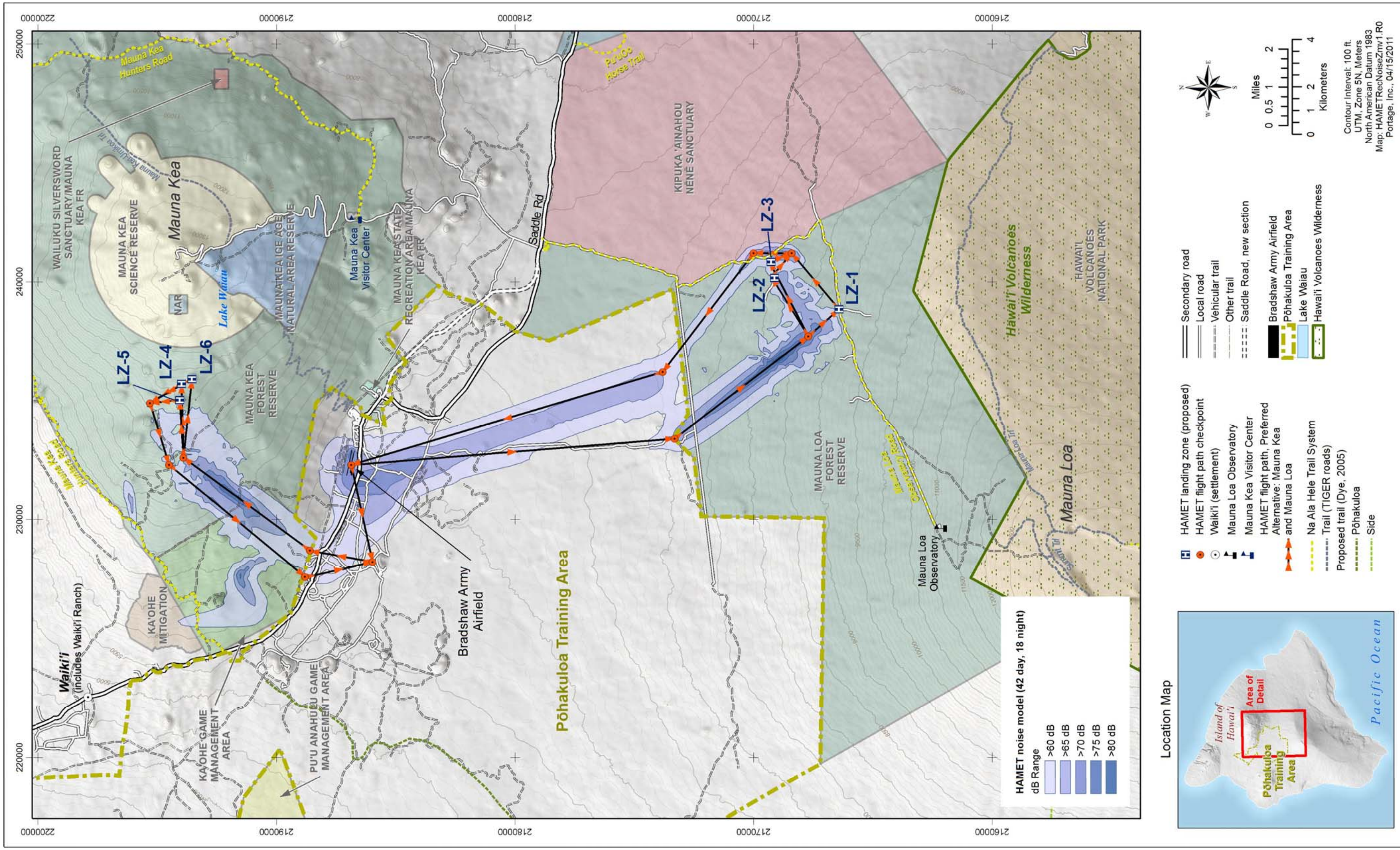

Figure 4-6. Closer view of modeled DNL noise contours in relation to recreational resources within and surrounding the Proposed Action/Alternatives area.

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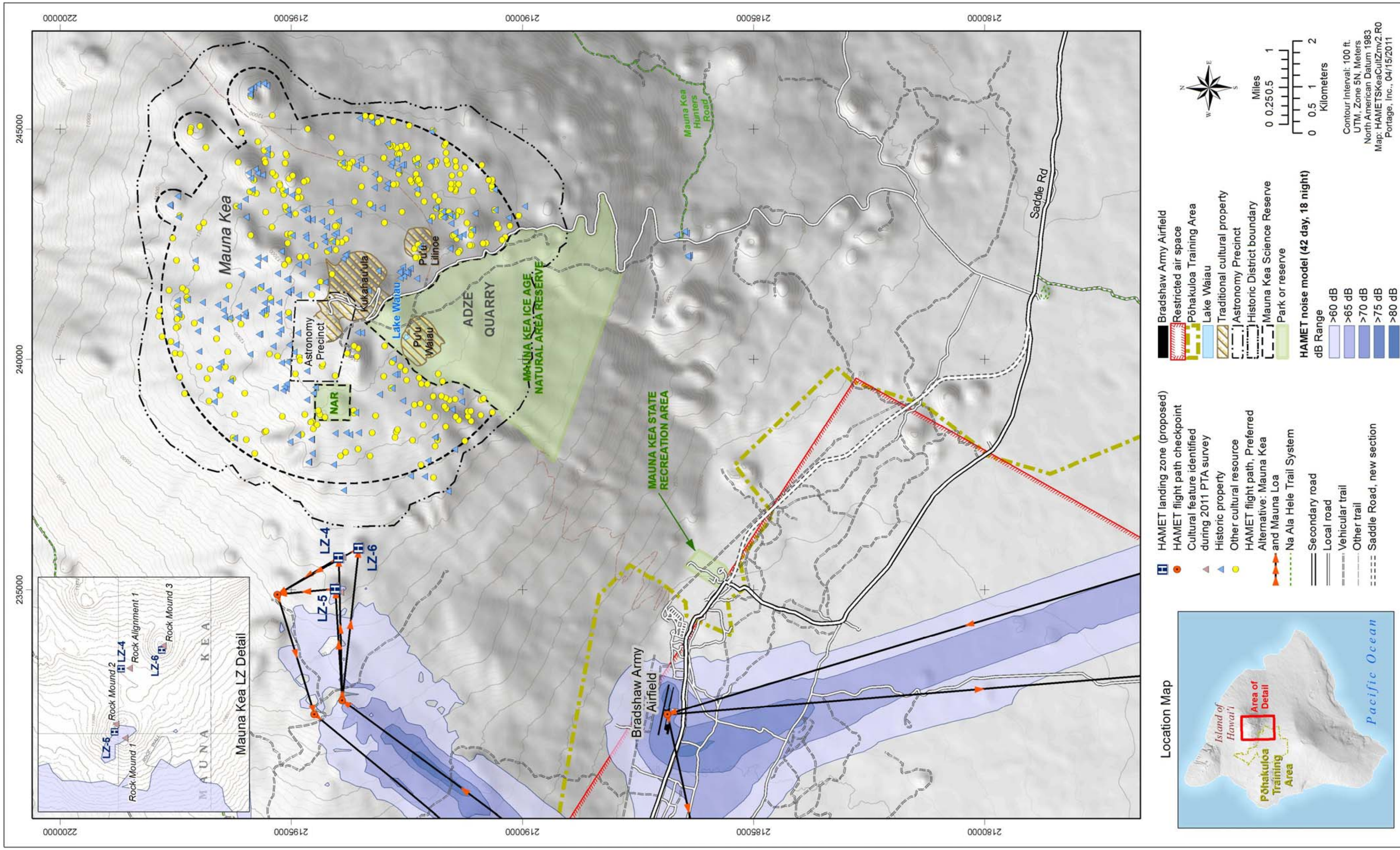

Figure 4-7. Modeled DNL noise contours in relation to Mauna Kea.

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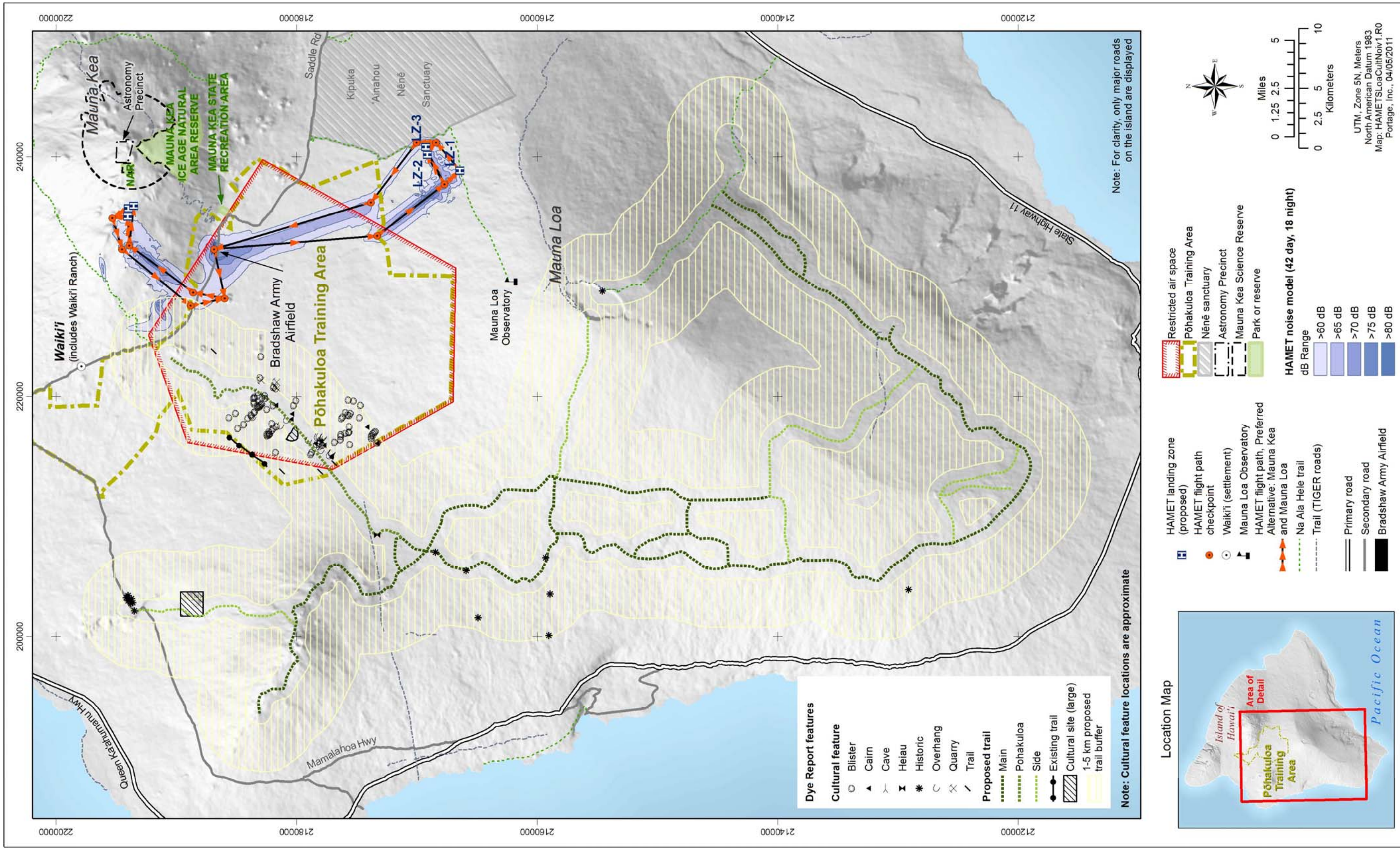

Figure 4-8. Modeled DNL noise contours in relation to cultural resources of the Proposed Action/Alternatives area with emphasis on the Mauna Loa LZs.

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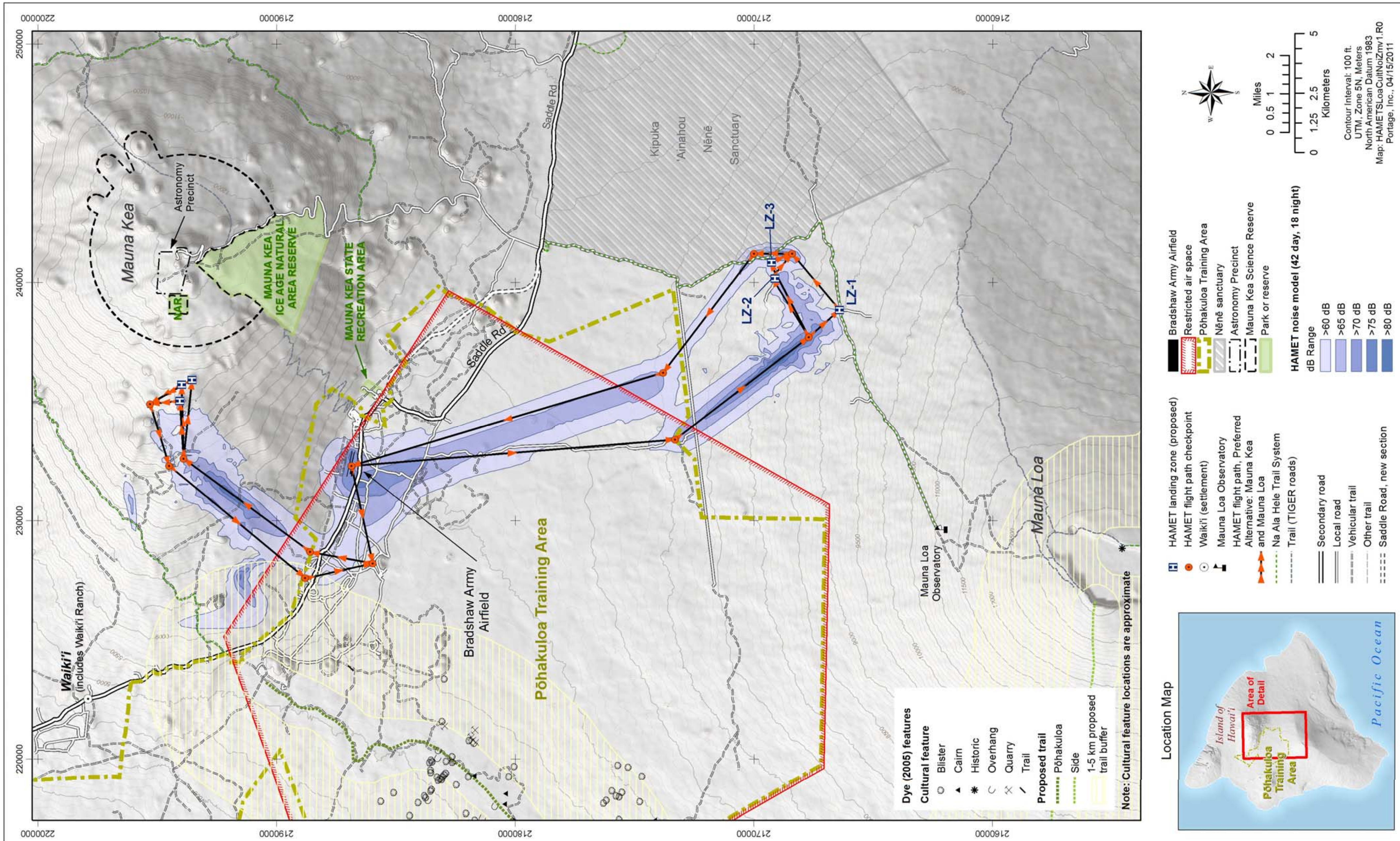

Figure 4-9. Closer view of modeled DNL noise contours in relation to cultural resources surrounding Mauna Loa LZs.

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4.11.2 Factors Considered for Impact Analysis

Factors considered in determining whether an alternative would have a significant impact on noise include the extent or degree to which its implementation would do the following:

- Exceed noise zone thresholds listed in the SONMP (U.S. Army 2010c) for current land uses in the ROI

- Affect wildlife in the ROI as outlined in Subsection 4.6 based on existing information on effects of helicopter noise on birds.

4.11.3 Summary of Impacts

Modeled noise levels resulting from the Proposed Action are compatible with existing land uses in the ROI; therefore, the impact on humans is considered less than significant. Potential impacts of noise on wildlife within the ROI, including threatened and endangered species, are considered less than significant due to the nature of the species habitat and range as well as established conservation measures (Peshut 2011). The potential impacts are discussed in the following subsections and summarized in Table 4-14.

Table 4-14. Summary of potential impacts from noise.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Rotary wing aircraft noise to humans	<SI	<SI	<SI	NI
Rotary wing aircraft noise to wildlife	<SI	<SI	<SI	NI
S = Significant. S/MI = Significant but can be mitigated to less than significant. <SI = Less than significant. NI = No impact.				

As previously mentioned, in addition to using modeled noise contours and maximum noise levels to assess impacts from noise associated with helicopter flights for Army training activities, a noise level study was conducted in March and April 2011 to provide additional information on the baseline noise conditions and noise associated with Army helicopter training activities. Preliminary results from this study showed that maximum noise levels observed on days when training was conducted were similar to those observed on days when training was not conducted.

Noise data were collected from March 19, 2011, through April 2, 2011. During this period, HAMET activities were conducted with the UH-60 Black Hawk on March 21 through 24 and March 28 through 31, 2011. One CH-47 Chinook flight also occurred on March 29, 2011. Flight paths followed the proposed HAMET flight paths to the three Mauna Kea LZs. Maximum noise levels on days when HAMET training activities were conducted (herein referred to as “flying days”) ranged from 82 to 104 dBA. Maximum noise levels on days when HAMET training activities did not occur (herein referred to as “non-flying days”) ranged from 82.3 to 102.1 dBA. Figure 4-10 shows the maximum noise level at each sample location for flying days and non-flying days. As the figure shows, maximum noise levels on

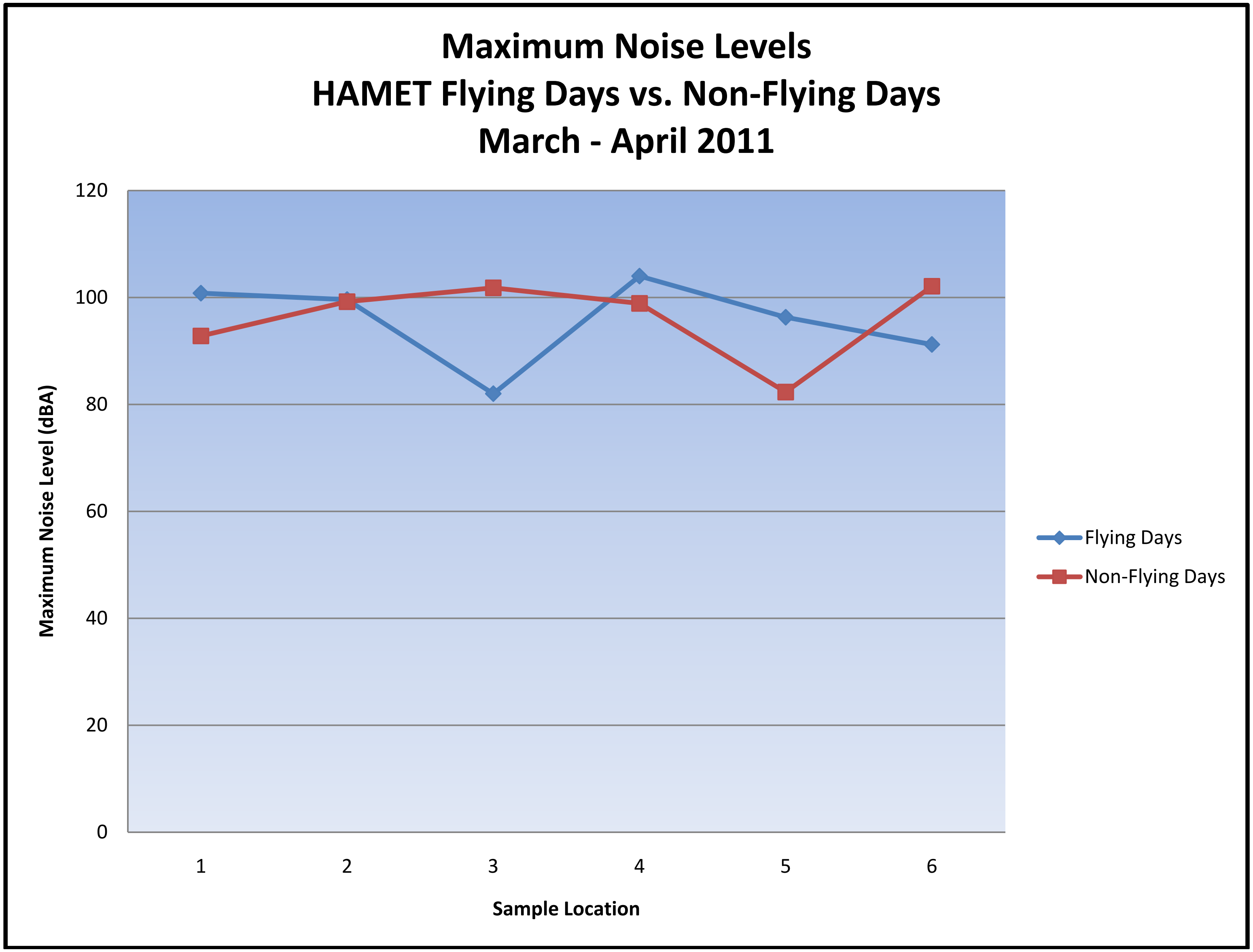

Figure 4-10. Maximum noise levels for HAMET flying days versus non-flying days.

flying days are similar to non-flying days; therefore, this preliminary assessment indicates HAMET activities do not significantly alter the existing maximum noise levels at each sample location.

4.11.3.1 Land Use Compatibility. Impacts on land use from noise associated with the Proposed Action are discussed below.

4.11.3.1.1 Alternative 1 – Mauna Kea and Mauna Loa. Modeled average noise levels (DNLs) in training areas leading to and including the Mauna Kea and Mauna Loa LZs due to helicopter training operations would likely result in noise contours above 65 dBA covering approximately 13 square miles (33.7 square kilometers) of land within the PTA property boundary, the Mauna Kea Forest Reserve, and the Mauna Loa Forest Reserve. As shown in the noise contour in Figures 4-5 through 4-9, and particularly on Figure 4-6, LUPZ/Zone I noise contours (60–65 dBA) generally lie within areas less than 1 mile (1.6 kilometers) from the training flight paths. Zone II (65–75 dBA) and Zone III (>75 dBA) noise contours exist directly under proposed flight paths; the cumulative area covered by Zone III noise contours is less than one-half square mile (less than 1.3 square kilometers). There is also one area with Zone I, II, and III noise contours approximately 2 miles (3.2 kilometers) west of the Mauna Kea outbound flight corridor. These contours lie within the Kaohe GMA as well as the 0.6–3.1 mile (1–5 kilometer) trail buffer for the proposed Pōhakuloa Trail. DNL noise contours above 60 dBA do not extend into other areas.

As shown on Figures 4-5 through 4-9, noise contours do not surround the Mauna Kea LZs. This likely results from a combination of the topography on Mauna Kea as well as the use of average noise levels to develop noise contours. Average noise levels are higher in areas common to all flight paths to each mountain, such as the portion of the flight path between PTA and the RP for each mountain. Once the flight paths diverge at the RP to travel to individual LZs, average noise levels decrease. This results in lower noise contours surrounding the individual LZs; in the case of the Mauna Kea LZs, average noise levels in the vicinity of the LZs are below the LUPZ/Zone I noise levels.

As discussed in Subsection 3.11 of this EA, Zone I noise levels are compatible with noise-sensitive uses such as residences and cultural activities, Zone II noise levels are compatible with activities such as resource protection, and Zone III noise levels are compatible with forestry-related activities, provided there are no residential buildings in the area (U.S. Army 2010c). Based on these land use planning guidelines, projected noise levels from proposed training exercises are compatible with current land uses in these areas. Therefore, impacts on humans due to training operations are considered less than significant.

4.11.3.1.2 Alternative 2 – Mauna Kea. As discussed previously, the impact of using LZs on Mauna Kea is considered less than significant for humans.

4.11.3.1.3 Alternative 3 – Mauna Loa. As discussed previously, the impact of using LZs on Mauna Loa is considered less than significant for humans.

4.11.3.2 Wildlife. Impacts on wildlife from noise associated with the Proposed Action are discussed below.

4.11.3.2.1 Alternative 1 – Mauna Kea and Mauna Loa. Maximum noise levels for the CH-47 Chinook and the UH-60 Black Hawk are listed in Table 4-12. As previously discussed, the CH-47 Chinook was used to assess maximum noise levels, because it is the loudest of the helicopters to be used for training purposes.

Flight paths to the LZs on Mauna Kea travel directly over PCH and ‘akiapola‘au habitat (Figures 3-12 and 3-13, respectively). The LZs on Mauna Loa lie within ‘io habitat, and the flight path for the Mauna Loa LZs extends approximately 1,640 ft (500 m) into the Kipuka ‘Ainahou Nēnē Sanctuary (Figures 3-11 and 3-14, respectively). The impact of noise on the listed endangered and threatened species, sensitive species, and other wildlife species is a concern throughout the ROI. The noise from helicopter training is a distraction to wildlife and may cause them to flee the area, which would interrupt life-cycle activities and result in behavior modification. Results from surveys conducted in March 2011 (Army 2011a) to identify potential wildlife species that may be impacted near the LZs are discussed further in Subsection 4.6. Research performed by the USFWS determined that some territorial songbirds exhibited reduced reproduction after exposure to low-altitude overflights (NoiseQuest 2011). However, conservation measures include maintaining a minimum altitude of 2,000 ft (610 m) AGL while enroute to all LZs, which includes those areas over the PCH and ‘akiapola‘au habitat, as described in Subsection 2.7.

At a slant distance of 2,000 ft (610 m), the maximum noise level of the CH-47 Chinook is 77 dBA; this noise level is comparable to a garbage disposal at a distance of 3 ft (1 m) (Berger et al. 2003). The duration maximum noise levels would be in the range of seconds, depending on the speed of the aircraft, with noise levels rising above background, peaking at approximately 77 dBA when the aircraft is directly overhead, and fading back to background levels. A study performed by Delaney et al. (2000) examined the responses of the red-cockaded woodpecker to military training events, including helicopters. Sound exposure levels for helicopter flights included in the study ranged from 72 to 88 dBA. The study showed that the proximity of the noise source and the noise level affected the frequency of flushing from nesting cavities. However, in all cases, the woodpeckers returned to their nests relatively quickly and a decline in reproduction was not noted (Delaney et al. 2000). Although results from studies cannot be applied across species, studies have demonstrated that birds can become habituated and co-exist with loud noises (U.S. Army 2011b; Delaney et al. 2000; Pater et al. 2009). In addition, academic literature on the effects of noise on bird species has indicated they are more affected by ground-based noise, such as hiking and hunting, than air-based noise (Delaney et al. 2000). Therefore, the impact of noise on wildlife, including threatened and endangered species, is less than significant due to the nature of the species habitat and range as well as established conservation measures (Peshut 2011).

4.11.3.3 Alternative 2 – Mauna Kea. As discussed previously, the impact of using LZs on Mauna Kea is considered less than significant for wildlife.

4.11.3.4 Alternative 3 – Mauna Loa. As discussed previously, the impact of using LZs on Mauna Loa is considered less than significant for wildlife.

4.12 Visual and Aesthetic Resources

4.12.1 Impact Methodology

A literature search was conducted to gather information on visual and aesthetic resources in the ROI, inclusive of the entire island of Hawai‘i. The search determined that the people that view the island of Hawai‘i can be described as residents, sightseers, and cultural practitioners, each with a different expectation of their visual experience. Sixteen representative view points were identified for Mauna Loa and Mauna Kea and were considered visually significant to the three viewer groups. Table 4-15 provides a listing of theses viewpoints.

Table 4-15. Representative view points.

Viewpoint	Location	Description	Viewer Group
1	Lake Waiau	Small lake near the summit of Mauna Kea that is accessible by trail and used for healing and worship practices.	Cultural practitioners
2	Pu‘u Poli‘ahu	Cinder cone on west side of Mauna Kea summit, home to Poli‘ahu, the Hawaiian snow goddess of Mauna Kea.	Cultural practitioners Sightseers
3	Mauna Kea summit	Highest point on Mauna Kea. Recognized as a sacred place to Native Hawaiians.	Cultural practitioners
4	Ice Age NAR	State reserve on the south summit flank of Mauna Kea and includes two rare communities: an aeolian desert and the state’s only alpine lake.	Cultural practitioners
5	Pu‘u Wa‘awa‘a	Summit of cinder cone that is of cultural importance to Native Hawaiians.	Cultural practitioners
6	Mauna Loa summit	Highest point on Mauna Loa and recognized as a sacred place to Native Hawaiians.	Cultural practitioners Sightseers
7	North Ridge of Mauna Kea Summit	Ridge north of the observatories on near the summit of Mauna Kea.	Sightseers
8	Mauna Kea Access Road	Road from Saddle Road to the Mauna Kea observatories.	Sightseers
9	Mauna Loa Trail	Trail from near Kilauea crater to the summit of Mauna Loa.	Sightseers
10	Mauna Loa Observatory	NOAA atmospheric research facility.	Sightseers
11	Saddle Road, State Highway 200	Road that traverses the island from Hilo to its junction with Hawai‘i Route 190.	Sightseers Residents
12	Kawaihae Harbor	Harbor northwest of Mauna Kea.	Cultural practitioners Sightseers

Table 4-15. (continued).

Viewpoint	Location	Description	Viewer Group
13	Department of Hawaiian Home Lands Waikoloa-Waialeale	Along old Manalahoa Highway through ranchlands.	Residents
14	Mauna Loa Observatory Road	Road from Highway 200 to the Mauna Loa Observatory.	Sightseers
15	Waiki‘i Ranch	3,000-acre ranch consisting of 10-, 20-, and 40-acre residential lots.	Residents
16	Mauna Kea State Recreation Area	20-acre state park used for picnicking, camping, lodging, and viewing.	Sightseers

With these points, viewsheds were calculated using the Spatial Analyst Observer Points tool in ESRI ArcMap 10 SP1. To define the existing conditions, a flight path around the perimeter of PTA and on a grid across PTA was used with helicopters flying at 2,000 ft (610 m) AGL. This provides a map of where current helicopter activities at PTA potentially could be seen from across the island. For the alternatives, the conditions used for the analyses were based on the alternative description, including the flight path (+/- 500 m) at 2,000 ft (610 m) AGL, an area inclusive of 3,280 ft (1,000 m) from the center point of the LZs and a 6-ft tall viewer. The viewsheds were then mapped and the maps analyzed.

4.12.2 Factors Considered for Determining Significance of Impacts

Factors considered in determining whether an alternative would have a significant impact on visual resources include the extent or degree to which its implementation would do the following:

- Introduce physical features that are substantially out of character with adjacent developed areas
- Alter a site so that a sensitive viewing point or vista is obstructed or adversely affected, or if the scale or degree of change appears as a substantial, obvious, or disharmonious modification of the overall view
- Be inconsistent with the visual resource policies of the *County of Hawai‘i General Plan* (County of Hawai‘i 2005).

4.12.3 Summary of Impacts

To evaluate the potential that an aircraft could be seen during its HAMET flight, viewsheds were calculated as previously described. Figure 4-11 illustrates the results of the analysis for the baseline conditions, i.e., the current potential visibility of training flights within the PTA boundary. Figures 4-12 through 4-14 illustrate the results of the analysis for Alternatives 1, 2, and 3, respectively. The areas highlighted in yellow are the locations where unobstructed views exist when near-ideal atmospheric

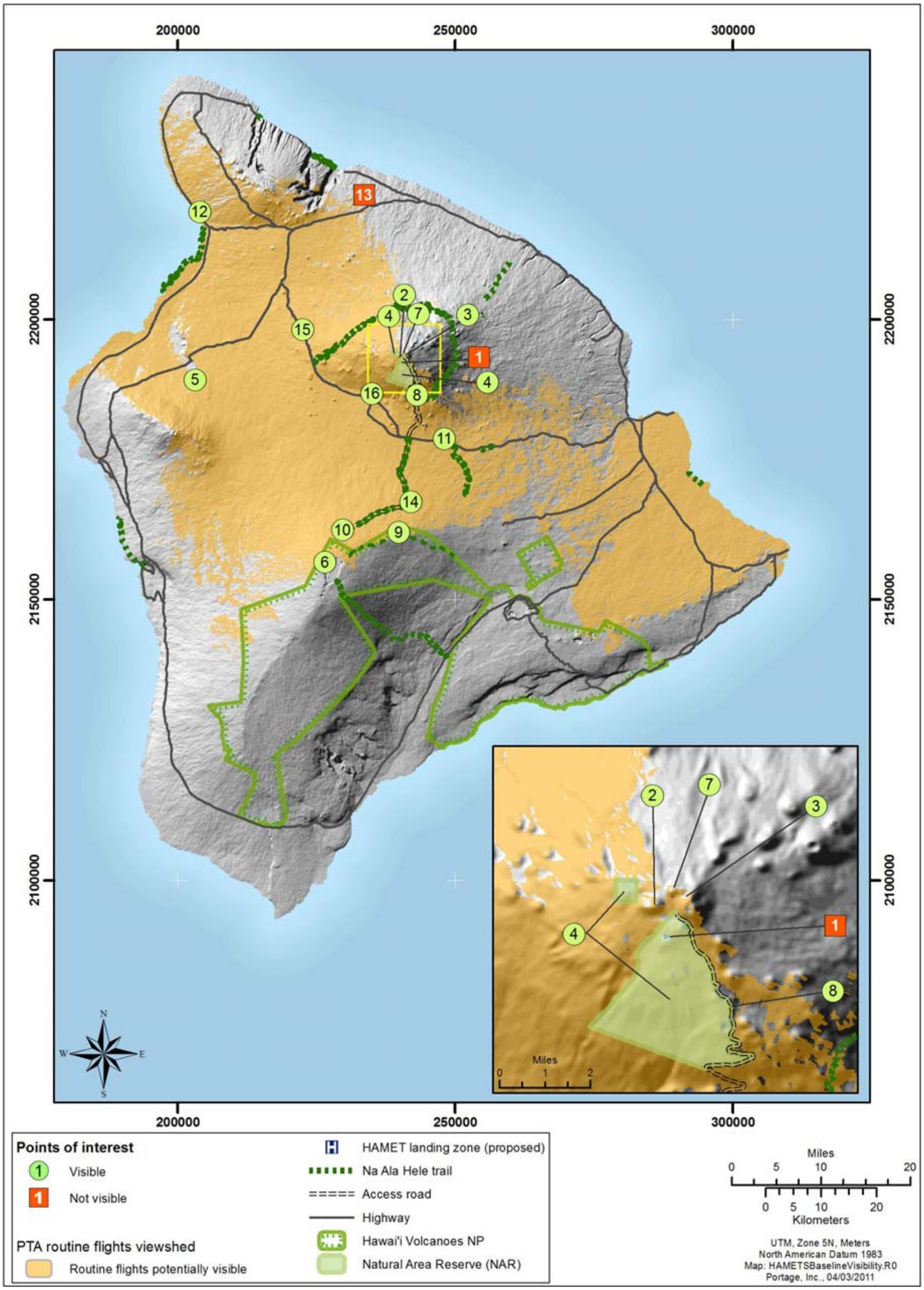

Figure 4-11. View plane analysis of the existing conditions.

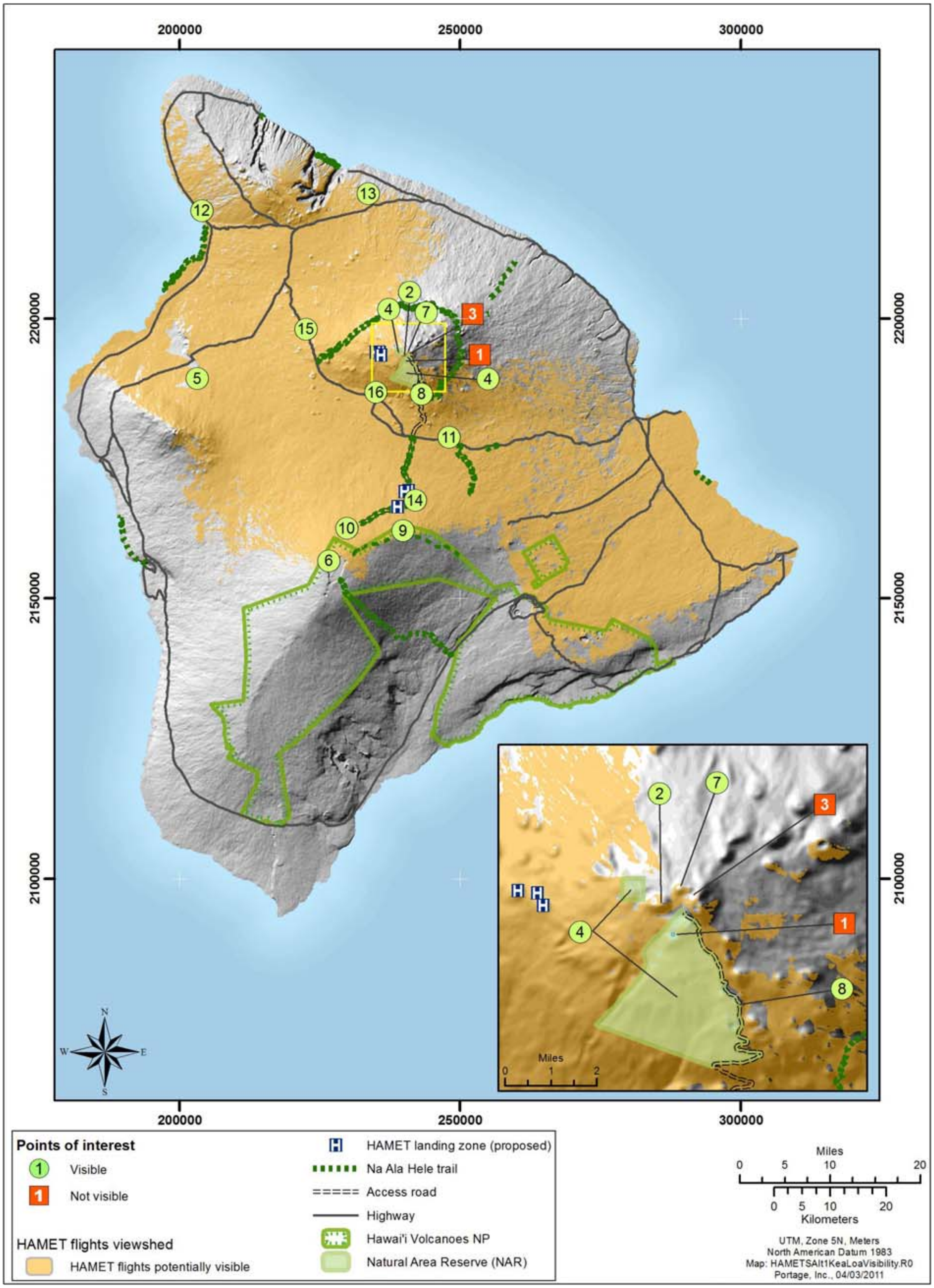

Figure 4-12. View plane analysis of Alternative 1 (Preferred Alternative) – Mauna Kea/Mauna Loa.

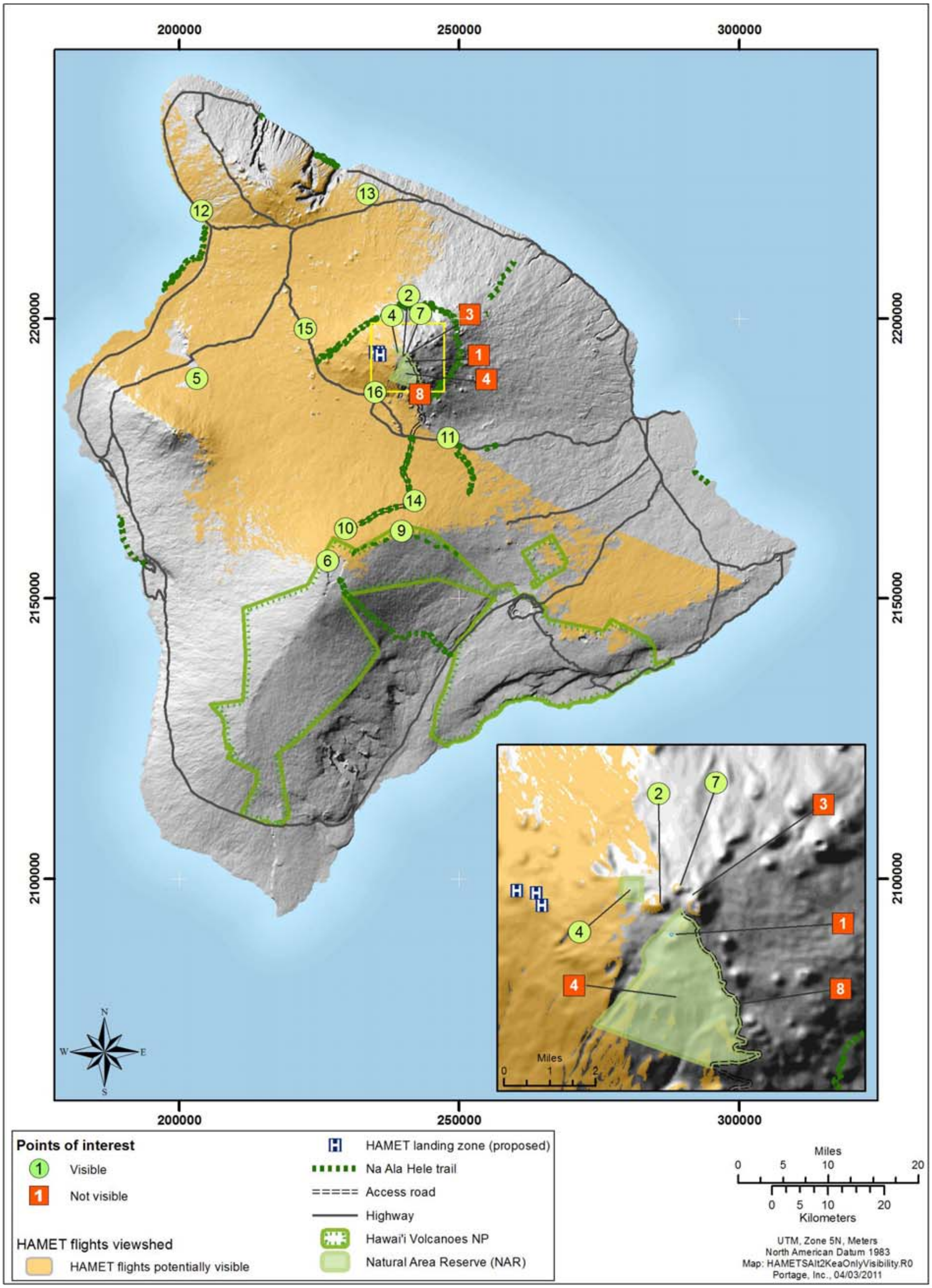

Figure 4-13. View plane analysis of Alternative 2 – Mauna Kea.

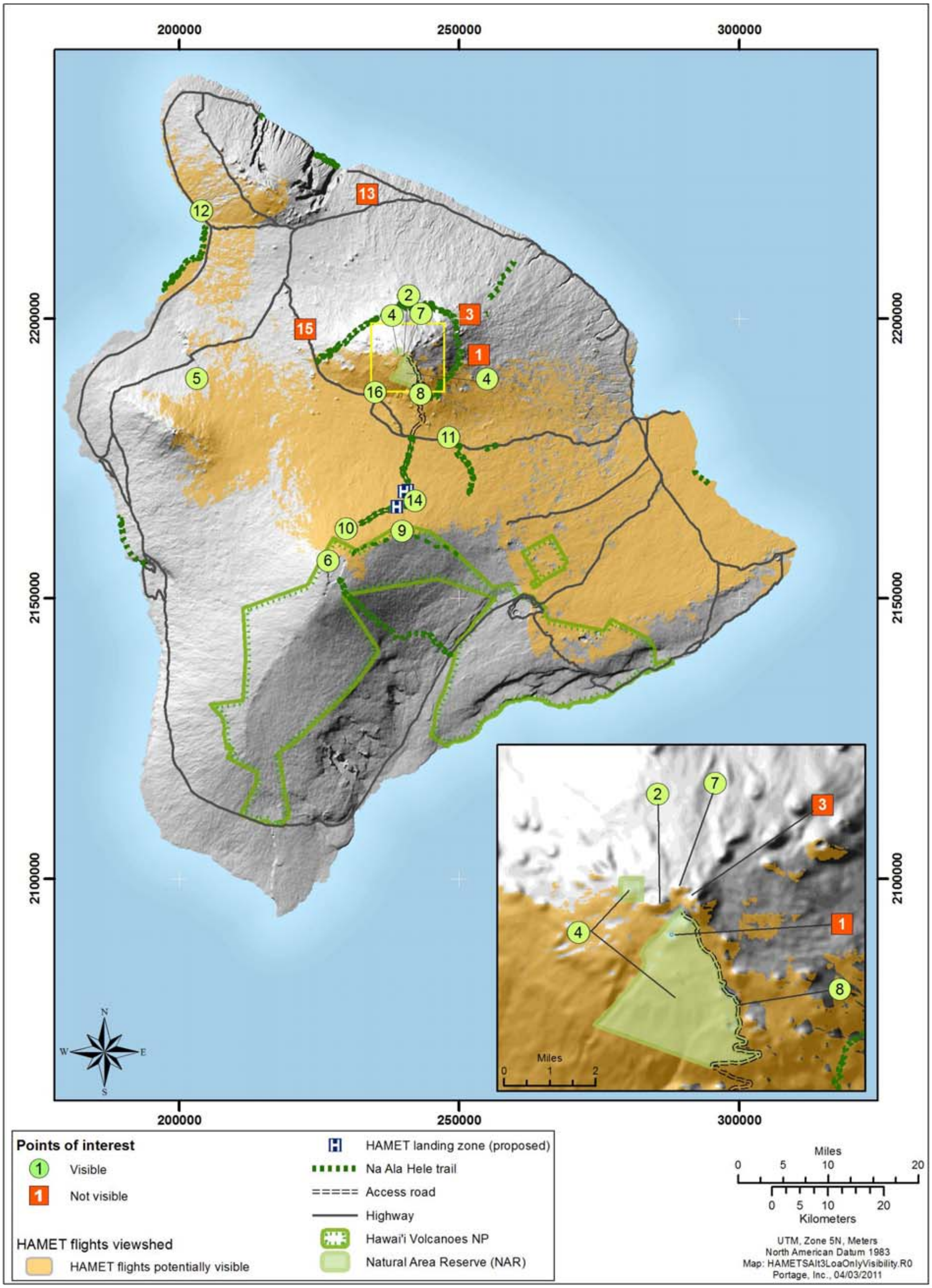

Figure 4-14. View plane analysis of Alternative 3 – Mauna Loa.

conditions occur. The numbers show the locations of the viewpoints identified in Table 4-15. For example, from Lake Waiau (Location 1), helicopters conducting HAMET would not be visible for any of the alternatives. However, a viewer from the Waiki‘i Ranch at Location 15 would not be able to see an aircraft conducting HAMET in Alternative 3 but would be able to see HAMET aircraft under Alternatives 1 and 2. Clouds, haze, trees, etc., would limit the ability to see an aircraft from many of the distant locations.

In addition to conducting a view plain analysis, photographs were taken from a vantage point on Pu‘u Poli‘ahu during the March 2011 HAMET. Figure 4-15 is a photograph of a Black Hawk helicopter as it approaches LZ-4. As can be seen in the photograph, the helicopter, at its nearest location to the viewer, is barely visible and only for a short time as it passes out of view.

Figure 4-15. Black Hawk helicopter flying to LZ and viewed from Pu‘u Poli‘ahu.

The view plain analysis shows that under ideal conditions, the potential this of a viewer to see a helicopter during HAMET from most locations is possible. However, as seen in the example photograph from the March 2011 data collection training period (Figure 4-15), it is highly unlikely that a viewer would be able to see an aircraft, unless the viewer was very near vicinity of the flight path. In addition, those sightings would be short term. For all alternatives, aircraft are not visible for the highly sensitive areas of Lake Waiau and the summit of Mauna Kea. Additionally, based on photographs, HAMET flights would be unlikely to obstruct the view of natural beauty sites within the Hamakua and North Hilo planning districts.

The visual character and quality of the areas defined by the Action Alternatives, including the proposed LZs, would not be impacted, because the Action Alternatives would not change basic land use or require any alterations to the LZs. The visual sensitivity of these areas would have less-than-significant impacts, because the areas are not identified as areas of high scenic quality (i.e., designated scenic corridors or locations) and are not readily accessible to, or used by, large numbers of people. In addition, air-quality impacts to visibility are less than significant, intermittent, and of short duration. Therefore, any impacts to visual and aesthetic resources are less than significant. The potential impacts are summarized in Table 4-16.

Table 4-16. Summary of potential impacts to visual resources.

Impact Issue	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Disturbance to visual sensitivity from rotary-wing aircraft	<SI	<SI	<SI	NI
Disturbance to landscape from rotary-wing aircraft	<SI	<SI	<SI	NI
Obstruct views of natural beauty sites	NI	NI	NI	NI
S = Significant. S/MI = Significant but can be mitigated to less than significant. <SI = Less than significant. NI = No impact.				

4.13 Human Health and Safety Hazards

Numerous federal, state, and local laws regulate the storage, use, recycling, disposal, and transportation of hazardous materials and waste. There are similar laws to prevent and abate wildfires, and the primary goal of these laws is to protect human health and safety.

Multiple LZ areas have been identified to use for high-altitude landing training activities. The environmental features and operation activities for each LZ are similar to each other, and there is no distinction between one LZ and the others for the human-health and safety-hazards discussion. Potential impacts are discussed in following subsections and summarized in Table 4-17.

There is a potential increase in human hazards to any people in the immediate vicinity of the LZ only during actual approach and landing maneuvers as part of HAMET operations.

4.13.1 Landing Zone Safety

This subsection identifies potential LZ safety impacts that may result from implementing the Action Alternatives. The pilots requiring HAMET are experienced pilots for the aircraft type being flown.

4.13.1.1 Impact Methodology. An impact is identified when the proposed training maneuvers increase the risk to human health and safety. Numerous procedures and training requirements are in place to prevent interaction of the public with military personnel during training. The primary goal of these procedures and training requirements is to protect human health and safety.

Table 4-17. Summary of potential human health and safety hazards impacts.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
LZ safety	<SI	<SI	<SI	NI
Hazardous material	NI	NI	NI	NI
Wildfires	< SI	<SI	<SI	NI
Accident/incident investigation and recovery	< SI	< SI	< SI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

4.13.1.2 Factors Considered for Determining Significance of Impacts. Factors considered in determining whether an alternative would have a significant impact on human health or are similar across all LZs and thus all Action Alternatives. The only hazards of consideration are when HAMET flights are being conducted. The general experience of the pilots as well as their qualifications as a proficient pilot of each aircraft type being flown are factors in determining the significance of impacts. The identified hazards during high-altitude training activities include the following:

- Noise
- Flying debris
- High elevation
- Risk of wildfire
- Operations in high wind
- Operations in extreme temperatures
- Operations at night or during low visibility
- Mechanical/moving parts.

During periods of training activities, military personnel follow standard safety procedures and practices that minimize the risks for the public. Standard procedures and practices include the following:

- Public notification of PTA training activities
- Specified mission objectives
- Mission-specific training
- Pilot and crew briefings

- Standard military safety protocol
- Equipment inspections
- GPS tracking systems
- Aircraft equipped with ABC fire extinguishers
- Mechanical shielding and operator training
- Hearing and eye protection
- Fall protection measures
- Go-around authority.

The Army's Public Affairs Office would notify the public about dates, times, and areas (possibly to include maps) that would be affected by training activities. For HAMET flights, the 25th CAB prepares the actual press release, which would be released to media outlets such as, but not limited to, newspapers, radio stations, and television stations. Press releases would possibly be re-posted by recipients to other locations, such as hunter check stations.

Regardless, it is possible that nonmilitary personnel or wildlife could be in the general area of HAMET flights. The hazards to nonmilitary personnel or wildlife in the vicinity of LZs during HAMET flights would be mitigated by the pilot conducting a reconnaissance flyover prior to conducting any HAMET maneuvers. During the reconnaissance flyover, pilots would visually inspect the LZ to ensure landing would not create an unreasonable risk to human health or safety. This procedural step would ensure that unauthorized personnel or wildlife are not exposed to the hazards associated with the training exercises.

The LZs are located such that obstructions and hazards to human health and safety and to biological species are minimized. Due to the geography and elevation of the proposed LZs, little vegetation exists in the immediate area, and wildlife is expected to be minimal. LZs for all alternatives are not located in areas where the public would be expected. Any obstructions that exist within the LZ would be associated with the LZ surface itself, such as a hole or depression, and would be clearly identified in mission plans such that pilots would be made aware of the obstructions before HAMET flights commence. Based on the methodology and factors considered, there is a less-than-significant impact to LZ safety for all Action Alternatives.

4.13.1.3 Summary of Impacts. Based on the methodology and factors considered, there is a less-than-significant impact to LZ safety for all Action Alternatives. The Action Alternatives will not be conducted if interaction with persons or wildlife in an LZ while HAMET maneuvers are being performed is suspected. Army training procedures as well as standard operational and emergency procedures minimize any impact to human health and safety in the LZ during HAMET.

4.13.2 Hazardous Material

This subsection identifies potential hazardous material and waste impacts that may result from implementing the proposed alternatives. Depleted uranium or other radiological materials will not be transported onboard aircraft participating in HAMET. In addition, aircraft are not allowed to land or conduct ground disturbance in any radiological-controlled area. Therefore, there will be no transport of radiological particulates to the LZs. The impact analysis compares projected conditions to the affected environment and ROI described in Subsection 3.13.

4.13.2.1 Impact Methodology. Numerous federal, state, and local laws regulate the storage, use, recycling, disposal, and transportation of hazardous materials and waste. The primary goal of these laws is to protect human health and the environment. The methods for assessing potential hazardous material and waste impacts generally include the following:

- Reviewing and evaluating each of the alternatives to identify the action's potential to use hazardous or toxic substances or to generate hazardous waste, based on the activities proposed

- Comparing the location of proposed training activities with baseline data on known or potentially contaminated areas (e.g., land contaminated with unexploded ordnance)

- Assessing the compliance of each alternative with applicable site-specific hazardous material and waste management plans

- Assessing the compliance of each alternative with applicable site-specific standard operating procedures and with health and safety plans in order to avoid potential hazards

- Using professional judgment to determine whether any additional known or suspected potential hazardous material and waste impacts or concerns relate to each alternative.

4.13.2.2 Factors Considered for Determining Significance of Impacts. Regulatory standards and guidelines have been applied to determine the significance of each alternative's potential impact related to hazardous materials and waste. Factors considered in determining whether an alternative would have a significant safety hazard or hazardous-material and waste impact include the extent or degree to which its implementation would result in the following:

- Cause a spill or release of a hazardous substance, as defined by 40 CFR § 302 (CERCLA) or 40 CFR §§ 110, 112, 116, and 117 (Clean Water Act)

- Expose the environment or public to any hazardous substance through release or disposal (i.e., open-burn/open-detonation disposal of unused ordnance)

- Generate either hazardous waste or acutely hazardous waste, resulting in increased regulatory requirements over the long term or violating the standards established for the conditionally exempt small-quantity generators and the small-quantity generators

- Endanger the public or environment during the storage, transport, or use of ammunition

- Expose military personnel or the public to areas potentially containing unexploded ordnance

- Increase the risk of an accident or a release from existing or proposed vehicles, equipment, procedures, or training practices

- Contaminate soils, groundwater, or surface water with lead from ammunition (i.e., migration due to vehicle, equipment, and foot traffic on ranges, thereby increasing potential exposure to military personnel and the public)

- Cause a release of pesticides or potentially expose military personnel or the public to pesticides

- Expose military personnel or the public to polychlorinated biphenyls
- Expose the public to electromagnetic fields with cycle frequencies greater than 300 hertz
- Cause a spill or release of petroleum-based products
- Require the removal or upgrade of an underground storage tank.

4.13.2.3 Summary of Impacts. Based on the methodology and factors considered, the expulsion or release of hazardous substances is not anticipated as part of HAMET flights. Should a spill occur, defensive actions would be implemented as necessary and appropriate in accordance Army, federal, and state notification and cleanup regulations to prevent impacts on human health and the environment. The Army has determined there would be no impact from hazardous materials resulting from the Proposed Action.

4.13.3 Wildfires

No fires were reported during previous iterations of HAMET flights (U.S. Army, 2003a; U.S. Army 2004b; U.S. Army 2005a).

4.13.3.1 Impact Methodology. Potential direct impacts from wildfires include possible damage to biological and cultural resources and impairment of air quality. Examples of potential indirect impacts from wildfires include increased soil erosion due to removal of vegetation from the land and diminished water quality from water running over land cleared by fire (USAEC and COE 2009).

The potential for wildfire ignition is used as the criterion for assessing wildfire impacts, because it is possible for many fires to affect a relatively limited area, resulting in limited impacts. It is also possible for one fire to affect a large area, resulting in many impacts. Therefore, the frequency of wildfires is not used as a means for assessing the impacts of wildfires. The scenario associated with potential wildfire ignition and HAMET activities would be a helicopter crash in a vegetated area with fuel loads sufficient to carry a fire.

4.13.3.2 Factors Considered for Determining Significance of Impacts. Factors considered in determining whether an alternative would have a significant wildfire ignition potential include the extent or degree to which implementing the alternative would involve the following wildfire ignition issues:

- Historical safety record (See Section 2.5, Previous HAMET Activities and the 25th CAB)
- Operation of aircraft at high altitudes
- Occurrence of nighttime training.

The aircraft proposed for HAMET would be unarmed for HAMET flights. Onboard HAMET aircraft are two 5-lb ABC fire extinguishers to extinguish fires manually. The CH-47 and UH-60 have an on-board fire-suppression system to control engine fires. The CAB reported safe operations during previous HAMET flights (see Subsection 2.5).

4.13.3.3 Summary of Impacts. The potential ignition of a wildfire within the ROI was analyzed. Based on the methodology and factors considered, there would be less-than-significant impacts under Alternatives 1–3, because the only credible risk of a wildfire would be as the result of a crash within a vegetated area with fuel loads sufficient to carry fire. HAMET flights are considered low risk, according to the 25th CAB Risk Assessment Worksheet (Lugo 2010), and the possibility of a wildfire as a result of a crash was determined remote. This conclusion is based on the CAB's historical safety record (see Subsection 2.5), the fact that training would be conducted outside of vegetated areas (i.e., at LZs), and the minimal flight time that would be spent over vegetated areas.

4.13.4 Hazards Associated with Incident/Accident Investigations or Recovery Activities

4.13.4.1 Impact Methodology. An impact is identified when the requirements of the Action Alternatives increase the risk to human health and safety. The risk to human health and safety is estimated and compared to the existing risk. These estimates are compared to the baseline risk to human health and safety.

4.13.4.2 Factors Considered for Determining Significance of Impacts. Factors were considered in determining whether an alternative would have a significant impact on human health and safety. These factors include the following:

- Historical safety record
- Emergency operational procedures
- Location of the alternatives.

The investigation into the history of high-altitude training at PTA indicated no accidents have taken place either at PTA or at any LZs.

The CAB has an excellent safety record, including during past HAMET flights (see Subsection 2.5). The 25th CAB has had two Class A accidents involving rotary-wing aircraft on the island of O‘ahu in February 2001 and May 2009. The 2001 incident was during an air-assault training operation in the Kahuku training area, and the 2009 incident was during a general maintenance test flight on Wheeler Army Airfield. HAMET does not involve air-assault or test-flight maneuvers and is considered a low-risk mission according to the 25th CAB Risk Assessment Worksheet (IAW FM 5-19 & AR 95-1) (Lugo 2010). In the event of an incident/accident or recovery activity, military procedures for conducting these activities would be followed.

4.13.4.3 Summary of Impacts. Based on the methodology and factors considered, the Army determined there are less-than-significant impacts associated with Alternatives 1–3 because of the CAB's safety record and the low potential for future accidents.

4.14 Traffic and Circulation

Multiple LZ areas have been identified for use during high-altitude landing training activities. The environmental features and operation activities for each LZ are similar to each other, and there is no distinction between one LZ and the others for the traffic and circulation discussion. The potential impacts to traffic and circulation are shown in Table 4-18 and discussed in following subsections.

Table 4-18. Summary of potential impacts to traffic and circulation.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Land-based traffic	<SI	<SI	<SI	NI
Aerial traffic	<SI	<SI	<SI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

4.14.1 Land-Based Traffic

4.14.1.1 Impact Methodology. An impact is identified when the requirements of the proposed alternatives increase the amount of land-based traffic. There may be an increase in traffic and circulation around Bradshaw Army Airfield during HAMET flights. Additional fuel is anticipated to be needed for HAMET missions. The additional fuel would be brought in via Saddle Road. The transport of the additional fuel may increase traffic volume from the available vendor to Bradshaw Army Airfield.

4.14.1.2 Factors Considered for Determining Significance of Impacts. Factors were considered in determining whether an alternative would have a significant impact on land-based traffic. These factors include the following:

- The potential increase of personnel traffic
- The potential increase of support traffic (i.e., fuel trucks)
- Capacity of existing infrastructure (Saddle Road).

4.14.1.3 Summary of Impacts. Based on the methodology and factors considered, the Army determined there are less-than-significant impacts associated with Alternatives 1–3. There may be an increase in traffic and circulation around Bradshaw Army Airfield during HAMET flights. Additional fuel is anticipated to be needed for HAMET missions. The additional fuel would be brought in on Saddle Road. The transport of the additional fuel may increase traffic volume from the available vendor to Bradshaw Army Airfield. However, the increase is expected to be less than significant, in part due to ongoing fuel supply activities for Bradshaw Army Airfield and the surrounding areas. In addition, the Saddle Road realignment project was undertaken to handle an increase in traffic. Saddle Road is being developed to rural arterial design standards of the Hawaiʻi Department of Transportation and American Association of State Highway and Transportation Officials, with a design speed of 60 mph (97 km/h). Uphill passing lanes, truck escape ramps, scenic pullouts, and military-vehicle crossings would be incorporated into the project design, as needed, to enhance safety and improve the projected level of service (DOT 2010b).

4.14.2 Aerial Traffic

4.14.2.1 Impact Methodology. An impact is identified when the requirements of the Action Alternatives increase the amount of aerial traffic in the area. The movement of aircraft to and from PTA in support of annual training would not be significantly increased by the addition of HAMET missions.

4.14.2.2 Factors Considered for Determining Significance of Impacts. Factors were considered in determining whether an alternative would have a significant impact on aerial traffic. These factors include the following:

- The increase of aerial traffic
- Already existing traffic levels for Army operations
- Already existing civilian traffic levels (commercial and recreational flights)
- Capability of existing procedures (standard FAA flight procedures).

4.14.2.3 Summary of Impacts. Originating from the Hilo International Airport and Kona International Airport, there are approximately 60 commercial sightseeing flights each day that may fly in or near the airspace proposed for all Action Alternatives (Munger 2010b). An unknown number of recreational pilots may also fly in or around the area. HAMET flights would increase air traffic 3% over current activity.

The pilots conducting HAMET flights follow standard FAA procedures for flights conducted in and out of controlled airspace. Airspace Mauna Kea and Mauna Loa is Class G uncontrolled airspace from surface to 1,200 ft (366 m) AGL. Pilots also use the Island Traffic Advisory Frequencies Northwest 127.05 and Southeast 122.85 to provide traffic advisories and perform airspace deconfliction with nonparticipating aircraft (DOT 2010a, p. 14). The Common Traffic Advisory Frequency (CTAF) is used for air-to-air communications for pilots flying in uncontrolled airspace. Pilots use the common frequency to coordinate their arrivals and departures safely, give position reports, and acknowledge other aircraft in the area. Use of the CTAF also provides commercial and recreational pilots information and allows them to stay clear of HAMET operations. The use of CTAF would help resolve conflicts associated with an increase in air traffic resulting from the Action Alternatives.

Based on the methodology and factors considered, the Army concluded that impacts to air traffic would be less than significant, because the overall volume of flights that HAMET would contribute (3%) would be small compared to current commercial and recreational air traffic, pilots could be redirected temporarily through FAA air traffic control, and the CTAF could be used to resolve potential conflicts in response to HAMET missions.

4.15 Utilities and Public Services

This subsection is an analysis of the potential impacts on public services and public utilities. Public services include police, fire, and emergency medical services. Public utilities include potable water, stormwater, wastewater, solid waste management, telephone, and electricity.

4.15.1 Impact Methodology

An impact is identified when the requirements of an Action Alternative increase demand on an existing public service or public utility. Analyzing a project alternative and its anticipated need for utilities and public services identifies potential impacts. When a project alternative requires additional resources of a public service or utility, the increase in demand is estimated. These estimates are compared to the capacity of the public utility to determine whether the capacity would be exceeded.

4.15.2 Factors Considered for Determining Significance of Impacts

Factors considered in determining whether an alternative would have a significant impact on public services or utilities include the extent or degree to which its implementation would do the following:

- Disrupt a public service as a result of a programmatic demand beyond the capacity of the provider

- Require a public utility service beyond the capacity of the provider to the point that substantial expansion, additional facilities, or increased staffing levels would be necessary

- Generate additional quantities of stormwater runoff that could not be disposed of by the existing drainage system.

4.15.3 Summary of Impacts for Alternatives 1–3

Impacts to utilities and public services are presented below and summarized in Table 4-19. Less-than-significant adverse impacts on law enforcement, fire protection, and emergency medical services would be expected. The increase in training activities could increase the demand for these services, but current services are adequate to accommodate such an increase. There would be no change in jurisdiction for any law enforcement agencies or fire departments (USAEC and COE 2009).

Increased training maneuvers could increase the demand for potable water at PTA, but this should not have a significant adverse impact on the potable water supply system. Water supplied to the Twin Pu‘u range location would be brought in by truck, and no wells or distribution lines would be required (USAEC and COE 2009).

The wastewater and stormwater collection and treatment systems at PTA are anticipated to have adequate capacity to handle increases in volume that could result from Alternatives 1–3 (USAEC and COE 2009).

The increased training maneuvers could result in an increase in the solid waste generated at PTA. These changes should be within the capacity of the existing waste-collection and disposal system.

The telephone systems at PTA are anticipated to have adequate capacity to handle increases in volume that could result from Alternatives 1–3.

The HELCO substation and distribution system are estimated to be adequate to supply the anticipated energy demands of the range facility. No upgrades to the existing system are anticipated.

Table 4-19. Summary of potential impacts to utilities and public services.

Impact Issues	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Police, fire, and emergency medical services	<SI	<SI	<SI	NI
Potable water	<SI	<SI	<SI	NI
Wastewater	<SI	<SI	<SI	NI
Solid waste management	<SI	<SI	<SI	NI
Telephone	<SI	<SI	<SI	NI
Electricity	<SI	<SI	<SI	NI

S = Significant.

S/MI = Significant but can be mitigated to less than significant.

<SI = Less than significant.

NI = No impact.

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5. CUMULATIVE IMPACTS

Federal and State regulations require that the cumulative impacts of a proposed action be assessed (40 CFR V §§ 1500-1508; HAR §11-200-5, -12). Cumulative impact is defined by CEQ as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions." (40 CFR V §1508.7). Cumulative impact is defined by the State of Hawaii as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (HAR §11-200-2). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. Effects and impacts are used synonymously throughout this discussion.

In general, guidance for considering cumulative effects should compare the cumulative effects of numerous actions with appropriate national, regional, state, or community goals to determine whether the total effect is significant. This section discusses other projects on the island of Hawaiʻi that may have cumulative effects when combined with impacts from the alternatives discussed in this EA. To be considered cumulative impacts, the effects must meet the following criteria: the effects would occur in a common locale or region; the effects would not be localized (i.e., they would contribute to effects of other actions); the effects would impact a particular resource in a similar manner; and the effects would be long term.

For this EA, cumulative impacts are described across the larger area of the preferred alternative, which is the maximum area proposed under the Proposed Action. Implementing HAMET is an activity that primarily occurs in the air, is of short duration, and, when in direct contact with the environment, has direct and indirect impacts that are less than significant. Additionally, the need for HAMET is a direct result of a specific military conflict (the war in Afghanistan) occurring within an environment requiring specialized high-altitude flight skills. Thus, cumulative impacts were considered throughout this area and in the time span of the identified reasonably foreseeable future actions. It was found that the incremental impacts from this action within other past, present, and foreseeable actions do not rise to the level of significant impact.

5.1 Past, Other Present, and Reasonable Foreseeable Future Actions

Past actions are described in Table 5-1. The results of past actions are reflected in the discussions of the VECs in Section 3, Affected Environment.

The projects listed in Table 5-2 are currently occurring or anticipated to occur in the reasonably foreseeable future on the island of Hawaiʻi. These activities largely involve Army activities at PTA and activities occurring within/involving the observatory campus. Within and around the ROI, about 36 current and reasonably foreseeable future actions were identified (Table 5-2). The results of the Army's evaluation of cumulative impacts for affected VECs are presented in the following subsections.

Table 5-1. Summary of past activities.

Activity	Location	Sponsor	Description	Dates
Adze quarry activity	Southern slopes of Mauna Kea		Radiocarbon dates from adze quarry sites document Native Hawaiian use of quarries.	1100–1800
Cattle and other ungulates graze	Mauna Kea		First cattle introduced through a gift from Captain Vancouver to Kamahameha I. Continues with cattle and sheep ranches and feral ungulates for hunting.	1793–1936 (some feral ungulates still present)
Hawai‘i Forest Reserve System established	Mauna Kea	Territory of Hawai‘i	System established to protect forests against fire and grazing – inspired by fires in Hamakua.	Established in 1903
Civilian Conservation Corps (CCC) activities	Mauna Kea	CCC	CCC plants trees and constructs horse and truck trails; trail around Mauna Kea at 7,000-ft (2133-m) elevation completed in 1935; stone cabins built at Hale Pōhaku.	1930s
Mauna Kea Forest Reserve fenced	Mauna Kea	Territory of Hawai‘i	Fence erected around the Mauna Kea Forest Reserve to keep sheep and goats out; more than 40,000 sheep and goats were exterminated within the forest reserve.	1935–1936
Mauna Kea access Jeep trail established	Mauna Kea southern slope	State of Hawai‘i	First road is bulldozed to facilitate astronomy development: originally built to support astronomical testing on Mauna Kea.	1964
University of Arizona 0.3-m Site Test Telescope	Pu‘u Poli‘ahu	University of Arizona	0.3-m site telescope; erected on Pu‘u Poli‘ahu and used intensively for a 6-month test program; all equipment was removed upon completion of testing.	1964–1964

Table 5-1. (continued).

Activity	Location	Sponsor	Description	Dates
Site testing for University of Hawai‘i 2.2-m Observatory	13N (Area E) Pu‘u Poli‘ahu and Pu‘u Kea (Area A)	University of Hawai‘i	Site testing was performed at the 13N location (the location for the Thirty Meter Telescope Observatory), Pu‘u Poli‘ahu (former location of Arizona Test Telescope), and on Pu‘u Kea (the current location of the University of Hawai‘i 2.2-m observatory). Jeep trails were built to access the test sites.	1965–1967
University of Hawai‘i 0.9-m Observatory	Astronomy Precinct, Area A	University of Hawai‘i	Observatory consisted of a 0.6-m optical telescope; was built by the U.S. Air Force and transferred to University of Hawai‘i; upgraded with a 0.9-m telescope in 2008; and is now used primarily for teaching and research by University of Hawai‘i at Hilo.	1968–present
Planetary Patrol 0.6-m Observatory	Astronomy Precinct, Area A	Lowell Observatory	Observatory consisted of a 0.6-m optical telescope; was used for long-term monitoring of the planets in the solar system until facility was removed to make way for Gemini North.	1968–1990s
University of Hawai‘i 2.2-m Observatory	Astronomy Precinct, Area A	University of Hawai‘i	Observatory consists of a 2.2-m optical/infrared telescope; was funded by National Aeronautics and Space Administration (NASA), now entirely funded and operated by the University of Hawai‘i.	1970–present
Mauna Kea access road improved	Mauna Kea southern slope		Original Jeep trail realigned to remove some sharp corners and improve access.	1975
United Kingdom Infrared Telescope	Astronomy Precinct, Area A	United Kingdom	Observatory consists of a 3.8-m infrared telescope operated by the Joint Astronomy Center with headquarters in Hilo.	1979–present
NASA Infrared Telescope Facility	Astronomy Precinct, Area B	NASA	Observatory consists of a 3.0-m infrared telescope; operated and managed by NASA.	1979–present

Table 5-1. (continued).

Activity	Location	Sponsor	Description	Dates
Canada-France-Hawai‘i Telescope	Astronomy Precinct, Area A	Canada/ France/ University of Hawai‘i	Observatory consists of a 3.6-m optical/infrared telescope; jointly funded by Canada, France, and the State of Hawai‘i through the University of Hawai‘i; headquarters located in Waimea.	1979–present
Hale Pōhaku expansion	Hale Pōhaku	University of Hawai‘i	The original construction camp, including stone cabins and temporary buildings, has been progressively upgraded and expanded to include dormitory and support facilities to accommodate astronomers and visitors to the summit of Mauna Kea.	1983–present
Mauna Kea Access road improved	Mauna Kea southern slope	State of Hawai‘i and Mauna Kea Observatories Support Services	Access road improved to allow for safer access to the summit. Portions paved and the alignment further straightened.	1985
Caltech Submillimeter Observatory (CSO)	Astronomy Precinct, Area C	Caltech/ National Science Foundation (NSF)	Observatory consists of 10.4-m millimeter/submillimeter telescope; operated by Caltech under an NSF contract and managed from CSO headquarters in Hilo.	1986–present
Installation of power and communica-tions utilities	Saddle Road to the Astronomy Precinct	University of Hawai‘i, with individual observatories	University of Hawai‘i funded the design and installation of the power and communication lines connecting the HELCO system at Saddle Road to the summit distribution loop. Lines are overhead from Saddle Road to near Hale Pōhaku and then underground from there to the summit area.	mid-1980s
Very long baseline array	Mauna Kea Science Reserve, outside Astronomy Precinct	National Radio Astronomy Observatory/ Associated Universities, Inc./NSF	25-m, centimeter-wavelength antenna; is an aperture-synthesis radio telescope consisting of 10 remotely operated antennas, funded by the NSF and managed from New Mexico.	1992–present

Table 5-1. (continued).

Activity	Location	Sponsor	Description	Dates
W. M. Keck Observatory	Astronomy Precinct, Area B	Caltech/ University of California/ California Association for Research in Astronomy (CARA)	Observatory consists of two 10-m optical/infrared telescopes, which are used individually most of the time. About 10 % of the time, they are used together as an interferometer, managed by nonprofit CARA and headquartered in Waimea.	1992 (Keck I)/ 1996 – present (Keck II)
GTE fiber optic cable installation	Saddle Road to Hale Pōhaku	Institute for Astronomy	A fiber optic telecommunications line was installed connecting the Mauna Kea observatories to the GTE Hawaiian Telephone Company fiber optic system.	1998
Subaru Observatory	Astronomy Precinct, Area B	Japan	Observatory consists of an 8.2-m optical/infrared telescope; formerly known as the Japan National Large Telescope, operated by the National Astronomical Observatory of Japan and headquartered in Hilo.	1999 – present
Gemini North Observatory	Astronomy Precinct, Area A	United States/United Kingdom/ Canada/ Argentina/ Australia/ Brazil/Chile	Observatory consists of an 8.1-m optical/infrared telescope; is the twin to the Gemini South Observatory located in Chile. NSF was the federal agency for the project and is headquartered in Hilo.	1999 – present
Jeep trail closure	Pu'u Poli'ahu	Office of Mauna Kea Management	A 300- to 400-yd (274- to 365-m) trail that extended up to Pu'u Poli'ahu was closed to vehicles to minimize disturbance of cultural sites.	2001
Submillimeter array	Astronomy Precinct, Area C	Smithsonian Astrophysical Observatory/ Taiwan	Observatory consists of eight 6-m submillimeter antennas; operated from a base facility in Hilo.	2002 – present
Proposed critical habitat	PTA	U.S. Fish and Wildlife Service	Proposal to formally designate critical habitat on the island of Hawai'i.	May 2003
Outrigger Telescopes Project	Mauna Kea	NASA	NASA proposes to construct, install, and operate six outrigger telescopes in the W. M. Keck Observatory at the Mauna Kea summit area.	2004–2007

Table 5-1. (continued).

Activity	Location	Sponsor	Description	Dates
Saddle Road improved	Saddle Road	Hawai‘i Department of Transport-ation	Saddle road is being realigned and improved, increasing access to Mauna Kea.	2005
High-altitude training	State of Hawai‘i land north of PTA	2-25th Aviation Regiment	2-25th Aviation Regiment established LZs to conduct high-altitude training.	2003–2006
West PTA Maneuver Training Area land acquisition	Land adjacent to PTA	U.S. Army	Proposal to acquire between 15,000 acres (6,070 hectares) and 23,000 acres (9,308 hectares) of land adjacent to PTA from Parker Ranch to be used for maneuver training.	Completed
Fixed Tactical Internet	PTA	U.S. Army	Construct vertical whip antennas at eight strategic locations, each with four antennas, on existing tower sites.	Completed
Installation Information Infrastructure Architecture (I3A)	PTA	U.S. Army	Install fiber optic cable from cantonment area to ranges, motor pool, and other facilities.	Completed
PTA improvements	PTA	25th CAB	Improvements include the construction of a four-point forward-arming and refueling point, construction of an aviation large-area maintenance shelter, and emplaced 28 “EOD-T” targets.	Completed
PTA 1010 land acquisition	PTA	U.S. Army	Land acquisition for ongoing training use.	Completed
Consolidated Command and Range Control Building	PTA	U.S. Army	Construct a consolidated command center for ongoing training.	Completed

Table 5-2. Summary of current and anticipated activities.

Project	Location	Sponsor	Project Description	Projected Completion Date
Saddle Road Realignment	Across island of Hawai‘i, near PTA	Federal Highways Administration, State of Hawai‘i	Improving and modifying (realignment of) Saddle Road from Hilo to Kona.	2010–2015 (Phased in over many years)
Kawaihae/ Waimea Road	Waimea Park to Merriman’s (near Kawaihae Harbor)	State of Hawai‘i	Conduct minor resurfacing and improvements on existing roadway and potentially provide right-of-way for roadway replacement.	Unknown
Waimea to Kawaihae Highway	South Kohala	Federal Highways Administration	Conduct highway improvements along 14 miles (23 kilometers) of existing roadway.	2009–2010
Former Waikoloa Maneuver Area and Nansay Unexploded Ordnance Cleanup	Hawai‘i, Former Waikoloa Maneuver Area and Nansay Combat Range	U.S. Army Corps of Engineers	Unexploded ordnance cleanup on lands used by Navy and Marine Corps for artillery and Navy gun fire, troop maneuvers, and weapons practice.	2015
Battle Area Complex	PTA	U.S. Army	Proposal to construct the Battle Area Complex at existing Range 12 for company gunnery training and qualification requirements of selected weapons systems and to support mounted and dismounted infantry platoon tactical live-fire operations.	2012
Military Vehicle Trail with Easement	PTA-Kawaihae	U.S. Army	Acquire easement and construct a new 27-mile (43-kilometer) roadway from Kawaihae Harbor and PTA for use by military vehicles.	Suspended

Table 5-2. (continued).

Project	Location	Sponsor	Project Description	Projected Completion Date
Ammunition Storage	PTA	U.S. Army	Proposal to construct three new earth-covered ammunition bunkers (igloos), totaling 6,750 ft^2 (627 m^2), within the existing ammunition storage facility.	2012
Tactical Vehicle Wash Facility	PTA	U.S. Army	Proposal to construct a tactical vehicle wash facility with four wash stations.	2012
Range Maintenance Facility	PTA	U.S. Army	Proposed construction of a 15,145-ft^2 (1,407-m^2) consolidated range maintenance complex on a previously developed site in a PTA cantonment.	2015
Runway Upgrade/ Extension, Bradshaw Army Airfield	PTA	U.S. Army	Proposed construction of an 18,667-ft (5,700-m) long, paved runway with 1,000-ft (300-m) long paved runway overrun areas on each end, plus an operations complex to support runway activity.	Speculative
Implementation of the Integrated Wildfire Management Plan	PTA	U.S. Army	Implement specific guidance, procedures, strategies, and protocols to prevent and suppress wildfires and manage fuel loads.	Ongoing
Thirty-Meter Telescope Observatory	13N site in Area E		Thirty-Meter Telescope Observatory will be built and operated at the 13N site in Area E. It will be decommissioned at the end of its life.	Unknown
Accessway to the Thirty-Meter Telescope Observatory	Between 13N site in Area E and the Mauna Kea Access Road Loop		An accessway will be built to allow access to the Thirty-Meter Telescope Observatory. It will be decommissioned at the end of its life.	Unknown

Table 5-2. (continued).

Project	Location	Sponsor	Project Description	Projected Completion Date
Panoramic Survey Telescope and Rapid Response System (Pan-STARRS)	Area A		Pan-STARRS would replace the existing University of Hawai‘i 2.2-m telescope in Area A. It would consist of four 1.8-m telescopes within a single enclosure. Pan-STARRS would be able to observe the entire available sky several times during the dark portion of each lunar cycle. It would enable remote and/or robotic operation.	Unknown
Smithsonian Astrophysical Observatory	Areas C and/or D		Smithsonian Astrophysical Observatory is considering adding two antenna pads and one antenna to the existing 24-pad, eight-antenna submillimeter array system.	Unknown
Caltech Submillimeter Observatory Decommission	Area C		Decommissioning and removal of the Caltech Submillimeter Observatory.	Unknown
Paving Mauna Kea Access Road	Hale Pōhaku		Paving of the remaining dirt portions of the Mauna Kea access road.	Unknown
Infantry Platoon Battle Area and PTA Modernization	PTA	USAG-HI and U.S. Army Pacific	Construct and use an infantry platoon battle course and a military-operations-in-urban terrain and shoot house, and modernize range and cantonment facilities.	2013–2022
U.S. Marine Corps MV-22 and Cobra Attack Squadron Training at PTA	PTA	U.S. Marine Corps	Conduct periodic U.S. Marine Corps training requirements.	Ongoing from 2013

Table 5-2. (continued).

Project	Location	Sponsor	Project Description	Projected Completion Date
Implementation of the Pōhakuloa Training Area Implementation Plan	PTA	U.S. Army	Implement specific guidance, procedures, strategies, and protocols to protect and enhance endangered species habitat and populations.	Ongoing

5.2 Climate and Air Quality

Air quality around PTA is generally good. Federal ozone standards have not been exceeded in Hawai‘i during the past decade despite the cumulative emissions from highway traffic, commercial and military aircraft operations, commercial and industrial facility operations, agricultural operations, and construction projects in both urban and rural areas (USAEC 2008). The Action Alternatives would do little to alter overall vehicle traffic or air traffic activity on Hawai‘i; therefore, air quality impacts are not expected to increase. Given historical air quality conditions, the cumulative impact of emissions associated with the Action Alternatives, in combination with other construction projects and continuing emissions from highway traffic and other sources, is not expected to violate state or federal ozone or PM_{10} standards (USAEC 2008). Consequently, the Army concludes that the cumulative air quality impacts on ozone or other secondary pollutants would be less than significant under the Action Alternatives, and that these Action Alternatives, when considered in combination with other past, present, and reasonably foreseeable future actions, would not be cumulatively significant.

5.3 Geology, Soils, and Topography

Within the Mauna Kea Summit Region, most of the changes associated with local geology are due to wind; movement of ice, snow, and water; and human activity (University of Hawai‘i 2010). The main human activities that disturb cinder and other geologic features include road grading and travel by vehicles, hiking, off-road vehicle use (now prohibited), and activities associated with infrastructure improvements. Most of these disturbances have taken place at or near the observatory areas. Following the construction of the Mauna Kea Access Road, erosion of materials next to the roadway has been an issue during heavy rainfall or rapid snowmelt.

Reasonably foreseeable future activities would involve construction of facilities, construction of roadways, and use of vehicles during operations. Large construction projects, including road construction projects listed in Table 5-2, are examples of potential slope stability-, geology-, and soil-disturbing projects that could contribute to cumulative impacts, primarily due to alteration of the cinder cone morphology. However, the Army concludes that the Action Alternatives do not contribute to slope-stability or geology-disturbing direct or cumulative impacts and contribute only negligibly to cumulative soil disturbance, because existing LZs would be used.

5.4 Water Resources

The drainage patterns have been minimally impacted by the past developments (University of Hawai‘i 2010). On the cinder cones, the introduction of impervious surfaces has not resulted in surface runoff, because the cinder is so porous it has the capacity to absorb water more quickly than the rate of precipitation. Access roads and paved surfaces have slightly altered the path of natural surface runoff; the resulting erosion and deposition of materials are minor.

The lack of surface water combined with the permeability of the lava rocks reduces the potential for cumulative impacts to surface water resources. Because groundwater exists far below ground surface at the LZs, the potential for cumulative impacts is negligible. Because the Action Alternatives do not pose impacts to water resources directly or indirectly, the Army concludes that the Action Alternatives, when considered in combination with other past, present, and reasonably foreseeable future actions, would not result in cumulative impacts.

5.5 Biological Resources

Past actions within or near the ROI have had significant impacts on the biological resources. Agriculture, land use, military activities, and public works projects have all had some impact on biological resources in the past. The impacts include loss of native habitat from land clearing for agriculture and wildland fires that have caused declines in populations such as the palila and Hawaiian mint (*Haplostachys haplostachya*). The Mauna Kea silversword has experienced population declines due to grazing by introduced ungulates. The nēnē had experienced a population decline until the 1950s, from recreational activities and habitat loss. These past activities have contributed to these species being designated as threatened and endangered. The nēnē has since experienced recovery on Hawaii Island due to successful management efforts. The nēnē population on Hawaii Island now numbers approximately 500. The status of the Hawaiian Hoary Bat as a federally-listed endangered species is equivocal. Data from the Pohakuloa Natural Resources Office indicates that bats are ubiquitous in the saddle region. There are informal discussions amongst the conservation and regulatory communities that the status of the bat may require revision. These discussions are preliminary at this time.

Current and future actions may contribute to the impacts that are affecting the biological resources within the ROI. Current and future actions include road maintenance near the PCH, construction activities, and military activities in habitats that contain sensitive species. The Action Alternatives include existing conservation measures to mitigate the direct and indirect impacts to PCH and sensitive species habitats. Because of the measures in place, the Army concludes that the cumulative impacts on PCH or other sensitive species habitats would be either no impact or less than significant under the Action Alternatives, and that these Action Alternatives, when considered in combination with other past, present, and reasonably foreseeable future actions, would not be cumulatively significant.

5.6 Cultural Resources

In ancient times, human activities in the mountain lands of the island of Hawaiʻi were mainly for religious or resource-procurement purposes. Hawaiians gathered tool-making materials at stone quarries, caught birds for sustenance and feathers, and buried the dead. Trees were harvested for canoes and *heiau* images, and other plants were gathered for medicine, ritual practice and personal adornment. Hawaiians took the umbilical cords and afterbirth of infants to Mauna Kea either for placement in Lake Waiau or for burial on the mountain. Oral traditions indicate that battles were fought in the area between the chiefs of different districts. Natural resources of importance to Native Hawaiians were impacted beginning in the late-1700s by feral sheep, goat, and cattle grazing. Development of astronomical observatories began at the mountains' summits in the mid-1900s. The associated infrastructure has had lasting impacts on the island's cultural resources. U.S. military use of the Hawaiian Islands began in the late 1800s and continues today. Currently, there are several military installations on the Big Island: Bradshaw Army Airfield, Kilauea Military Camp, Keaukaha Military Reserve, Kawaihae Military Reserve, and PTA.

Tourists and recreationists from around the world have traveled to the island of Hawai‘i to experience its scenic beauty and vistas from the ground, sea, and air (University of Hawai‘i 2009, p. 6-1).

Future activities include the possibility of construction of new astronomical observatories and modifications, including possible expansions, demolitions, and replacements of existing observatories and other scientific research structures. Possible construction activities related to visitation include expansion of visitors’ centers, parking areas, rest areas, and scenic lookouts (University of Hawai‘i 2009, pp. 6-8 and 6-11). In addition, military training in the area may continue to accelerate and may result in construction of new, or modifications to existing, infrastructure. If practitioners perceive disruptions from increases in audio and visual impacts from these activities during practices or if practitioners have access increasingly restricted, adding to areas that are currently restricted or even made temporarily restricted, these restrictions and disturbances would be considered cumulative impacts.

Additionally, the cumulative impact of past and possible future activities that is related to direct alteration or destruction of archaeological sites and the character and setting of places of religious and cultural importance to Native Hawaiians would be considered adverse and significant. However, the Army has concluded that the cumulative impacts associated with the Action Alternatives would be less than significant, and that these Alternatives, when considered in combination with other past, present, and reasonably foreseeable future actions, would not be significant, because access would not be restricted, flights would avoid known cultural resources, noise modeling showed insignificant impacts, the LZs have no historic properties to alter or destroy and the training would be infrequent and sporadic and leave no lasting impression on the landscape.

5.7 Land Use and Recreation

Construction and operation of the observatories and access roads have been consistent with state and local land use policies and land use designations (University of Hawai‘i 2010). Each of the existing observatories underwent required permitting processes and reviews. Therefore, past development does not conflict with existing land use plans or policies.

Large construction projects, including road construction projects listed in Table 5-2, are examples of potential alterations to land use that could contribute to cumulative impacts and that could be cumulatively significant. However, the Army concludes that the Action Alternatives do not contribute to land use alterations and thus not to cumulative impacts, because no changes to existing land use would occur. The Action Alternatives also do not alter use of land for recreation and thus do not cumulatively impact recreation.

5.8 Noise

Noise effects from proposed helicopter training operations would be intermittently audible in areas near Bradshaw Army Airfield and PTA and in the vicinity of the Mauna Kea and Mauna Loa LZs. Worst-case noise levels were assessed using DoD’s NoiseMap model (Subsection 4.11.1). Modeling results demonstrated average noise levels (DNLs) for training operations would be compatible with existing land uses near the LZs when PCH mitigation measures were followed. These noise levels are considered less than significant. While noise sensitivity is species specific and varies among individuals within each species, average noise levels for the combination of any of the Action Alternatives with existing and future noise sources are unlikely to cause excessive disruption or annoyance in noise-sensitive locations in or near the ROI. Thus, the Army concludes that the cumulative noise impacts associated with implementing any of the Action Alternatives would be negligible.

5.9 Visual and Aesthetic Resources

The visual character and quality of the areas encompassed by the LZs would not be impacted, because the Action Alternatives would not change basic land use or require any alterations to the LZs. The visual sensitivity of these areas would have less-than-significant impacts, because the areas are not identified as areas of high scenic quality (i.e., designated scenic corridors or locations), are not readily accessible, or are not used by large numbers of people, and air quality impacts to visibility are less than significant, intermittent, and of short duration. Therefore, the Army concludes that any cumulative impacts to visual and aesthetic resources as a result of implementing any of the Action Alternatives, in combination with other past, present, and reasonably foreseeable future actions, would not be cumulatively significant.

5.10 Utilities and Public Services

During periods of HAMET activity, the need and use of utilities and public services, such as wastewater and stormwater collection and treatment systems at PTA, telephone systems, water- and energy-distribution systems, and law-enforcement, fire-protection, and emergency-medical services, would be expected to increase; however, these increases are anticipated to be within the current capacity of all systems. As a result of implementing any of the Action Alternatives, in combination with other past, present, and reasonably foreseeable future actions, the increases would not be cumulatively significant.

5.11 Traffic and Circulation

During periods of HAMET activity, the incremental increase to air traffic by HAMET is 3% over current levels (Munger 2010b). This increase is not cumulatively significant. Vehicle ground traffic is not expected to increase as a result of the proposed action (because there is no land vehicle support) therefore cumulatively significant impacts are not anticipated.

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6. CONCLUSIONS

This section presents conclusions of the environmental consequences analysis (Section 4) of the Action Alternatives and the No Action Alternative (Table 6-1).

Table 6-1. Summary of overall impacts.

Resource Area/Impacts	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Climate	NI	NI	NI	NI
Air Quality				
PM_{10} emissions	<SI	<SI	<SI	NI
Pollutant emissions	<SI	<SI	<SI	NI
Geology and Topography	NI	NI	NI	NI
Soils				
Results in substantial soil loss (e.g., through increased erosion) or terrain modification (e.g., altering drainage patterns through large-scale excavation, filling, or leveling)	NI	NI	NI	NI
Results in soil or sediment contamination exceeding regulatory standards or other applicable or relevant human-health or environmental-effects thresholds	NI	NI	NI	NI
Adversely alters existing geologic conditions or processes such that the existing or potential benefits of the geologic resource are reduced	NI	NI	NI	NI
Results in soil dispersion from helicopter-generated winds; causes soil compaction from helicopters landing on the soil	<SI	<SI	<SI	NI
Water Resources				
Degrades water quality in a manner that would reduce the existing or future beneficial uses of the water	<SI	<SI	<SI	NI

Table 6-1. (continued).

Resource Area/Impacts	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Substantially increases risks associated with human health or environmental hazards	NI	NI	NI	NI
Reduces the availability of, or accessibility to, one or more of the beneficial uses of a water resource	NI	NI	NI	NI
Alters water movement patterns in a manner that would adversely affect the uses of the water within or outside the ROI	NI	NI	NI	NI
Is out of compliance with existing or proposed water quality standards or requires an exemption from permit requirements in order for the project to proceed	NI	NI	NI	NI
Biological Resources – Endangered and Threatened Species				
Impacts to endangered and threatened species from helicopter-caused fire	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from nonnative species	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from noise	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from aircraft collisions	<SI	<SI	<SI	NI
Impacts to endangered and threatened species from wind from helicopters	NI	NI	NI	NI
Biological Resources – Sensitive Species				
Impacts to sensitive species from helicopter-caused fire	NI	NI	NI	NI
Impacts to sensitive species from nonnative species	<SI	<SI	<SI	NI
Impacts to sensitive species from noise	<SI	<SI	<SI	NI

Table 6-1. (continued).

Resource Area/Impacts	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Impacts of sensitive species from aircraft collisions	<SI	<SI	<SI	NI
Impacts to sensitive species from wind from helicopters	NI	NI	NI	NI
Biological Resources – Other Vegetation and Wildlife Species				
Impacts to other vegetation and wildlife species from helicopter-caused fire	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from nonnative species	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from noise	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from aircraft collisions	<SI	<SI	<SI	NI
Impacts to other vegetation and wildlife species from wind from helicopters	NI	NI	NI	NI
Cultural Resources				
Cultural resources – inadvertent landings resulting in the physical destruction, damage, or alteration of all or part of the property	NI	NI	NI	NI
Beliefs/practices – access restrictions that could isolate the property or alter the character of the property's setting when that character contributes to the property's qualifications for the NRHP	<SI	<SI	<SI	NI

Table 6-1. (continued).

Resource Area/Impacts	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Beliefs/practices – introduction of visual, audible, or atmospheric elements due to the presence of military aircraft that could impact the quality or frequency of cultural practices and beliefs. For some native Hawaiians, any flights in the vicinity of Mauna Kea or Mauna Loa will be perceived as causing significant impacts. However, alternative design features and mitigations lessen the level of significance.	<SI	<SI	<SI	NI
Beliefs/practices – introduction of visual, audible, or atmospheric elements due to the presence of military aircraft that could impact the quality or frequency of cultural practices and beliefs. Native Hawaiians who believe that cultural practices can exist along side with secular activities will see that compliance with regulations and careful planning and implementation can ensure less-than-significant impacts to the culturally significant lands.	<SI	<SI	<SI	NI
Socioeconomics and Environmental Justice	NI	NI	NI	NI
Economic development	NI	NI	NI	NI
Protection of children	NI	NI	NI	NI
Environmental justice	NI	NI	NI	NI
Land Use				
Curtails the range of beneficial uses of the environment	NI	NI	NI	NI
Involves substantial secondary impacts, such as population changes or effects on public facilities	NI	NI	NI	NI
Conflicts with existing or planned land uses on or around the site	NI	NI	NI	NI

Table 6-1. (continued).

Resource Area/Impacts	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Conflicts, or is incompatible, with the objectives, policies, or guidance of state and local land use plans	NI	NI	NI	NI
Conflicts, or is incompatible, with acceptable use governed by NNL status for Mauna Kea	NI	NI	NI	NI
Recreation				
Curtails the range of recreational uses of the environment	NI	NI	NI	NI
Substantially affects scenic vistas and view planes identified in county or state plans or studies	<SI	<SI	<SI	NI
Disrupts recreational use of land-based resources, such as parks or recreational paths, or interferes with the public’s right of access	<SI	<SI	<SI	NI
Prevents long-term recreational use or use during a peak season or impedes or discourages existing recreational activities	<SI	<SI	<SI	NI
Noise				
Noise – wildlife	<SI	<SI	<SI	NI
Noise – humans	<SI	<SI	<SI	NI
Visual and Aesthetic Resources				
Disturbance to visual sensitivity from rotary-wing aircraft	<SI	<SI	<SI	NI
Disturbance to landscape from rotary-wing aircraft	<SI	<SI	<SI	NI
Obstruction of views of natural beauty sites	NI	NI	NI	NI
Human Health and Safety Hazards				
LZ safety	<SI	<SI	<SI	NI
Hazardous material	NI	NI	NI	NI
Wildfires	<SI	<SI	<SI	NI
Accident/incident investigation and recovery	<SI	<SI	<SI	NI

Table 6-1. (continued).

Resource Area/Impacts	Alternative 1 – Mauna Kea/ Mauna Loa	Alternative 2 – Mauna Kea	Alternative 3 – Mauna Loa	No Action Alternative
Traffic and Circulation				
Land-based traffic	<SI	<SI	<SI	NI
Aerial traffic	<SI	<SI	<SI	NI
Public Services and Utilities				
Police, fire, and emergency medical services	<SI	<SI	<SI	NI
Potable water	<SI	<SI	<SI	NI
Wastewater	<SI	<SI	<SI	NI
Solid waste management	<SI	<SI	<SI	NI
Telephone	<SI	<SI	<SI	NI
Electricity	<SI	<SI	<SI	NI

NI = No impact.

<SI = Less than significant.

S/MI = Significant but can be mitigated to less than significant.

S = Significant.

6.1 Conclusions from No Action Alternative

The impact analysis of the No Action Alternative resulted in the following findings:

- Impacts to climate and air quality are not anticipated under the No Action Alternative. The alternative would not change current climate or air quality conditions.

- Impacts to geology or soils are not anticipated under the No Action Alternative. The alternative would not alter the current physical state of the environment.

- Impacts to biological or cultural resources are not anticipated under the No Action Alternative. The alternative would not alter the current state of these resources.

- Impacts to sociological resources, economic resources, environmental justice, and environmental health effects on children are not anticipated under the No Action Alternative. The alternative would not alter the current state of the current conditions.

- Impacts on noise or visual and aesthetic resources are not anticipated under the No Action Alternative. Noise levels, visual character, visual quality, and sensitivity levels would remain as described in Section 3.

- Impacts to human health and safety, traffic and circulation, public services, and utilities are not anticipated under the No Action Alternative. These VECs would remain as described in Section 3.

The No Action Alternative would result in no changes in the existing environment. The No Action Alternative would be impracticable, undesirable and costly when trying to capture the training needs of new pilots assigned to the CAB during this time and those pilots who need to conduct additional training to meet the advanced requirement. The perstempo would create an additional 45 days away from Families prior to the upcoming year-long deployment and helicopters and maintenance crews will spend additional time on the mainland resulting in higher costs to the taxpayer. Furthermore, this would leave the DoD stationed in Hawaiʻi at a disadvantage with no home station training similar to the type of environment the unit will experience in Afghanistan. Familiarity with this specialized high altitude environment is critical to save the lives of our 25th CAB aircrews and the Soldiers they transport when operating in support of Operation Enduring Freedom in Afghanistan.

6.2 Conclusions from Alternatives 1–3

The impact analysis of Alternatives 1–3 resulted in the following findings:

- Impacts to climate are not anticipated under Alternatives 1–3. The climate at the proposed LZs, and the island of Hawaiʻi overall, would remain cool and tropical (upper montane to alpine), with no impacts on average temperatures, rainfall, or wind patterns.

- Impacts to air quality under Alternatives 1–3 are anticipated to be less than significant. Based on modeling, the impact of fugitive dust from helicopter activity on either Mauna Loa or Mauna Kea LZ areas would be less than significant. The maximum concentration at 1,093 yd (1,000 m) away from the center of the LZ(s) is less than 17.98 $\mu g/m^3$, which is below the state and EPA emission standards.

- Impacts to land use, geology, and topography are not anticipated under Alternatives 1–3. Basic land use would not change with the Alternative Actions. The Proposed Action does not involve acquiring land or rezoning land for use, and, as such, the Proposed Action and the use of the LZs would not result in any changes of current or planned land uses or zonings. There would be no impact to geology or topography, because no further construction to the LZs would be required.

- Impacts to recreation are not anticipated under Alternatives 1–3. Overflights may be perceived as a slight noise and visual distraction by people in the immediate area of any of the Action Alternatives, but HAMET would not significantly impact or result in the cessation of any recreational activities or access to them, including Mauna Loa Observatory Access Road, Saddle Road, and Mauna Kea Summit Access Road.

- Impacts to soils are anticipated to be less than significant under Alternatives 1–3. The soils present may be compacted or crushed by the weight of the helicopter. However, the soils are very resilient to wind forces, and fugitive dust has been modeled to be below state and EPA emission standards.

- Impacts to water resources are anticipated to be less than significant under Alternatives 1–3. No impacts to surface water are expected as a result of the Alternative Actions, because there are no perennial streams or other surface water resources that could potentially be affected. The only potential, but unlikely, impact to groundwater would be contamination of an aquifer through an unlikely spill.

- Impacts to biological resources are divided between endangered and threatened species, sensitive species, and other vegetation and wildlife species for Alternatives 1–3. The impacts to endangered and threatened species are anticipated to be less than significant. In February, March, May and

June 2011, presence surveys for vegetation, birds, bats, and arthropods were conducted at the proposed LZs on Mauna Kea and Mauna Loa. The surveys were conducted by the Army and the Center for Environmental Management of Military Lands (CEMML). Vegetation surveys were conducted to determine the presence of listed species near the LZs, and no listed species were located within a 328-ft (100-m) radius of the LZs (Peshut and Evans 2011). The nearest known population of silversword is located 2,500 meters (8,202 ft) west of Mauna Kea LZ-5. Surveys for birds occurred within a 2,000-ft (610-m) buffer around each LZ and generally observed limited resources for bird habitat near the LZs, which would limit bird occurrence near those areas (Peshut and Schnell 2011a). The survey for bats concluded that there is little vegetation near the LZs or in the general region of the LZs where the Hawaiian hoary bats can roost (Peshut and Doratt 2011a). Surveys for arthropods near the LZs on Mauna Kea found no wekiu bugs or invasive ants (Peshut and Doratt 2011b; Peshut and Doratt 2011c). There are no identified active dark-rumped petrel breeding colonies near (within the 2000-ft radius survey area) the Mauna Kea and Mauna Loa LZs (Peshut and Schnell 2011a; Peshut and Schnell 2011b). There are no identified active ***band-rumped storm petrel*** breeding colonies near (within the 2000-ft radius survey area) the Mauna Kea and Mauna Loa LZs (Peshut and Schnell 2011a; Peshut and Schnell 2011b). The impacts to sensitive species are anticipated to be less than significant due to the likelihood that sensitive species are not located near the proposed LZs. The impacts to other vegetation and wildlife species are expected to be less than significant because of the measures in place to reduce the impacts from invasive species, noise, and collisions. As a whole, impacts to biological resources would be less than significant.

- Impacts to cultural resources are divided between direct, indirect, and cumulative impacts for Alternatives 1–3. There are no direct impacts to cultural resources from HAMET activities, because the flight paths have been designed to avoid known cultural resources and there are no cultural resources in and directly around the LZ. Indirect and cumulative impacts relating to cultural beliefs and practices are determined to be less than significant, because access will not be restricted and flight paths have been designed to avoid cultural resources and ensure accuracy of landings. The training will be infrequent and the impacts temporary, with no lasting effects on the landscape.

- Impacts to sociological resources, economic resources, environmental justice, and environmental health effects on children are not anticipated under Alternatives 1–3. The alternatives would not alter the current state of the current conditions described in Section 3.

- Impacts from noise on humans are not anticipated under Alternatives 1–3. The anticipated noise levels are acceptable for current land uses in these areas. The noise sampling results did not measure the maximum decibel level discernable above background levels for areas of concern to cultural practitioners or recreationists. Impacts from noise on wildlife would be less than significant under Alternatives 1–3. While noise sensitivity is species specific and varies among individuals within each species, average noise levels for the combination of any of the Action Alternatives with existing and future noise sources are unlikely to cause excessive disruption or annoyance in noise-sensitive locations. The noise could impact sensitive species by causing the wildlife to flee the area and interrupting life-cycle events like breeding; however, wildlife activities return to normal when the disturbance is over, and wildlife often adapt to the frequent noise. Design features of the alternatives (e.g., flight-corridor and minimum-elevation requirements through the flight corridor) also result in a less-than-significant determination.

- Impacts to visual and aesthetic resources are anticipated to be less than significant under Alternatives 1–3. The visual sensitivity associated with HAMET would have less-than-significant impacts, because the areas are not identified as areas of high scenic quality and are not readily accessible to, or used by, large numbers of people. HAMET flights would be unlikely to obstruct a one's view of natural beauty sites within the Hamakua and North Hilo planning districts. In addition, air-quality impacts to visibility are less than significant, intermittent, and of short duration.

- Impacts to human health and safety are anticipated to be of no impact for hazardous materials under Alternatives 1–3. A less-than-significant determination has been made for the remote possibility of a crash that results in wildfire in vegetation that could sustain a wildfire. There is no such habitat at the LZs. A less-than-significant determination was made for LZ safety, because it is possible, but highly unlikely, for the public to be in the vicinity of operations. A less-than-significant determination was made for accident/incident investigation and recovery because of the CAB's safety record and the low potential for future accidents.

- Impacts to traffic and circulation are anticipated to be less than significant under Alternatives 1–3. Impacts to air traffic would be less than significant because of the small volume of commercial and recreational air traffic involved and the ability for recreational pilots to be redirected temporarily through air traffic control and use of CTAF in response to HAMET missions.

- Impacts to public services and utilities are not anticipated under Alternatives 1–3. No activities at the LZs would require public services or utilities. While HAMET could marginally increase the demand for public services at PTA, current services are adequate to accommodate such an increase.

6.3 Conservation Recommendations

Conservation recommendations, such as mitigations and best management practices, for the Action Alternatives are shown in Table 6-2. The table shows the means by which the recommendations would be implemented.

Table 6-2. Conservation recommendations.

Recommendation Type	Action Alternative	Law or Policy	Standard Operating Procedure	Conservation Measure	Best Management Practice
General					
Non-permanent markings would be used to identify LZs during training. LZs would be cleared of all markings after completion of HAMET.	1, 2, 3		X		
Have firefighting resources on standby while training, and have transportation available for firefighting personnel.	1, 2, 3		X		
Notify Mauna Loa Observatory air-quality instrumentation personnel prior to conducting HAMET missions (requested by NOAA personnel).	1, 3				X
Notify the general public, through press releases, of training schedules.	1, 2, 3				
Biological Resources					

Table 6-2. (continued)

Recommendation Type	Action Alternative	Law or Policy	Standard Operating Procedure	Conservation Measure	Best Management Practice
Maintain a minimum altitude of 2,000 ft (610 m) in the flight corridor (when flying over the PCH).	1, 2		X		
Inspect the exterior of the aircraft and clean as required to reduce the potential for spread of invasive species.	1, 2, 3		X		
Inpsect the landing pads at Bradshaw Air Field and apply pesticide to eliminate the threat of invasive ants spreading to LZ areas.	1,2,3				
Cultural Resources					
Continue to participate in open communication with Native Hawaiians, other land use groups, and other interested parties to evaluate resources and reduce impacts.	1, 2, 3				X
Avoid close hovering over potential cultural features in the vicinity of the LZ's	1,2,3				
Conduct cultural awareness training for all HAMET personnel, with particular emphasis on intangible resources and their importance to Native Hawaiians.	1, 2, 3		X		

7. CONSULTATION AND COORDINATION

Table 7-1 lists persons who were contacted or consulted for information to develop this EA.

Table 7-1. Persons and agencies contacted or consulted.

Contact	Title/Role and/or Organization
Kahu Ku Mauna The Office of Mauna Kea Management, 640 N. Aohoku Place, Room 203, Hilo, HI 96720	Advises the Mauna Kea Management Board, Office of Mauna Kea Management (OMKM), and University of Hawaiʻi, Hilo, Chancellor in Hawaiian cultural matters affecting the Mauna Kea Science Reserve
William J. Aila Jr., Kalanimoku Building 1151 Punchbowl Street, Room 227 Honolulu, HI 96813	Chairperson, Board of Land and Natural Resources State Historic Preservation Officer
David A. Conner NASA Langley Research Center, Mail Stop 461 2 North Dryden Street Hampton, VA 23681-2199	Flight Acoustics Group, Leader/Noise Modeling Subject Matter Expert, NASA
Paul J. Conry 1151 Punchbowl Street, Room 325 Honolulu, HI 96813	Administrator, Division of Forestry and Wildlife
Joseph Czech Wyle Laboratories 128 Maryland Street El Segundo, CA 90245	Principal Engineer/Noise Modeling Subject Matter Expert, Wyle Laboratories
Theresa Dunham Hawaiʻi State Historic Preservation Division Kakuhihewa Building 601 Kamokila Blvd., Suite 555 Kapolei, HI 96707	Acting Archaeology Branch Chief, Hawaiʻi State Historic Preservation Division
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Jacqui Hoover Hawaiʻi Innovation Center at Hilo 117 Keawe Street Hilo, HI 96720-2811	Hawaiʻi Island Economic Development Board
Jacqui Hoover Hale Kea Office Building 65-1410 Kawaihae Road Kamuela, HI 96743	Hawaiʻi Leeward Planning Conference

Table 7-1. (continued).

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Laura Thielen State Historic Preservation Division 40 Po‘okela Street Hilo, HI 96707	Previous-State Historic Preservation Officer, State Historic Preservation Division
PTA Cultural Advisory Committee	PTA

Table 7-1. (continued).

Contact	Title/Role and/or Organization
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Hawaii Island Leeward Planning Commission	
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8. PREPARERS

Table 8-1 presents the names of individuals who prepared this EA and their area, or areas, of responsibility and their respective organizations.

Table 8-1. Individuals who prepared this EA and their area(s) of responsibility.

Name	Title	Organization
Rogelio E. Doratt, MSc	Wildlife Program Manager	Center for Environmental Management of Military Lands, PTA
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Kevin Landroop	Legal Advisor	USAG-HI, Fort Shafter
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Kerry Abramson	Environmental Attorney	USARPAC
William Rogers	NEPA Program Manager	USAG-HI, Schofield Barracks, Department of Public Works, Environmental Division
Capt. Geovanny Rojas	Environmental Attorney	8th Theater Sustainment Command/USAG-HI Office of Staff Judge Advocate
Julie M. E. Taomia, PhD	Archaeologist	USAG-HI, PTA, Cultural Resources Office
Mark H. Taylor	TacOps Officer	USAG-HI, Schofield Barracks, 25th CAB TacOps

Table 8-1 (continued).

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Max E. Voigtritter	Program Manager/Range Division Liaison	Portage, Inc.

9. REFERENCES

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Appendix A

Section 7 Consultation

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DEPARTMENT OF THE ARMY
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UNITED STATES ARMY GARRISON
PŌHAKULOA
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IMPC-HI-PS

MEMORANDUM FOR RECORD 20 June 2011

SUBJECT: ESA-7(c) Determination of No Effect for High-Altitude Mountainous Environment Training (HAMET) at Mauna Kea and Mauna Loa, Hawaii Island

The US Army developed the HAMET program to prepare pilots for successful combat operations as part of Operation Enduring Freedom in Afghanistan (US Army, 2009). HAMET involves three phases: 1) academic and simulator training; 2) basic qualification, and; 3) tactical operations exercises. HAMET is essential pilot training because high altitudes and mountainous terrain produce aerodynamic and atmospheric effects on rotary-wing aircraft that differ from effects at lower altitudes and over moderate terrain. Conditions at high altitudes may include high winds, extreme turbulence, low air density, and unpredictable air stability. These conditions can significantly affect engine performance and handling characteristics of rotary-wing aircraft (US Army, 2011). Army helicopter pilots need to understand and experience the challenges of flight planning and aircraft operations at high altitudes in order to be competent for missions in mountainous environments such as Afghanistan.

In preparation for deployment to theatre of operation and to satisfy compulsory aviation training requirements, the 25th Combat Aviation Brigade stationed at Wheeler Army Airfield, Hawaii, proposes to provide HAMET for helicopter aviators at landing zones (LZs) on Mauna Kea and Mauna Loa, Hawaii. The proposed action sustains Department of Army and Department of Defense training requirements and meets HAMET Phase 3 objectives. Aviators and crews will train on aircraft internal to the 25th Combat Aviation Brigade, Hawaii.

The US Army has developed Action Alternatives and a No Action Alternative to evaluate the proposed HAMET Action, as described in the HAMET Environmental Assessment (US Army, 2011). The No Action Alternative serves as a benchmark against which the proposed alternatives can be evaluated. Since the proposed action is to conduct HAMET Phase 3 tactical operations exercises, the purpose of the Action will not be achieved if the No Action Alternative is selected (US Army, 2011).

Action Alternatives 1-3 involve the execution of HAMET flights between Bradshaw Army Airfield at Pohakuloa Training Area and six landing zones selected on Mauna Kea and Mauna Loa. These six LZs were chosen based on training-appropriate characteristics and safety considerations. The selected LZs meet the criteria for HAMET objectives and are suitable for use without further modification.

Biological resources within the HAMET project area include vegetation and wildlife. Potential impacts to vegetation (including palila critical habitat) include habitat disturbance, including habitat loss from wildland fire, temporary localized impacts from dust and wind generated from helicopter rotorwash, and the spread of invasive plant species. Potential impacts to wildlife are noise disturbance, habitat disturbance, including habitat loss from wildland fire, the spread of invasive ant species, and direct impact with aircraft.

Biological surveys were conducted for each LZ to determine the reasonable likelihood that potential impacts will occur to biological resources as a result of HAMET operations. A Memorandum For Record that describes findings for each survey was prepared for the file record. Based on findings, there is no reasonable likelihood that HAMET operations will have a sustained detrimental effect on biological resources of the Mauna Kea and Mauna Loa LZs. Surveys results and conclusions are summarized briefly below.

Botanical surveys were conducted 23 February 2011 at Mauna Loa LZ 1, LZ 2 and LZ 3, and 24 February 2011 at Mauna Kea LZ 4, LZ 5 and LZ 6, to determine the presence of federally-listed plant species and to assess overall vegetation in the general vicinities of the LZs (see Peshut and Evans Memorandum For Record 30 March 2011). Survey areas for each LZ included a square ~650 ft (200 m) on each side centered on the geographic coordinate of respective LZs.

No federally-listed or candidate plant species were located at any of the LZs or within any LZ survey area. In general, vegetation at the LZs is extremely sparse or absent, and is limited to a few common native or introduced species. HAMET operations will produce little or no dust at LZs, and the highly localized and short duration winds generated from aircraft rotorwash are not likely to permanently impact the sparse and stressed vegetation that occur at LZs (see Peshut Memorandum For Record 18 April 2011).

There are no effects to vegetation from human foot traffic at any LZ because there is no disembarkation of personnel during HAMET operations.

The impact to biological resources from wildland fire generated from a helicopter crash at an LZ is negligible because of the extremely sparse vegetation around the LZs, which provides a low density fuel load and limits the spread of fire.

The impact to biological resources from wildland fire generated from a helicopter crash along a flight path to an LZ (including over palila critical habitat) during HAMET operations, is considered negligible. For the military, hundreds of helicopter flights and thousands of hours of flight time are logged at Pohakuloa each year. Moreover, commercial helicopters plying the tourist trade on Hawaii Island transit palila critical habitat regularly throughout the year, with no restrictions on flight paths or elevation. At a larger scale, thousands of commercial flights for public and private travel cross population centers and biologically sensitive areas daily, across the globe. Aircraft crashes are phenomenally rare given the numbers of aircraft and flight hours logged worldwide. It is reasonable to suggest that the potential for a helicopter crash from HAMET operations is extremely low. The likelihood of a helicopter crash during HAMET operations was not considered tenable.

Surveys to assess potential available treeland roosting habitat and potential foraging habitat for the federally-listed Hawaiian Hoary Bat were conducted 02 March 2011 at Mauna Loa LZ 1, LZ 2 and LZ 3, and 03 March 2011 at Mauna Kea LZ 4, LZ 5 and LZ 6, to determine the potential for bat presence in the general vicinities of the LZs (see Peshut and Doratt Memorandum For Record 04 April 2011). Survey areas for each LZ included a square ~650 ft (200 m) on each side centered on the geographic coordinate of respective LZs, similar to the survey area for the botanical surveys. Botanical survey data was used to augment the assessment of potential bat habitat.

As described for the botanical surveys, in general, vegetation at the LZs is extremely sparse or absent, and is limited to common native or introduced species. The Mauna Kea LZs are essentially devoid of vegetation and provide no habitat that could reasonably be considered as potential roosting or foraging habitat for the Hawaiian Hoary Bat. Vegetation at the Mauna Loa LZs is also extremely sparse, and there is no vegetation greater than 3 ft (1 m) in height within any of the Mauna Loa LZ survey areas. Overall, the LZs do not provide potential roosting or foraging habitat for the Hawaiian Hoary Bat.

Bat presence within the LZ areas is expected to be limited to rare and infrequent transiting bats, and bat density in the LZ areas is expected to be extremely low. Airstrike of bats is therefore considered to be unlikely. The potential for a helicopter collision with the Hawaiian Hoary Bat is unlikely because the bats are solitary, are only active from sunset to sunrise, only roost in trees in forested areas, and are not expected to depend upon the habitat around the LZs for resources. If transiting bats are present during HAMET operations, bats are expected to vacate the immediate vicinities of the aircraft and the LZ.

Preliminary and final surveys to assess the presence of the candidate species *Nysius wekiuicola* (Wekiu bug) and the presence of invasive ant species were conducted 02 March 2011 at Mauna Kea LZ 4, LZ 5 and LZ 6, on 03 March 2011 at Mauna Loa LZ 1, LZ 2 and LZ 3, on 31 May 2011 at Mauna Loa LZ 1, LZ 2 and LZ3, on 06 June 2011 at Mauna Kea LZ 4, LZ 5and LZ 6, and on 08 June 2011 at Mauna Kea LZ 5 and LZ 6. See

Peshut and Doratt Memorandum For Record 04 April 2011, and Peshut and Doratt Memorandum For Record 20 June 2011. Surveys for Wekiu and ants covered a period of several months to account for the seasonal behavior of these species. It was determined that Mauna Kea LZ 4 does not present viable habitat for the Wekiu bug, and this LZ was not subject to a final survey to confirm the presence or absence of the bug. The Wekiu bug is not known to inhabit Mauna Loa LZs. Mauna Loa LZs were surveyed for invasive ant species only. Survey areas for each LZ included a circle of ~650 ft (200 m) radius centered on the geographic coordinate of respective Mauna Kea LZs. No Wekiu bug or ants were found at any LZ during any survey.

Preliminary and final surveys to determine bird presence and habitat use in the general vicinities of the LZs (including listed and candidate petrel species) were conducted 02 March 2011 at Mauna Loa LZ 1, LZ 2 and LZ 3, on 03 March 2011 at Mauna Kea LZ 4, LZ 5 and LZ 6, and on 25-26 May 2011 and 06-07 June 2011 at all Mauna Kea and Mauna Loa LZs. Surveys for petrels covered a period of several months to account for the seasonal behavior of these species. See Peshut and Schnell Memorandum For Record 04 April 2011, and Peshut and Schnell Memorandum For Record 10 June 2011. Survey areas for each LZ included a circle of 2000 ft (610 m) radius centered on the geographic coordinate of respective LZs, corresponding to the 80 dB noise contour for helicopter operations at LZs.

Several bird species protected under the Migratory Bird Treaty Act were identified at the LZs, as were game bird species not protected under federal law. Overall densities of these birds within the survey areas were extremely low. These bird species are expected to vacate the immediate vicinities of the aircraft and LZs if present during HAMET operations.

The Hawaiian Goose (Nene) is known to frequent the regions within several miles of the Mauna Loa LZs, but geese densities are expected to be extremely low in the areas of LZs, and if present geese are expected to vacate the immediate vicinities of aircraft and LZs during HAMET operations. An air collision with the Nene is unlikely. The island-wide population of nene is ~500, of which only ~200 are known to transit Pohakuloa between population centers in Hakalau (east) and Puuanahulu (west). Nene do not spend a significant portion of their time in the air, and do not typically fly at night. Nene spend most of their time on the ground, loafing, feeding, sleeping, or tending nests. Nene are not expected to be present in the vicinities of the Mauna Kea LZs.

There was no evidence of habitat use or colony activity by the listed and candidate species of Dark-rumped Petrel and Band-rumped Petrel. Although the region of the Mauna Loa LZs is thought to be part of the flyway used by petrels transiting the saddle region to colonies in Hawaii Volcanoes National Park, petrel presence in the flyway is indeterminable. Like other birds, petrels are expected to vacate the immediate vicinities of the aircraft and LZs if present during HAMET operations.

Collision with palila is highly unlikely because aircraft will maintain an altitude of at least 2000 feet above ground level when flying over critical habitat.

The spread of invasive species within the project area will be reduced by inspecting and cleaning the exterior of the HAMET aircraft at the Bradshaw Army Air Field prior to training flights.

The impact to biological resources due to noise is considered negligible. HAMET operations will produce ~10 minutes of noise disturbance per LZ per landing event, with the highest noise levels ~100 dB within ~100 ft of the geographic center of the LZ.

The impact to biological resources due to wind generated by helicopter rotorwash is considered negligible. HAMET operations will produce <2 minutes of wind disturbance per LZ per landing event, with the highest wind velocities within ~50 ft of the geographic center of the LZ, and falling off to ambient wind conditions ~140 ft from the aircraft, which is within the LZ perimeter.

The US Army will implement the following mitigation measures for HAMET operations:

- Helicopters will maintain an altitude of at least 2000 feet above ground level when flying over palila critical habitat;
- Helicopters will be inspected for invasive arthropod and plant species prior to each mission, and cleaning protocols will be followed if invasive species are identified;
- Firefighting resources will be on stand-by while HAMET operations are conducted and transportation will be available for firefighting personnel;
- All pilots will be briefed on the mitigation requirements prior to HAMET missions.

Based on field surveys and supporting documents, the US Army has determined that the HAMET operations will have no appreciable effect on federally-listed species or federally-designated critical habitat, and no effect on biological resources, within the project area.

This assessment and supporting documents satisfy US Army responsibilities under Section 7(c) of the Endangered Species Act at this time. The US Army will continue to remain aware of any change in the status of these species or critical habitat, and will be prepared to re-evaluate potential project impacts if necessary.

Point of contact to discuss this no effect determination is Peter Peshut, 808-969-1966, peter.peshut@us.army.mil.

PETER J. PESHUT, PhD
Program Manager
Natural Resources Office
Pohakuloa Training Area

References

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Peshut, P.J. and Evans, S.A. 2011. Memorandum For Record 30 March. Botanical Surveys for HAMET Environmental Assessment. US Army Garrison Hawaii, Pohakuloa Training Area Natural Resources Office, 11 pp.

Peshut, P.J. and Schnell, L.D. 2011. Memorandum for Record 04 April. Hawaiian Avifauna Surveys for HAMET Environmental Assessment. US Army Garrison Hawaii, Pohakuloa Training Area Natural Resources Office, 47 pp.

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Appendix B

Section 106 Consultation

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DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND, PACIFIC REGION
HEADQUARTERS, UNITED STATES ARMY GARRISON, HAWAII
851 WRIGHT AVENUE, WHEELER ARMY AIRFIELD
SCHOFIELD BARRACKS, HAWAII 96857-5000

REPLY TO
ATTENTION OF:

APR 15 2011

Office of the Commander

Mr. William Aila
State Historic Preservation Officer
Chairperson
Department of Land and Natural Resources Kakuhihewa Building, Room 555
601 Kamokila Boulevard
Kapolei, HI 96707

Dear Mr. Aila:

I am in receipt of the memo from Ms. Theresa Donham, SHPD Hawaii Island Archaeologist, regarding the Environmental Assessment (EA) and Section 106 consultation for the proposed High Altitude Mountainous Environment Training (HAMET). I am writing to clarify some points raised by the letter. The Environmental Assessment is currently under revision, and some of the points raised by Ms Donham will be addressed in the revised document.

With regard to the discrepancies between the EA project area and Area of Potential Effect (APE), we have revised the APE to include an area encompassing 100 meters diameter from the center of the landing zones (Enclosure 1) to take into account the potential effects of rotor wash. The helicopters will follow specific flight routes for the proposed trainings (Enclosure 2). They will fly 2000 feet above ground level to a release point, and from that point they will begin descent to the landing zones. Based upon discussions with the pilots, rotor wash begins to affect the ground once the helicopters have reached an altitude of 90 feet above ground level. This altitude will be reached at 100 meters from the center of the landing zone. In addition, most of the effects of rotor wash on the ground are felt on liftoff. Thus, the overall acreage for the six discontinuous APEs is 14.8 acres. The map in the original draft EA depicted available airspace according to the Federal Aviation Administration, and was not intended to depict the project area. Training will be restricted to these landing zone locations using modern GPS equipment, which has improved in recent years in accuracy and reliability. In addition, the pilots are briefed before they begin the high altitude training on the sensitivity of the area for cultural resources and the importance of landing only in the landing zones.

PTA Cultural Resources staff has surveyed the APE as defined above (see Enclosures 3 and 4). The flight routes are generally available to all aircraft that fly through the Saddle Region and are not specific to effects from this project. No historic properties were identified within the 100 meter square area at the LZs on Mauna Loa. On Mauna Kea, the mound previously identified by PTA Cultural Resources staff (Godby & Head 2003) was found to be 50 meters from the center of the LZ. For the purposes of the EA and this consultation this LZ is identified as LZ 6; it was formerly identified as LZ 5a. The mound is still present on this unnamed pu'u, and is in good condition. In addition, two more mounds were identified near LZ 5. One mound is 80 meters from the center of LZ 5, the other is 146 meters from the center of the LZ. Detailed descriptions of these mounds can be found in Enclosure 4. The mounds consist of piled 'a'ā cobbles. No other materials – pre-Contact artifacts, historic artifacts, or modern rubbish – were found in association with these mounds.

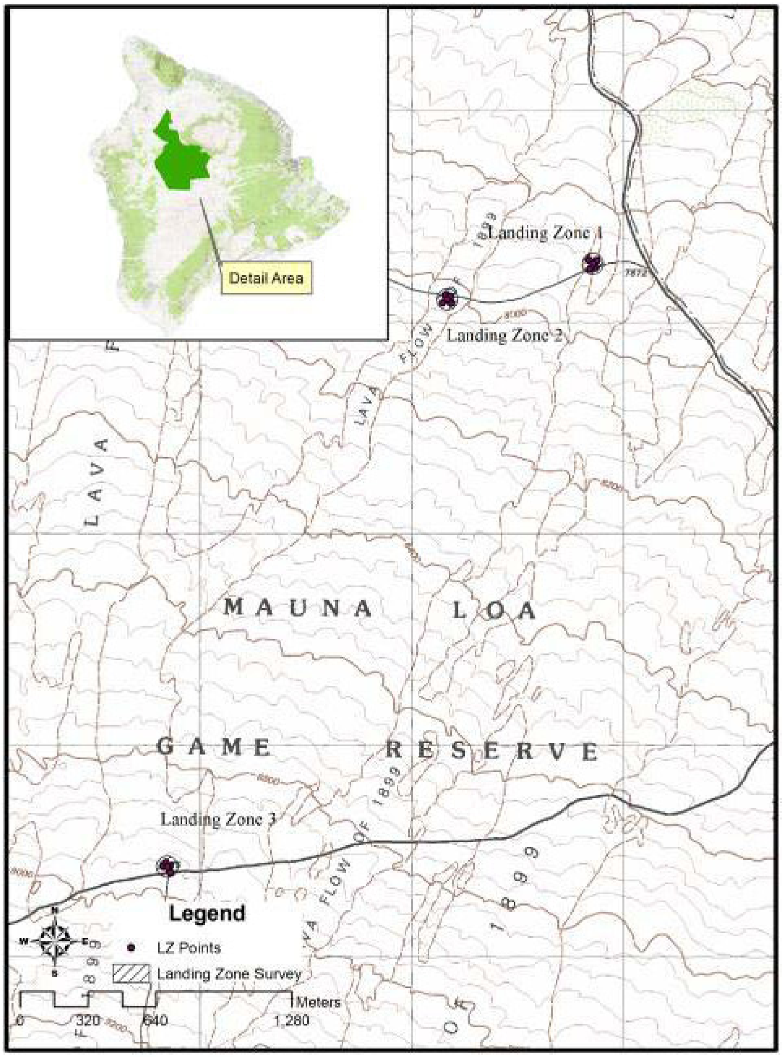
During a two week period for which DLNR issued a permit for Army helicopters to fly to the Mauna Kea landing zones for the purposes of collection additional data for the EA, PTA Cultural Resources staff revisited the Mauna Kea LZs twice to assess any effects of rotor wash or other unanticipated effects of the helicopter training scenarios on the mounds. Details of the first visit, after the first two days of helicopter flights, are found in Enclosure 5; details of the final site visit, after completion of the two week period, are found in Enclosure 6. There were no observable effects to the mounds from the helicopter activities. Noise monitoring was also done during this time, with monitors placed at the locations indicated on the map at Enclosure 7. PTA Cultural Resources staff accompanied the personnel who placed the noise monitors and an Office of Mauna Kea Management Ranger to ensure that no archaeological sites on Mauna Kea were disturbed either in the placement of the monitors or in the hike to the monitoring locations.

In sum, the concerns expressed by the SHPD have been addressed in this letter with regard to the Section 106 consultation. Concerns specific to NEPA are being addressed in the revised EA. The US Army Garrison Hawaii anticipates presenting the EA and the request to conduct training at these LZs to the Board of Land and Natural Resources hearing in late May or early June. We would appreciate notification from the SHPD of any additional concerns by May 6, 2011 so that they can be addressed. In the absence of an indication that there remain concerns regarding this Section 106 consultation we will assume that there are none and that you concur with my determination that this project will have no adverse effect to historic properties. Should you require additional information about this project, please contact Dr. Julie M. E. Taomia, PTA Archeologist, at telephone number (808) 969-1966.

Sincerely,

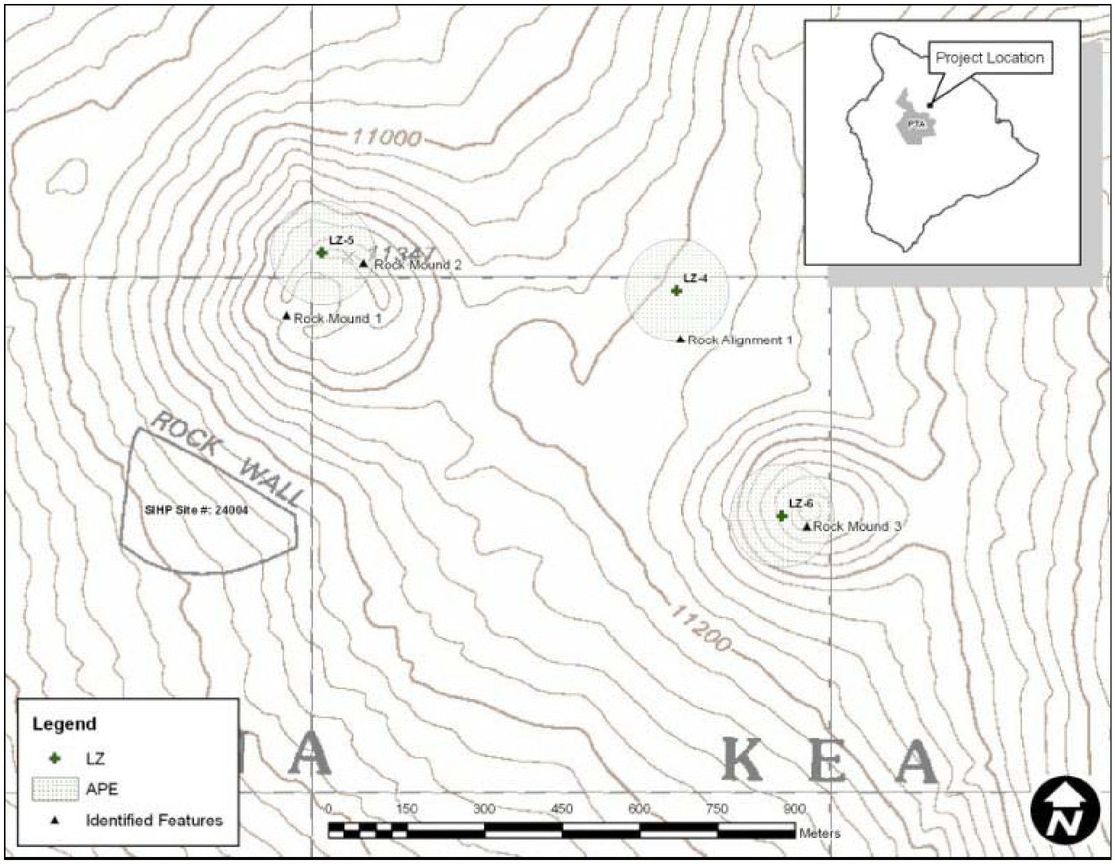
Douglas S. Mulbury
Colonel, US Army
Commanding

Enclosures

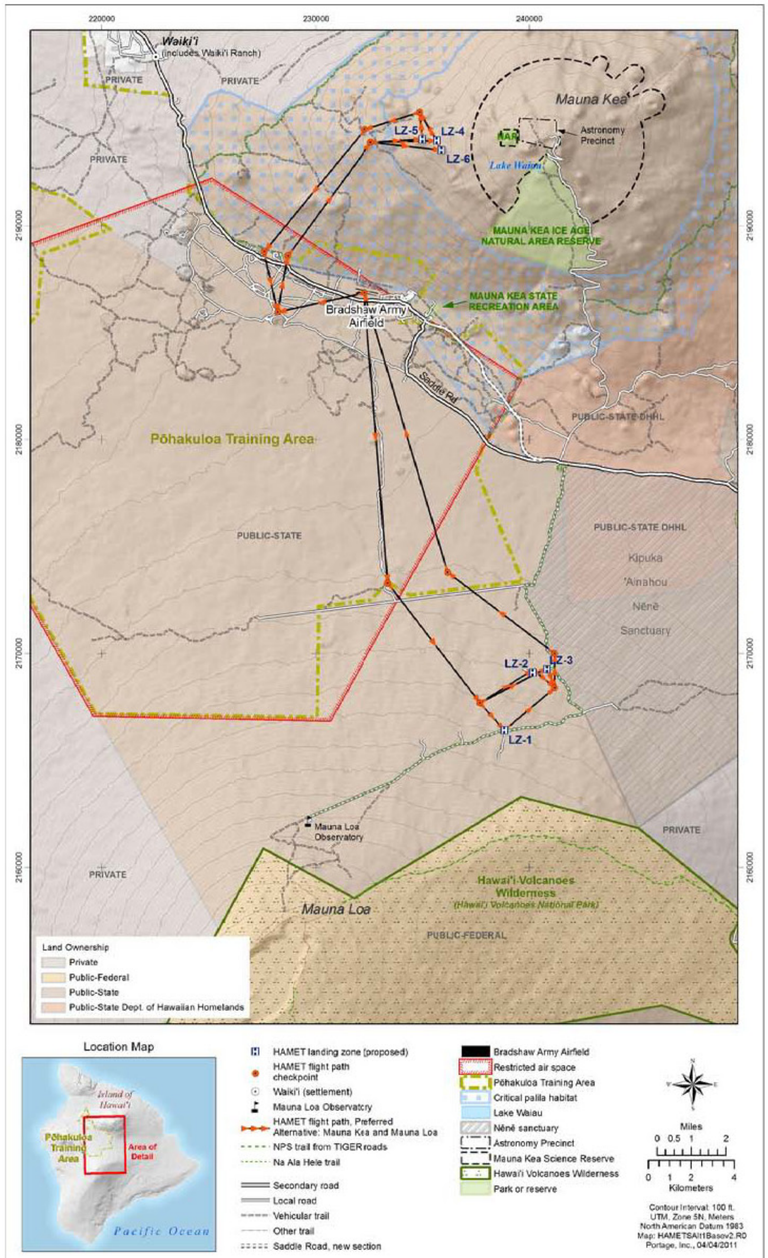


Mauna Loa APE

Enclosure 1



Mauna Kea APE



Flight paths for high altitude training

Enclosure 2

IMPC-HI-PWE March 2, 2011

MEMORANDUM FOR THE RECORD

SUBJECT: Survey of proposed landing zones on State Land on Mauna Loa (TMK: (3) 3-8-001:001) in Humuʻula Ahupuaʻa, North Hilo District, Hawaiʻi Island.

1. On February 14, 2011, Dr. Julie Taomia, PTA Archeologist, Ms. Lauren Morawski and Ms. Teresa Davan, USAG-HI Cultural Resources Specialists, travelled to Mauna Loa to conduct surveys of three proposed landing zones (LZ). The landing zones had been previously surveyed (Rumsey 2009), but rotor wash was not taken into account at that time. Therefore, in conjunction with the revision of the Environmental Assessment for the High Altitude Mountainous Environment Training proposed by the CAB, PTA Cultural Resources staff with assistance from O'ahu conducted surveys of each LZ covering 100 meters from the center of the LZ, the distance to which rotor wash would affect anything.
2. Landing Zone 2 is a leveled area in ʻaʻā lava of the 1899 Mauna Loa lava flow (Figure 1, 2 below). No historic properties were identified within 100 meters of the center of the LZ (Figures 3-8).
3. Landing Zone 1 is a leveled area in ʻaʻā lava along another finger of the 1899 Mauna Loa lava flow (Figures 1, 2). Pāhoehoe lava is present around the edges of the LZ. Several cavities were identified in this pāhoehoe; these were investigated, but no cultural resources were identified. An area 100 meters from the center of the LZ was surveyed, and no historic properties were identified within this area (Figures 9-11). Bulldozer tread marks were identified on some of the adjacent pāhoehoe (Figure 10).
4. Landing Zone 3 is a previously leveled area on the south side of the road to the Mauna Loa NOAA Observatory (Figure 12). The LZ is in ʻaʻā from the 1899 Mauna Loa lava flow, and the remnants of a wind sock are present across the road from the LZ. No historic properties were identified within the 100 meter survey area at this landing zone.
5. The use of the three previously existing landing zones on Mauna Loa will not have any effect on historic properties, as none are present in the vicinity of the landing zones.

Julie M. E. Taomia, Ph.D.
Archeologist
Environmental Office, PTA

Enclosure 3

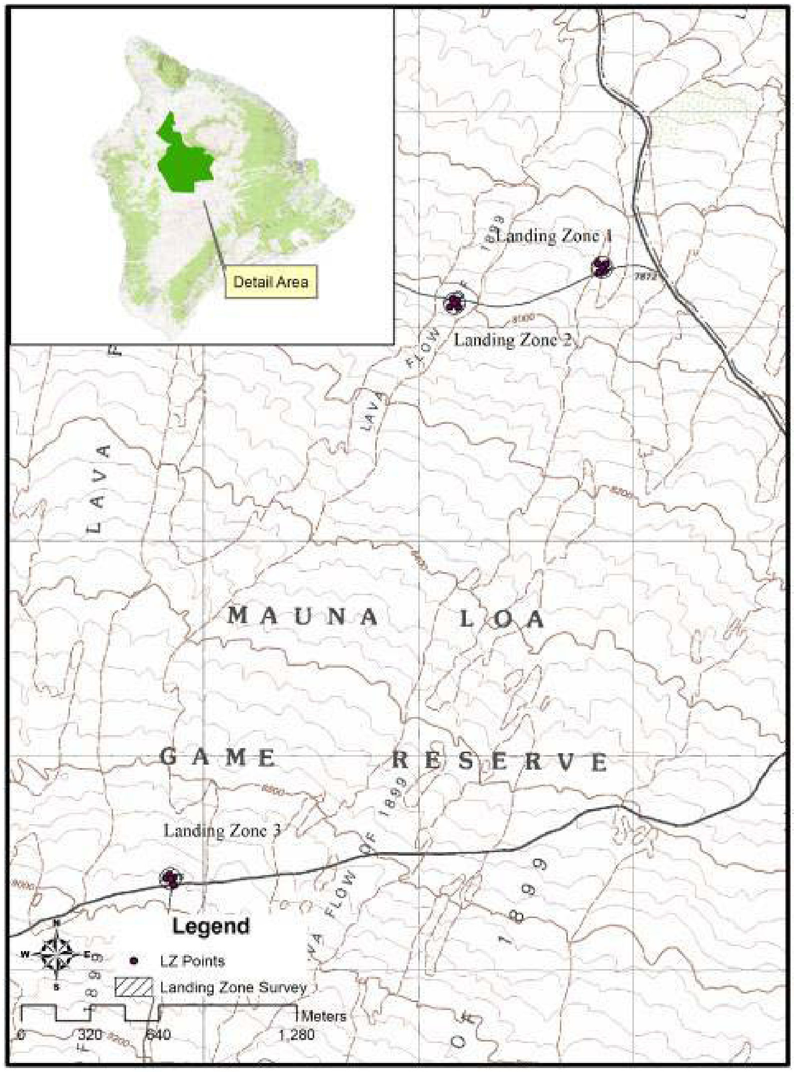


Figure 1. Overview of Mauna Loa Landing Zone locations

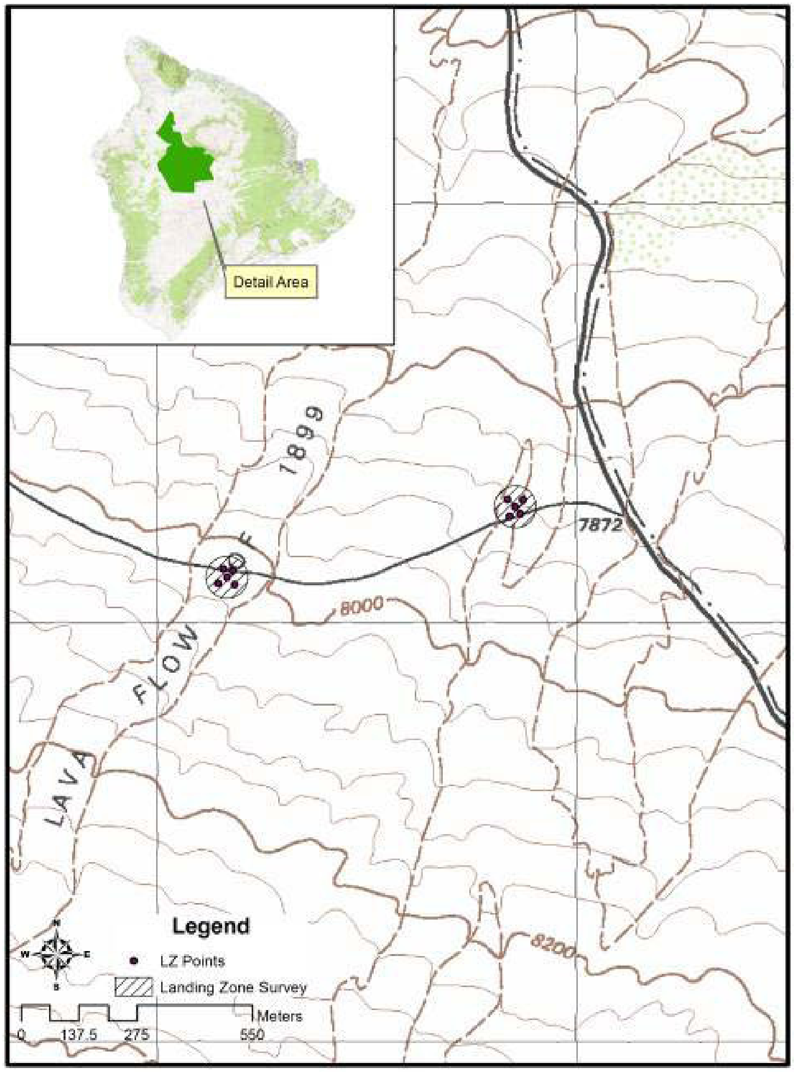


Figure 2. Detail of two lower level Mauna Loa Landing Zone Locations


Figure 3. LZ 2 View from the west edge beyond end of rotor wash area


Figure 4. LZ 2 View to south beyond end of rotor wash area

Figure 5. LZ 2 View to east beyond edge of LZ and rotor wash area

Figure 6. LZ 2 View to the west across LZ

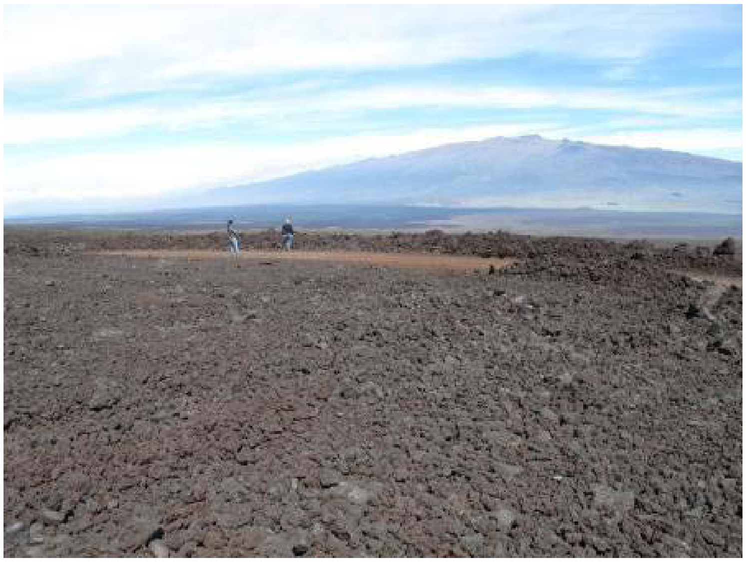


Figure 7. LZ 2 View to the north across the LZ to the road

Figure 8. LZ 2 View to the north, beyond area of rotor wash influence.

Figure 9. LZ 1 view to northeast across LZ toward older lava.

Figure 10. LZ 1 view to southeast showing bulldozer tread marks, beyond edge of rotor wash.

Figure 11. LZ 1 Photo to the north showing road created by bulldozer, also edge of rotor wash area

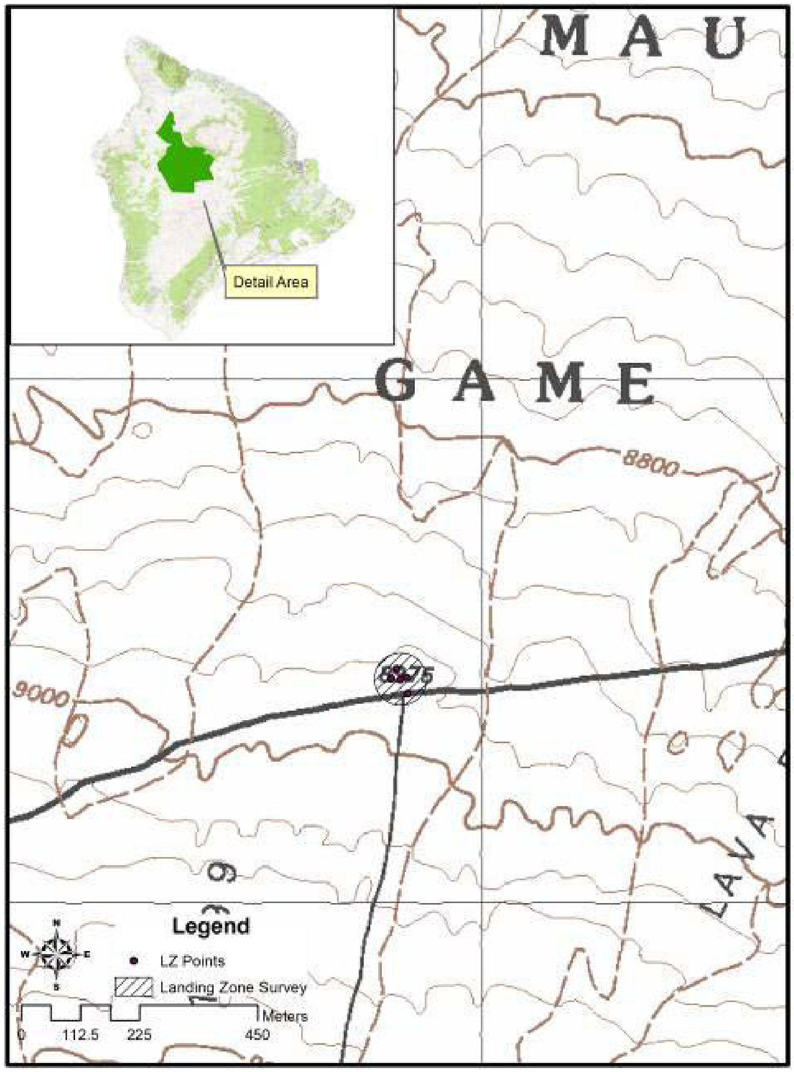


Figure 12. Detail location of LZ 3


Figure 12. LZ 3 view to the west showing rotor wash area


Figure 13. LZ 3 View to the west across the LZ


Figure 14. LZ 3 View to the north beyond the rotor wash area


Figure 15. LZ 3 view to the northwest beyond rotor wash area, poured concrete in foreground

Figure 16. View to the east beyond rotor wash area

Figure 17. View to the south showing road, power line, beyond extent of rotor wash

IMPC-HI-PWE **24 February 2011**

MEMORANDUM FOR THE RECORD

SUBJECT: Cultural Resources Reconnaissance Survey of Existing High Altitude Mountainous Environmental Training (HAMET) Landing Zones (LZ) on Mauna Kea, [TMK (3) 4-4-015:001, Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island.

1. On February 24, 2010, Mr. David Crowell and Ms. Kehaulani S. Kerr, Cultural Resources Program Manager and Cultural Resources Specialist at Pōhakuloa Training Area (PTA) and Ms. Dominique L. Cordy, intern with the U.S. Army Corps of Engineers (USACE), performed a cultural resources reconnaissance survey of the existing HAMET LZ locations on Mauna Kea (LZ-4, LZ-5, LZ-6). The HAMET LZ locations are located approximately 8km north of PTA on the northwestern flank of Mauna Kea, below the summit at approximately 11,000 – 12,000 fasl.

2. The HAMET LZ locations were previously surveyed in October and December 2003 (Godby and Head 2003a, Godby and Head 2003b). The previous efforts investigated only the 15m x 15m footprint of the LZs while the current investigation included a 100m area from the center of the LZs as the Area of Potential Effect (APE). The APE was established to account for rotor wash created by helicopters. The previous surveys did not identify any cultural resources within the 15m x 15m footprints of LZ4 and LZ-5. LZ-6 was designated LZ5a in the previous survey and a rock mound was identified approximately 50m south of the LZ (Godby and Head 2003b). The project area, APE, and results of the current survey are depicted in Figure 1. This report follows the order in which the LZs were visited.

3. Mr. Crowell, Ms. Kerr, and Ms. Cordy surveyed the APE at LZ-5 which is located on the top of an unnamed *pu'u* at 235019E, 2194049N. Two stacked rock features were identified near LZ-5 and were termed Rock Mound 1 and Rock Mound 2.

4. Rock Mound 1 is located between the southern edge of a large crater and the southern crest of the *pu'u* and overlooks the saddle region of Hawai'i Island. Rock Mound 1 is located approximately 144m south-southwest from LZ-5 and is just outside of the APE at 234950E, 2193928N. Rock Mound 1 is a pyramidal shaped stacked rock mound constructed in 5-7 courses of large and medium sized pieces of locally available rock with smaller rock and cobble infill. The area around the feature appears to have been cleared, ostensibly due the construction of Rock Mound 1.The feature measures approximately 2.65m x 1.75 m x 1.25m and is oriented roughly east-west. The feature is somewhat formally constructed with the rocks tightly placed and infilling with smaller rocks. Some of the rocks have tumbled from the top and the sides of the feature and lie immediately adjacent at the base (Figure 2).

Enclosure 4

5. Rock Mound 2is located between the northern edge of a large crater and the northern crest of the *pu'u*. T-022411-02 is located within the APE, approximately 82m east-southeast from LZ-5 and 181m northeast from Rock Mound 1 at 235099E, 2194029N. The feature is pyramidal shaped stacked rock mound constructed in 5-7 courses of large and medium sized pieces of locally available rock with some smaller rock infill, but less infilling than present at Rock Mound 1. Additionally, Rock Mound 2 has a more rectangular and less pyramidal shape than Rock Mound 1, but is wider at the base than at the top. The feature displays somewhat formal construction characteristics, with tightly placed rocks and some evidence of a faced profile on the north side of the feature. The area around the feature shows evidence of clearing due to the construction of the mound. Rock Mound 2 measures approximately 2.55m x 1.67 x 1.12m and is oriented roughly east-west. A few of the rocks have tumbled from the sides and the top of the feature and lie immediately adjacent at the base (Figure 3-Figure 4).

6. Mr. Crowell, Ms. Kerr, and Ms. Cordy next surveyed the APE at LZ-6 which is located on the top of another unnamed *pu'u* located approximately 1023m southeast of LZ-5 at 235702E, 2193975N. One stacked rock feature was identified near LZ-6 and was termed Rock Mound 3. This feature was previously identified in Godby and Head (2003b) and described as a rock mound constructed with local cobbles and boulders with faced sides on the north and the east. The current survey identified Rock Mound 3 located within the APE, approximately 56m east-southeast from LZ-6 at 235709E, 2193881N. The feature is a pyramidal shaped stacked rock mound constructed in 6-8 courses of large and medium pieces of locally available rock with smaller rock and cobble infill. Rock Mound 3 is fairly formally constructed with tightly placed rocks and infilling. The faced profiles discussed in the previous survey were not readily apparent to the current survey team. Rock Mound 2 displayed a more clearly faced profile on the north elevation than any possible facing observed at Rock Mound 3. The area around the feature was cleared during the construction of the mound. Rock Mound 3 is approximately 2.13m x 1.37m x 1.35m and is oriented roughly north south. Rock Mound 1 and Rock Mound 2 are clearly visible from Rock Mound 3 (Figure 5 - Figure 6).

7. Mr. Crowell, Ms. Kerr, and Ms. Cordy final survey area was the APE at LZ-4 which is located on a relatively flat area approximately 687m east of LZ-5 and 481 m north-northwest of LZ-6 at 235702E, 2193975N. One small, single course diamond shaped rock alignment feature was identified near LZ-4 and was termed Rock Alignment 1. Rock Alignment 1is located within the APE, approximately 97m south from LZ-4 at 235954E, 2193517N. The feature is constructed of small and medium pieces of locally available rock with some cobble infilling. Rock Alignment 1 does not display formal construction characteristics, with the rocks simply sitting on top of the ground without being tightly placed or imbedded in the soil. Rock Alignment 1 is approximately 1.63m x 1.11m x .021m and is oriented roughly northwest-southeast (Figure 7 - Figure 8).

David M. Crowell
Cultural Resources Program Manger
Environmental Office, PTA

Godby, William and James Head

2003 Trip Report for the Archaeological Survey of Proposed Helicopter Landing Areas (LZ-5, LZ-5a, and LZ-6) for High Altitude Training from December 8, 2003 to December 12, 2003. On File at PTA.

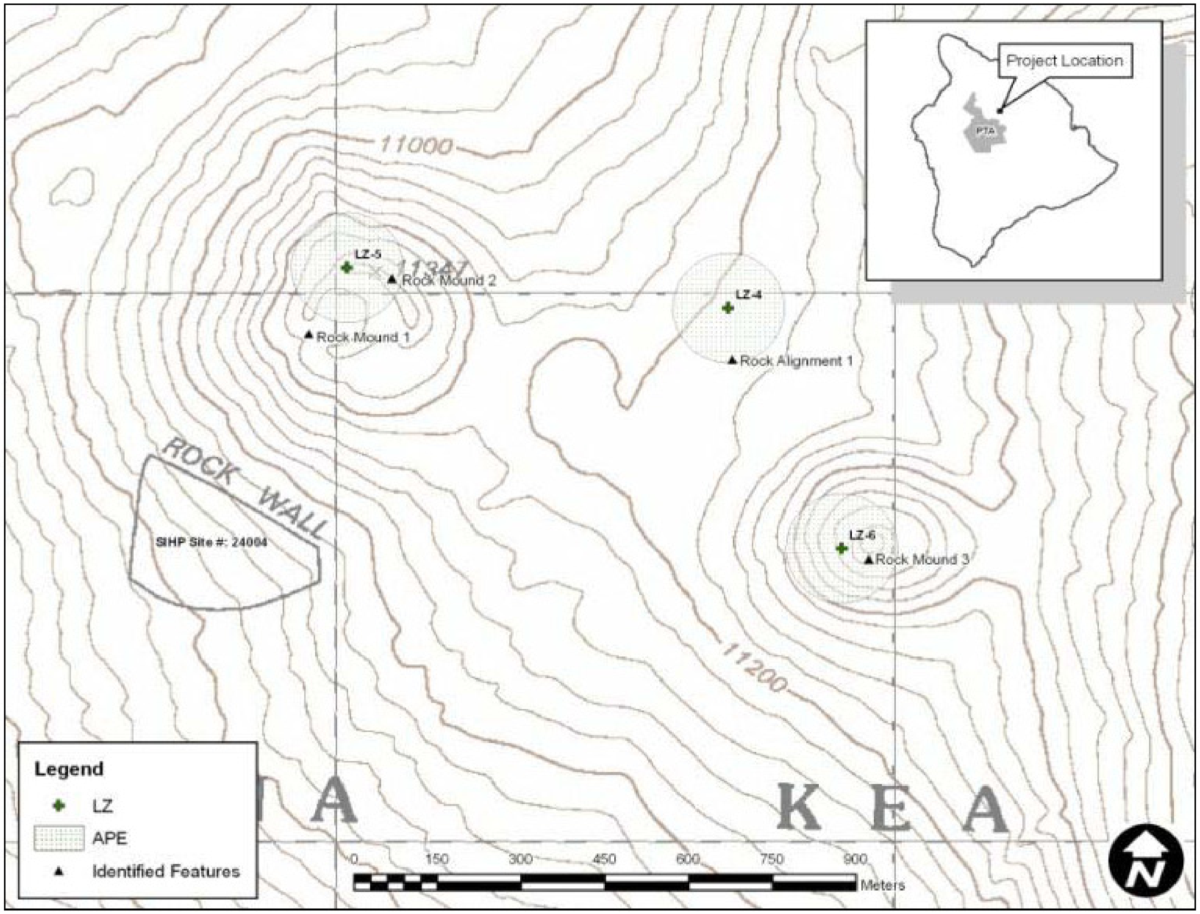


Figure 1. Location of LZs, APE, and identified cultural resources

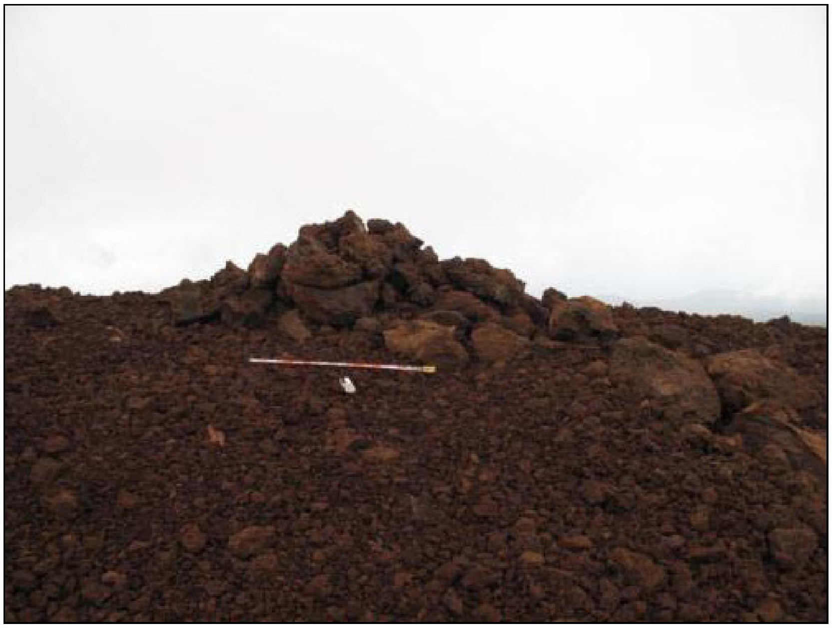


Figure 2. Rock Mound 1 near LZ5, looking south

Figure 3. Rock Mound 2 near LZ5, looking south

Figure 4. View from top of Rock Mound 2 to Rock Mound 1 near LZ5, looking south

Figure 5. Rock Mound 3 near LZ 6, looking west

Figure 6. Rock Mound 3 near LZ6 with view of Rock Mounds 1 and 2 near LZ5, looking west

Figure 7. Rock Alignment 1 near LZ4, looking east

Figure 8. Rock Alignment 1 near LZ4, looking west-southwest

IMPC-HI-PWE **24 March 2011**

MEMORANDUM FOR THE RECORD

SUBJECT: Archaeological Monitoring of Rock Mounds near Landing Zones 5 and 6 (LZ-5 and LZ-6) of the High Altitude Mountainous Environmental Training (HAMET) LZ's on Mauna Kea, [TMK (3) 4-4-015:001, Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island.

1. On March 24, 2011 , Mr. David Crowell and Ms. Kehaulani S. Kerr, Cultural Resources Program Manager and Cultural Resources Specialist at Pōhakuloa Training Area (PTA), performed monitoring of the rock mounds (Rock Mounds 1-3) identified near LZ-5 and LZ-6 HAMET locations on Mauna Kea. The LZ-5 and LZ-6 HAMET locations are located approximately 8km north of PTA on the northwestern flank of Mauna Kea, below the summit at approximately 11,000 – 12,000 fasl.

2. The rock mounds at LZ-5 and LZ-6 HAMET locations were previously identified in December 2003 (Godby and Head 2003) and February 2011 (Crowell 2011). The project area, APE, and results of the 2011 (Crowell) survey are depicted in Figure 1. Rock Alignment 1 near LZ-4 was not identified for monitoring. Monitoring of Rock Mound 1 and 2 near LZ-5 and Rock Mound 3 near LZ-6 was performed on March 24, 2011 during a break in the U.S. Army Combat Aviation Brigade (CAB) training that used the HAMET LZ's from March 21 – April 1, 2011. The monitoring is being performed to ascertain whether the HAMET training has any potential effects on the rock mounds. Follow up monitoring of the Rock Mounds will also be performed on April 4, 2011 at the conclusion of CAB training.

3. Monitoring consisted of a visual inspection of each rock mound and the immediate vicinity around each mound. Locations of photographs from the 02/24/11 survey were identified (Figure 2, Figure 7, and Figure 12) and new photographs were taken from those locations to document any potential effects to the mounds. Additional photographs were taken of the remaining profiles of each rock mound in order to more fully document the mounds and to provide additional baseline data from which monitoring of potential effects may be performed.

4. Mr. Crowell and Ms. Kerr began archaeological monitoring at Rock Mound 1 near LZ-5. Rock Mound 1 was observed to be partially collapsed during the February 24, 2011 survey with several rocks having tumbled from the mound especially on the north, west, and south profiles. On March 24, 2011 no additional tumbled rocks or collapse of the mound was observed and it appeared to be intact from the previous visit with no adverse effects from the HAMET training (Figure 2 - Figure 3). The east, south, and west profiles were also photographed (Figure 4 - Figure 6) for comparison purposes.

Enclosure 5

5. Rock Mound 2 near LZ-5 was the next location that was monitored. During the February 24, 2011 survey Rock Mound 2 was observed as being partially collapsed, with some rocks that had tumbled from the north and west profiles, but not as extensively as Rock Mound 1. On March 24, 2011 no additional tumbled rocks or collapse of the mound was observed and it appeared to be intact from the previous visit with no adverse effects from the HAMET training (Figure 7 - Figure 8). The east, south, and west profiles were also photographed (Figure 9 - Figure 11) for comparison purposes.

6. Rock Mound 3 near LZ-6 was the final location that was monitored. During the February 24, 2011 survey Rock Mound 3 was observed as being slightly collapsed, with some rocks that had tumbled from the south profile. On March 24, 2011 no additional tumbled rocks or collapse of the mound was observed and it appeared to be intact from the previous visit with no adverse effects from the HAMET training (Figure 12 - Figure 13). The south, west, and north profiles were also photographed (Figure 14 - Figure 16) for comparison purposes.

David M. Crowell
Cultural Resources Program Manger
Environmental Office, PTA

References

Godby, William and James Head

2003 Trip Report for the Archaeological Survey of Proposed Helicopter Landing Areas (LZ-5, LZ-5a, and LZ-6) for High Altitude Training from December 8, 2003 to December 12, 2003. On File at PTA.

Crowell, David M.

2011 Cultural Resources Reconnaissance Survey of Existing High Altitude Mountainous Environmental Training (HAMET) Landing Zones (LZ) on Mauna Kea, [TMK (3) 4-4-015:001, Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island. On File at PTA

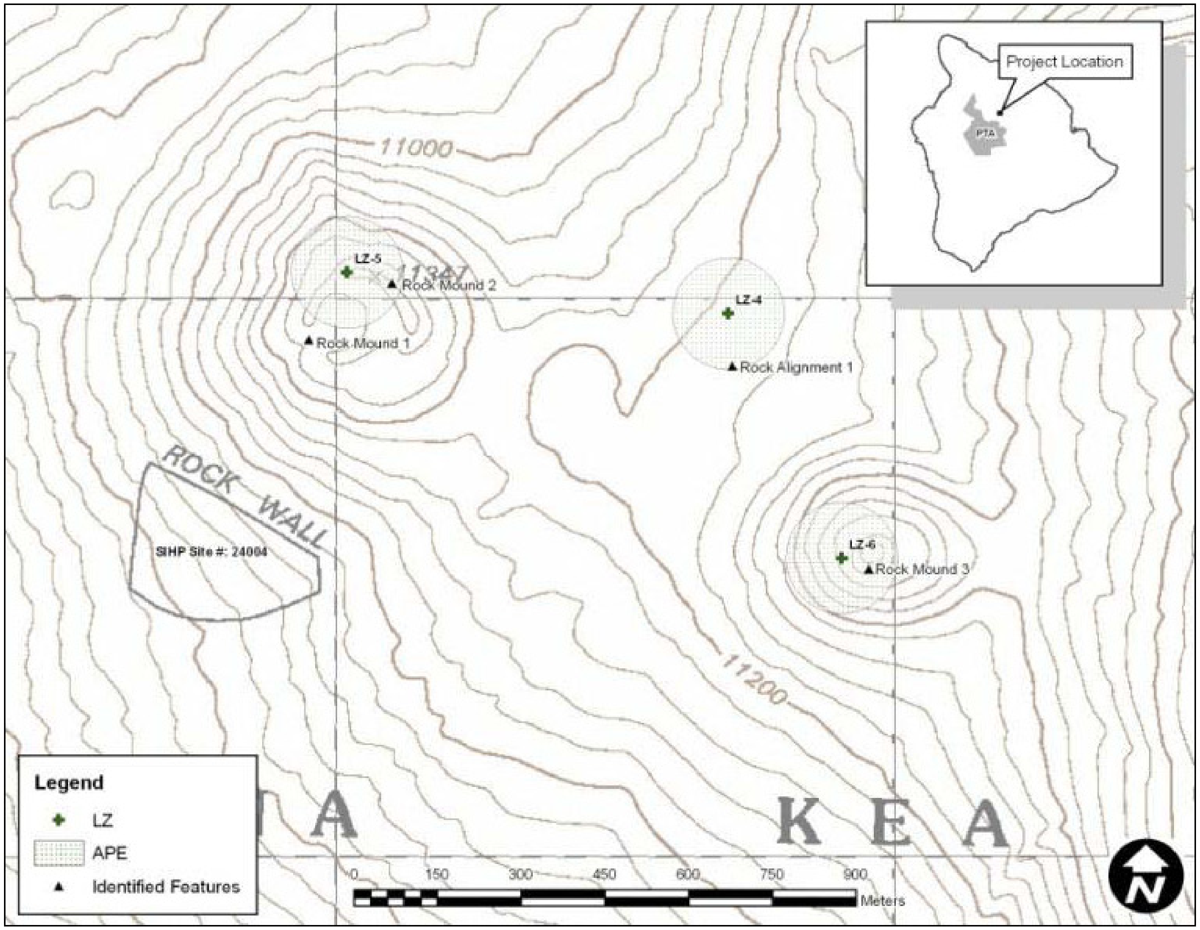


Figure 1. Location of LZs, APE, and identified cultural resources

Figure 2. Rock Mound 1 near LZ-5, looking south, photo taken on 02/24/11

Figure 3. Rock Mound 1 near LZ-5, looking south, photo taken on 03/24/11

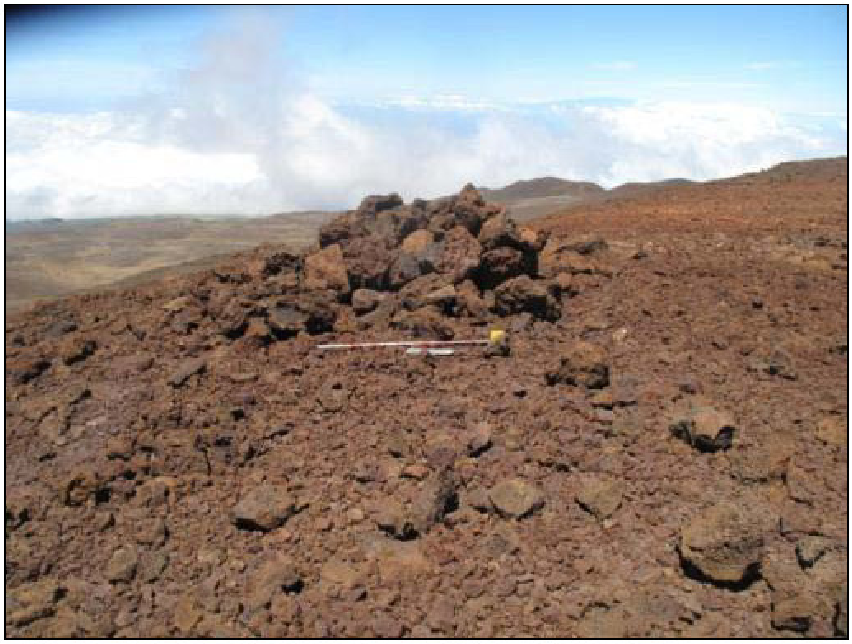


Figure 4. Rock Mound 1 near LZ5, looking west, photo taken on 03/24/11

Figure 5. Rock Mound 1 near LZ5, looking north, photo taken on 03/24/11

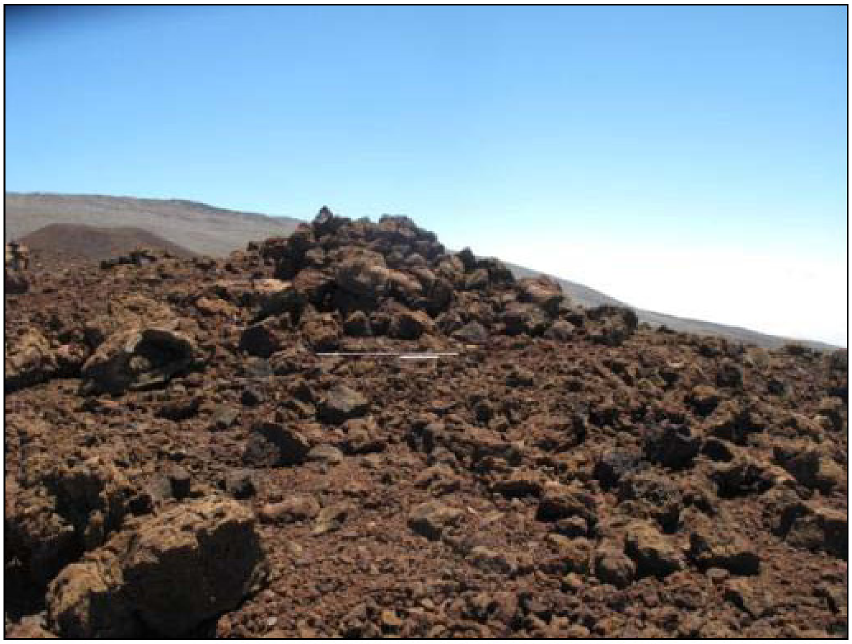


Figure 6. Rock Mound 1 near LZ5, looking east, photo taken on 03/24/11

Figure 7. Rock Mound 2 near LZ5, looking south, photo taken on 02/24/11

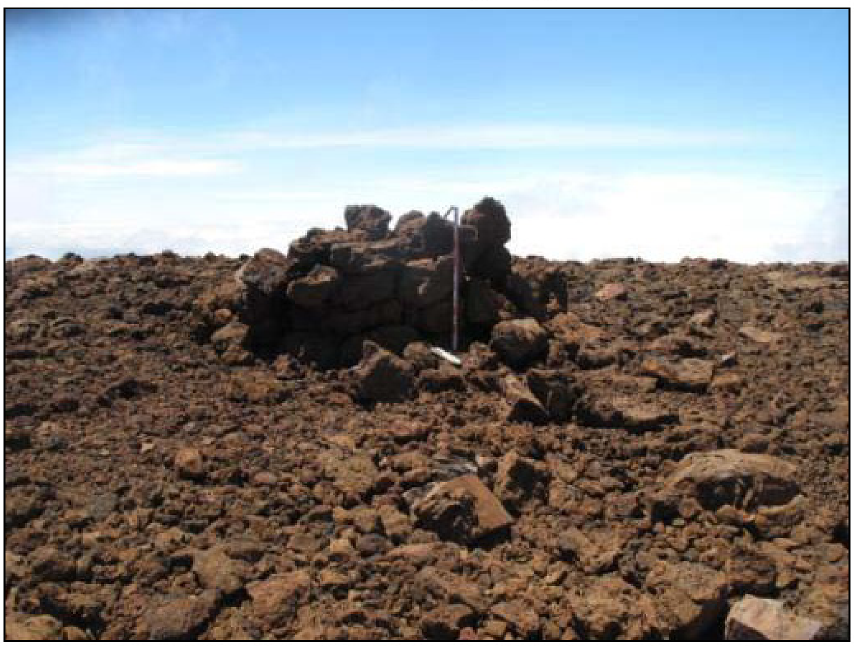


Figure 8. Rock Mound 2 near LZ5, looking south, photo taken on 03/24/11

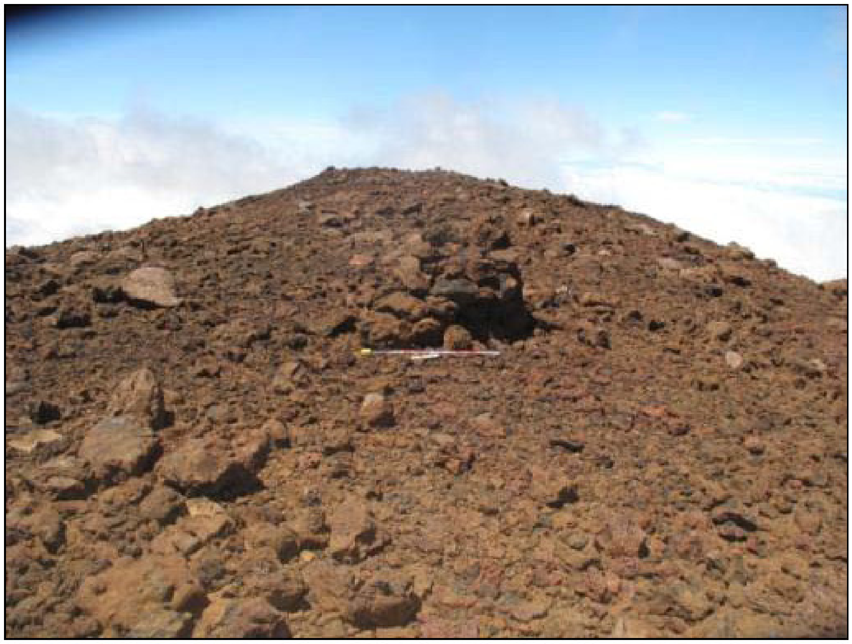


Figure 9. Rock Mound 2 near LZ5, looking west, photo taken on 03/24/11

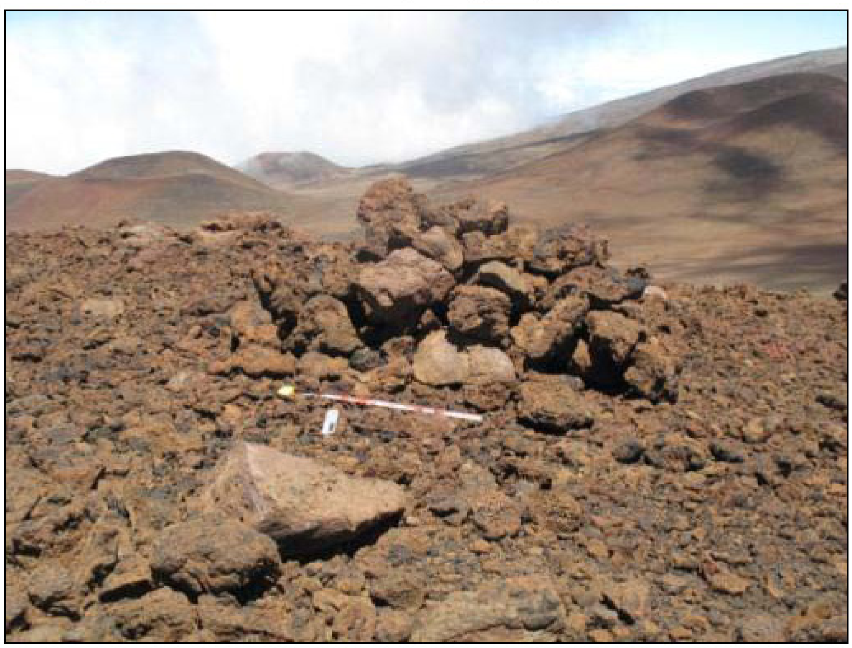


Figure 10. Rock Mound 2 near LZ-5, looking north, photo taken on 03/24/11

Figure 11. Rock Mound 2 near LZ5, looking east, photo taken on 03/24/11

Figure 12. Rock Mound 3 near LZ-6, looking west, photo taken on 02/24/11

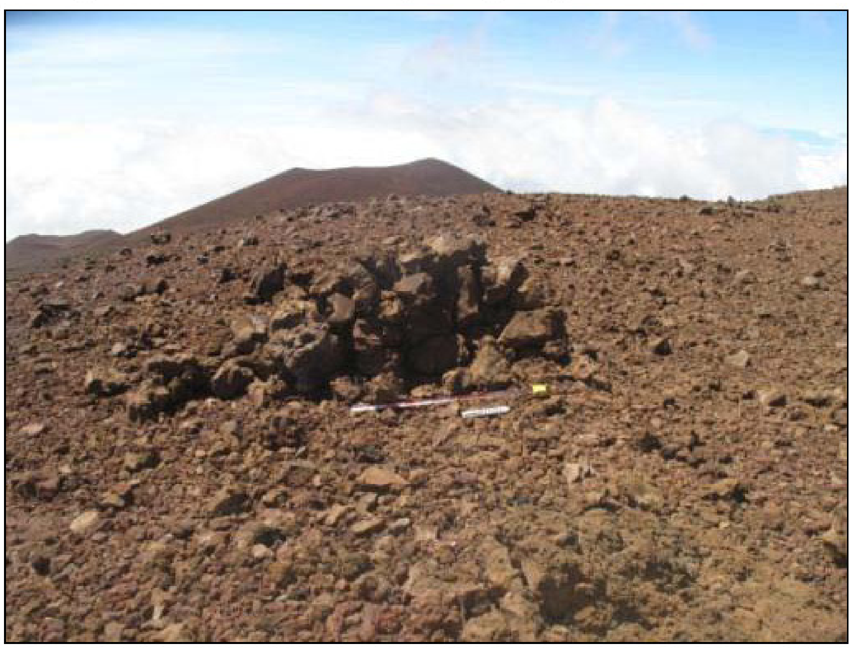


Figure 13. Rock Mound 3 near LZ-6, looking west, photo taken on 03/24/11

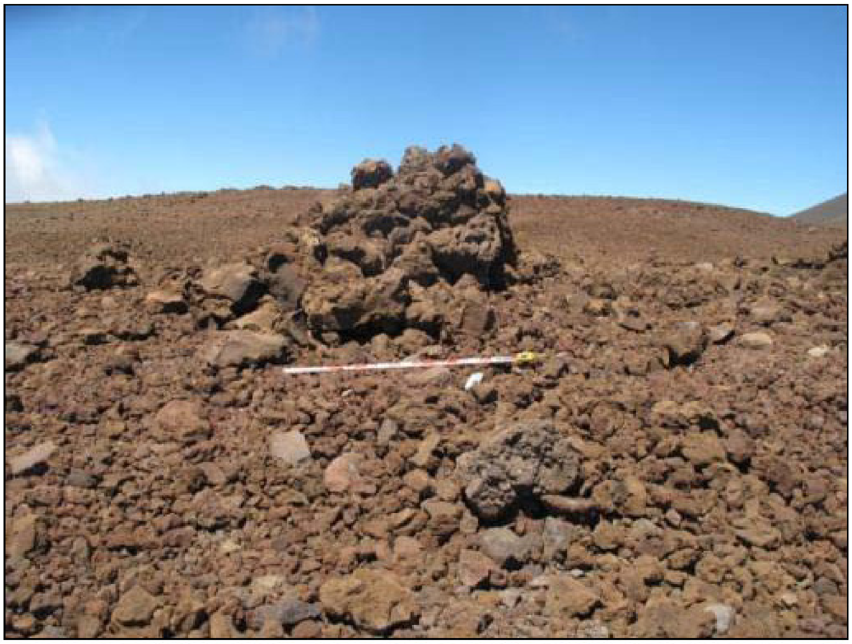


Figure 14. Rock Mound 3 near LZ-6, looking north, photo taken on 03/24/11

Figure 15. Rock Mound 3 near LZ-6, looking east, photo taken on 03/24/11

Figure 16. Rock Mound 3 near LZ-6, looking south, photo taken on 03/24/11

IMPC-HI-PWE **04 April 2011**

MEMORANDUM FOR THE RECORD

SUBJECT: Archaeological Monitoring of Rock Mounds near Landing Zones 5 and 6 (LZ-5 and LZ-6) of the High Altitude Mountainous Environmental Training (HAMET) LZ's on Mauna Kea, [TMK (3) 4-4-015:001, Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island.

1. On April 4, 2011 , Mr. David Crowell and Ms. Kehaulani S. Kerr, Cultural Resources Program Manager and Cultural Resources Specialist at Pōhakuloa Training Area (PTA), performed monitoring of the rock mounds (Rock Mounds 1-3) identified near LZ-5 and LZ-6 HAMET locations on Mauna Kea. The LZ-5 and LZ-6 HAMET locations are located approximately 8km north of PTA on the northwestern flank of Mauna Kea, below the summit at approximately 11,000 – 12,000 fasl.

2. The rock mounds at LZ-5 and LZ-6 HAMET locations were previously identified in December 2003 (Godby and Head 2003) and February 2011 (Crowell 2011). The project area, APE, and results of the 2011 (Crowell) survey are depicted in Figure 1. Rock Alignment 1 near LZ-4 was not identified for monitoring. Monitoring of Rock Mound 1 and 2 near LZ-5 and Rock Mound 3 near LZ-6 was performed on March 24, 2011 during a break in the U.S. Army Combat Aviation Brigade (CAB) training episode using the HAMET LZ's. The monitoring is being performed to ascertain whether the HAMET training has any potential effects on the rock mounds. Follow up monitoring of the Rock Mounds was also performed on April 4, 2011 at the conclusion of CAB training.

3. Monitoring consisted of a visual inspection of each rock mound and the immediate vicinity around each mound. Locations of photographs from the February 24, 2011 survey were identified (Figure 2, Figure 11, and Figure 18) and new photographs were taken from those locations to document any potential effects to the mounds. Additional photographs were taken of the remaining profiles of each rock mound in order to more fully document the mounds and to provide additional baseline data from which monitoring of potential effects may be performed.

4. Mr. Crowell and Ms. Kerr began archaeological monitoring at Rock Mound 1 near LZ-5. Rock Mound 1 was observed to be partially collapsed during the February 24, 2011 survey with several rocks having tumbled from the mound especially on the north, west, and south profiles. On April 4, 2011 no additional tumbled rocks or collapse of the mound was observed and it appeared to be intact from the previous visit with no adverse effects from the HAMET training (Figure 2 -Figure 4). The east, south, and west profiles were also photographed (Figure 5 - Figure 10) and compared with the photographs from the March 24, 2011 monitoring episode. No adverse effects were observed on any side of Rock Mound 1.

Enclosure 6

5. Rock Mound 2 near LZ-5 was the next location that was monitored. During the February 24, 2011 survey Rock Mound 2 was observed as being partially collapsed, with some rocks that had tumbled from the north and west profiles, but not as extensively as Rock Mound 1. On April 4, 2011 no additional tumbled rocks or collapse of the mound was observed and it appeared to be intact from the previous visit with no adverse effects from the HAMET training (Figure 11 - Figure 13). The east, south, and west profiles were also photographed (Figure 14 - Figure 17) and compared with the photographs from the March 24, 2011 monitoring episode. No adverse effects were observed on any side of Rock Mound 2.

6. Rock Mound 3 near LZ-6 was the final location that was monitored. During the February 24, 2011 survey Rock Mound 3 was observed as being slightly collapsed, with some rocks that had tumbled from the south profile. On April 4, 2011 no additional tumbled rocks or collapse of the mound was observed and it appeared to be intact from the previous visit with no adverse effects from the HAMET training (Figure 18 - Figure 20). The south, west, and north profiles were also photographed (Figure 21- Figure 26) and compared with the photographs from the March 24, 2011 monitoring episode. No adverse effects were observed on any side of Rock Mound 3.

David M. Crowell
Cultural Resources Program Manger
Environmental Office, PTA

References

Godby, William and James Head

2003 Trip Report for the Archaeological Survey of Proposed Helicopter Landing Areas (LZ-5, LZ-5a, and LZ-6) for High Altitude Training from December 8, 2003 to December 12, 2003. On File at PTA.

Crowell, David M.

2011 Cultural Resources Reconnaissance Survey of Existing High Altitude Mountainous Environmental Training (HAMET) Landing Zones (LZ) on Mauna Kea, [TMK (3) 4-4-015:001, Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island. On File at PTA

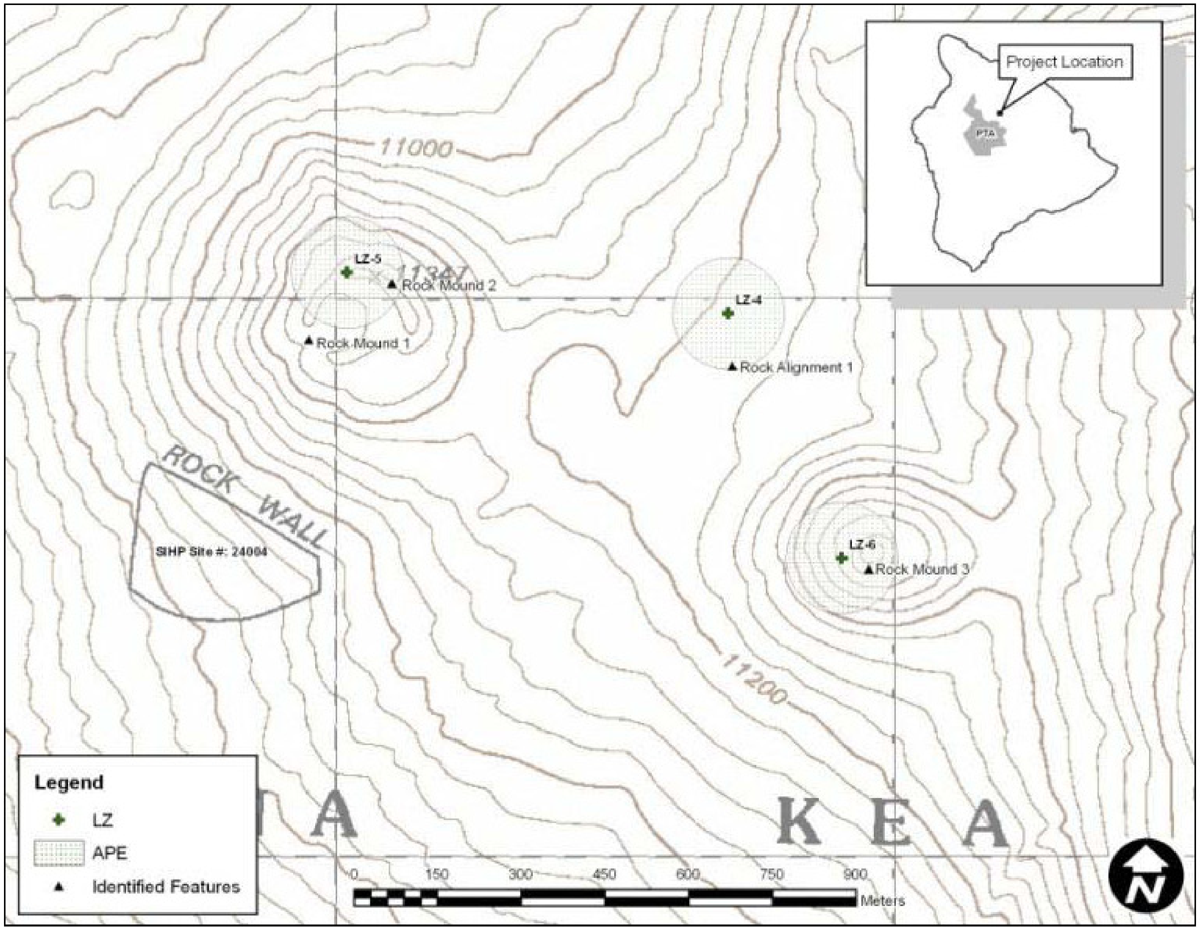


Figure 1. Location of LZs, APE, and identified cultural resources

Figure 2. Rock Mound 1 near LZ-5, looking south, photo taken on 02/24/11

Figure 3. Rock Mound 1 near LZ-5, looking south, photo taken on 03/24/11

Figure 4. Rock Mound 1 near LZ-5, looking south, photo taken on 04/04/11

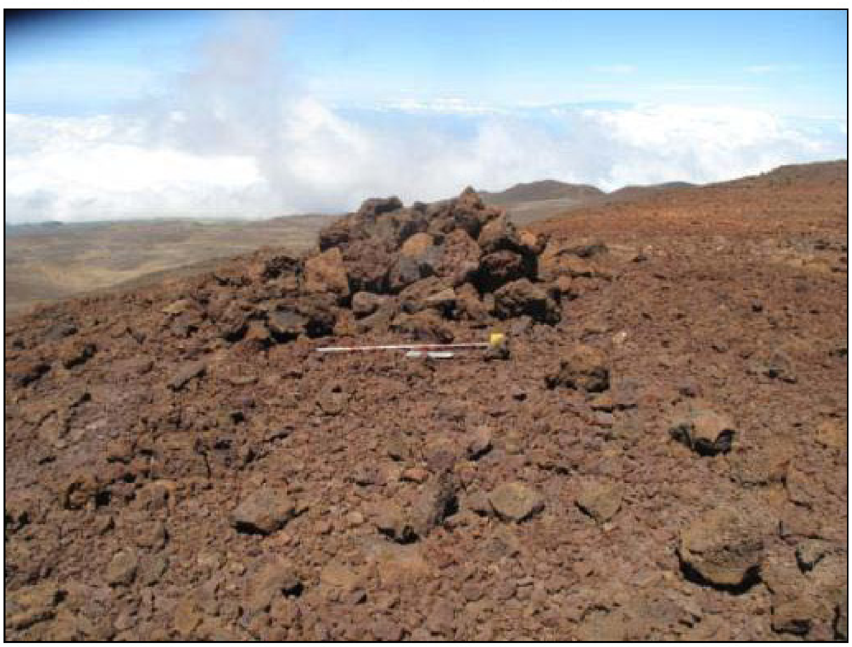


Figure 5. Rock Mound 1 near LZ5, looking west, photo taken on 03/24/11

Figure 6. Rock Mound 1 near LZ-5, looking west, photo taken on 04/04/11

Figure 7. Rock Mound 1 near LZ5, looking north, photo taken on 03/24/11

Figure 8. Rock Mound 1 near LZ-5, looking north, photo taken on 04/04/11

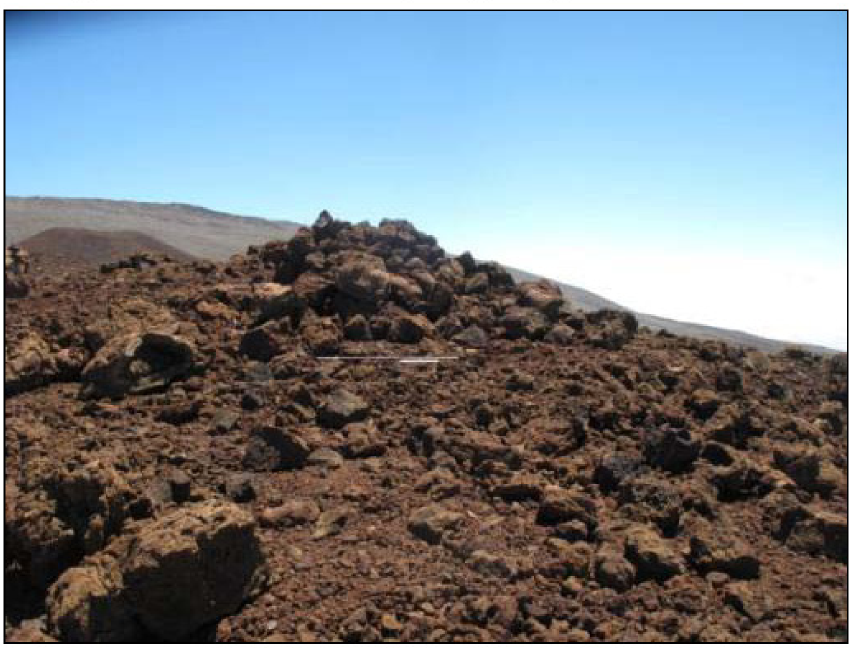


Figure 9. Rock Mound 1 near LZ5, looking east, photo taken on 03/24/11

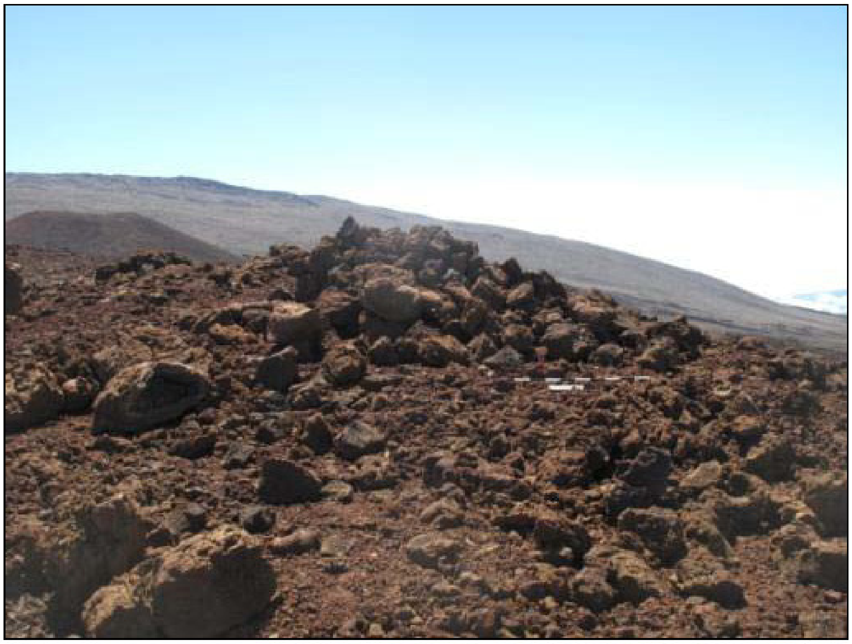


Figure 10. Rock Mound 1 near LZ-5, looking east, photo taken on 04/04/11

Figure 11. Rock Mound 2 near LZ5, looking south, photo taken on 02/24/11

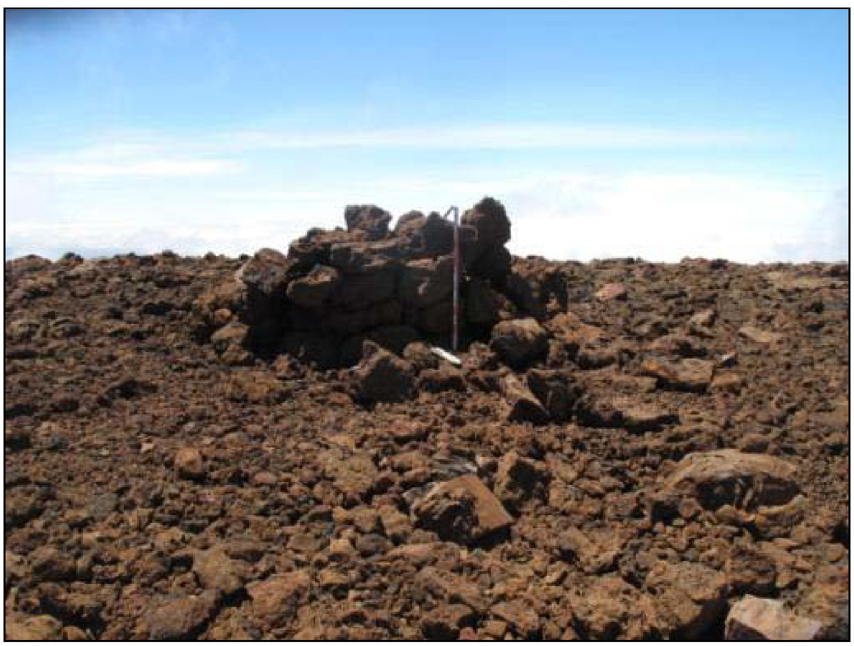


Figure 12. Rock Mound 2 near LZ5, looking south, photo taken on 03/24/11

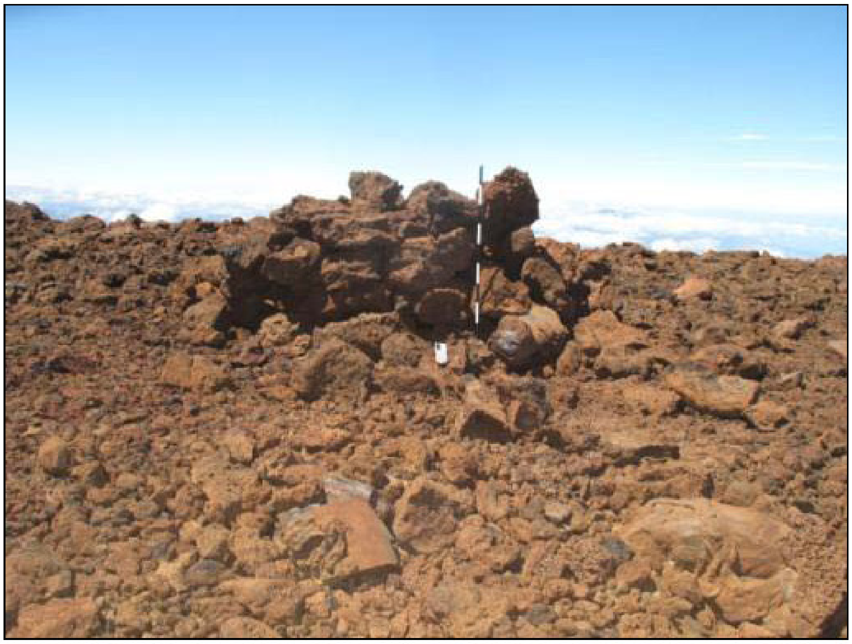


Figure 13. Rock Mound 2 near LZ5, looking south, photo taken on 04/04/11

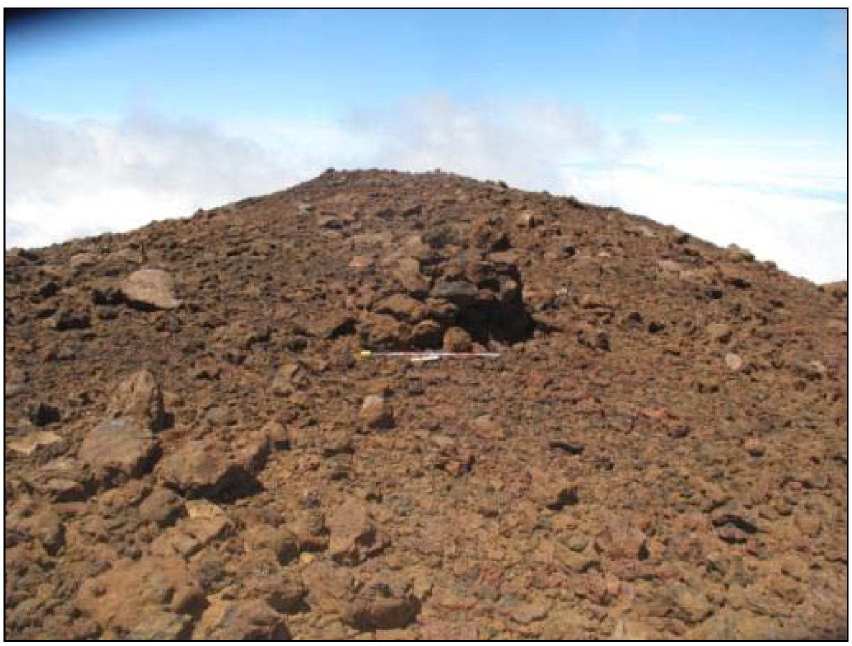


Figure 14. Rock Mound 2 near LZ5, looking west, photo taken on 03/24/11

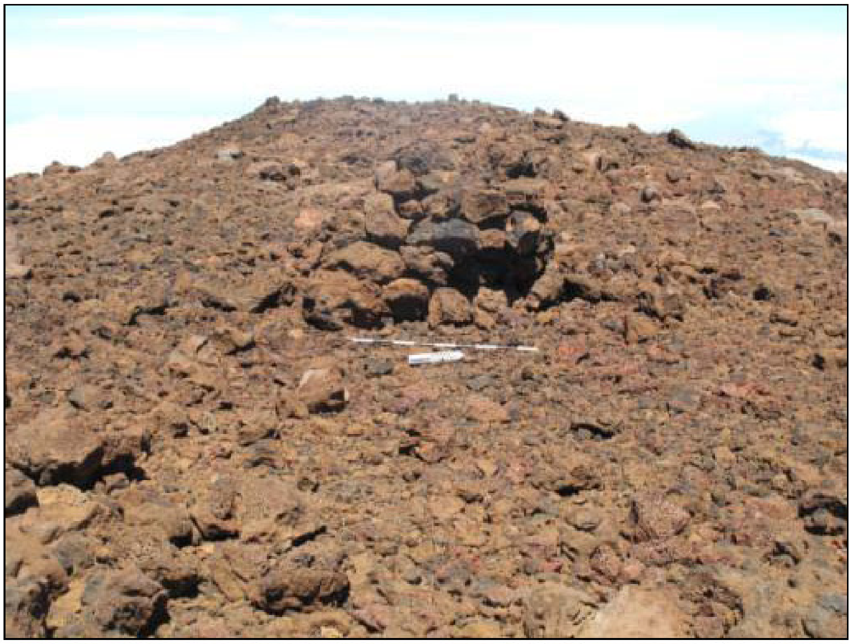


Figure 15. Rock Mound 2 near LZ5, looking west, photo taken on 04/04/11

Figure 16. Rock Mound 2 near LZ5, looking east, photo taken on 03/24/11

Figure 17. Rock Mound 2 near LZ5, looking east, photo taken on 04/04/11

Figure 18. Rock Mound 3 near LZ-6, looking west, photo taken on 02/24/11

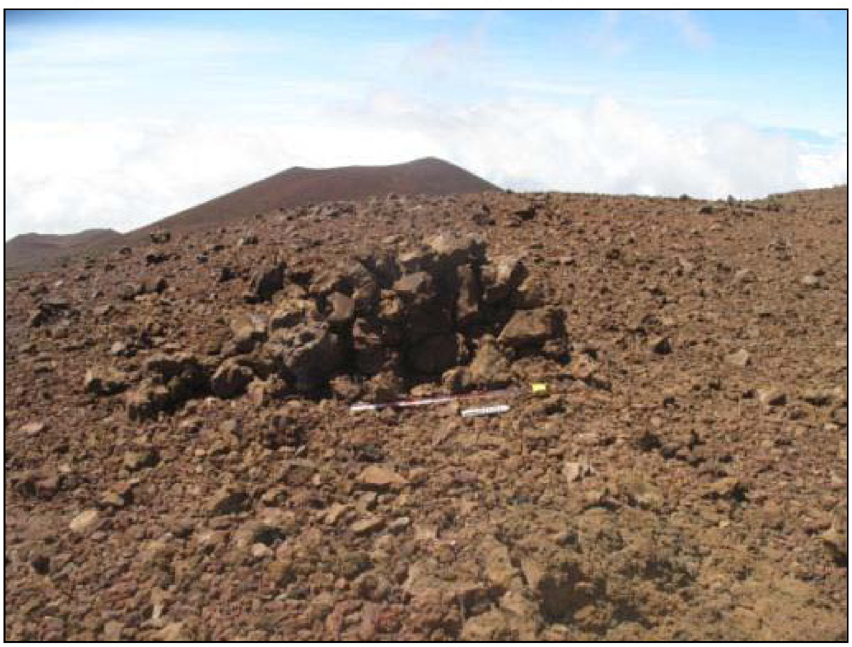


Figure 19. Rock Mound 3 near LZ-6, looking west, photo taken on 03/24/11

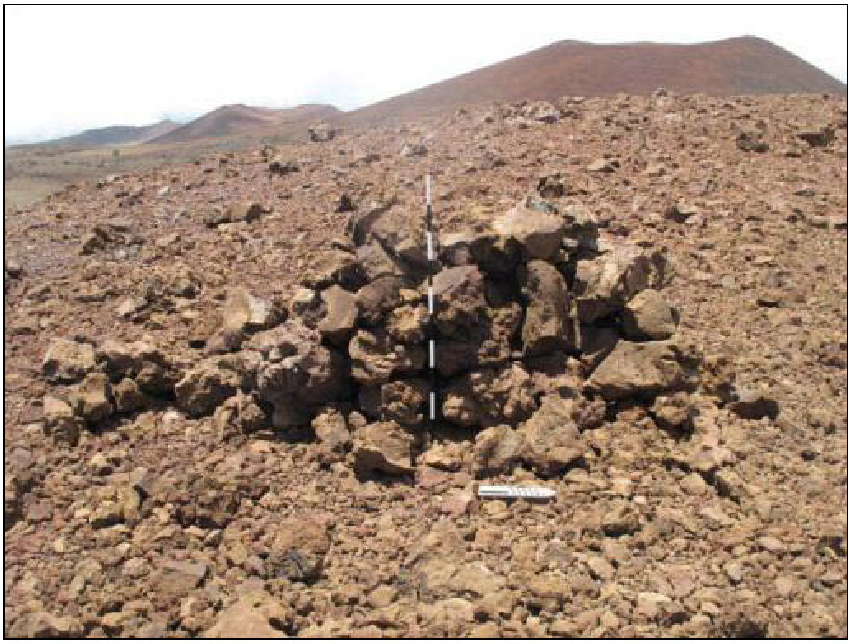


Figure 20. Rock Mound 3 near LZ-6, looking west, photo taken on 04/04/11

Figure 21. Rock Mound 3 near LZ-6, looking north, photo taken on 03/24/11

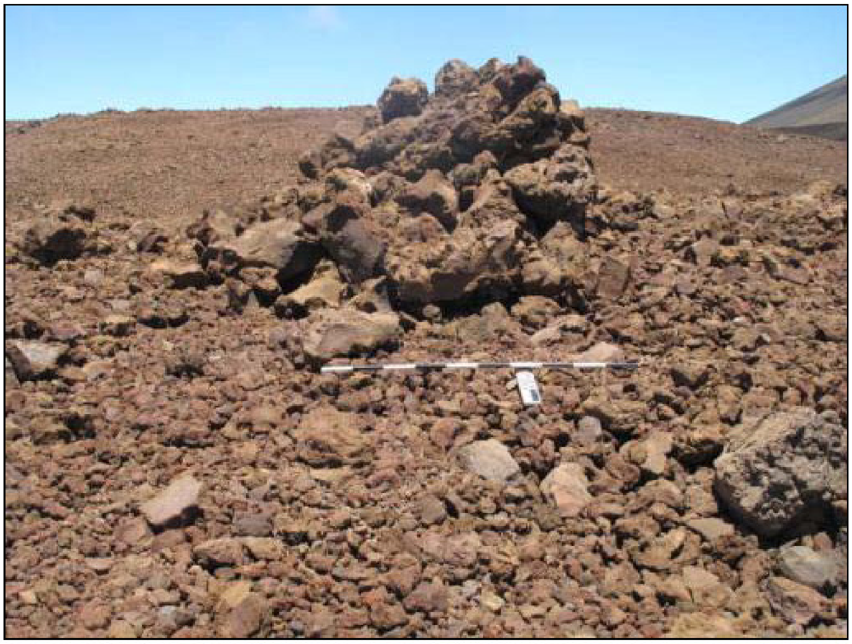


Figure 22. Rock Mound 3 near LZ-6, looking north, photo taken on 04/04/11

Figure 23. Rock Mound 3 near LZ-6, looking east, photo taken on 03/24/11

Figure 24. Rock Mound 3 near LZ-6, looking east, photo taken on 04/04/11

Figure 25. Rock Mound 3 near LZ-6, looking south, photo taken on 03/24/11

Figure 26. Rock Mound 3 near LZ-6, looking south, photo taken on 04/04/11

IMPC-HI-PWE **22 March 2011**

MEMORANDUM FOR THE RECORD

SUBJECT: Cultural Resources Reconnaissance Survey for noise monitor placements on Mauna Kea, [TMK (3) 4-4-015:001 & TMK (3) 4-4-015:09] Ka'ohe Ahupua'a, Hāmākua District, Hawai'i Island.

1. On March 19th & 20th, 2011, Mr. David Crowell and Ms. Kehaulani Kerr, Cultural Resources Program Manager and Cultural Resources Specialist at Pōhakuloa Training Area (PTA), conducted a cultural resources reconnaissance survey of six locations on Mauna Kea to monitor the noise associated with the high altitude training at the existing HAMET LZ locations on Mauna Kea (LZ-4, LZ-5, LZ-6). The HAMET LZ locations are located approximately 8km north of PTA on the northwestern flank of Mauna Kea, below the summit at approximately 11,000 – 12,000 feet above sea level (fasl). The noise monitors (1-3) covers approximately 850 *hectares* and is located to the northwest of the cantonment area at PTA. The noise monitors (4-6) covers approximately 150 *hectares* and is located to the western side of the summit on Mauna Kea (figure 1).

2. The HAMET LZ locations were previously surveyed in October and December 2003 (Godby and Head 2003a, Godby and Head 2003b). The previous efforts investigated only the 15m x 15m footprint of the LZs while the current investigation included a 100m area from the center of the LZs as the Area of Potential Effect (APE). On February 24th, 2010, PTA cultural resources (CR) staff preformed the cultural resources reconnaissance survey for the existing HAMET LZ locations on Mauna Kea. On March 19th, 2011, Mr. Crowell and Ms. Kerr joined Don Weir (Ranger- Office of Mauna Kea Management), David Lodman and Jim Jackson (Portage, Inc.) at the visitor center and proceeded to the summit of Mauna Kea to install noise monitors (4-6). The noise control study will collect scientific data that shows if the archaeological sites in the area will be impacted by the high altitude training as well as study the impacts from recreational uses by the visiting public and hunters. On March 20^{th}, 2010, Mr. Crowell and Ms. Kerr along with the contractors from Portage Inc. installed noise monitors (1-3). The noise monitors (1-3) located in Ka'ohe Game Management Area have been strategically place within the critical *Palila* habitat to study the effect of noise pollution to their environment.

3. Noise monitor #1 is located 470m north of Saddle road at the approximate elevation of 6000 fasl (0228474E, 2189226N) to the north side of saddle road. No archaeological sites were found within the area (figure 2).

Enclosure 7

4. Noise Monitor # 2 1 is located about 200m to the north of Pu'uokauha at the approximate elevation of 8000 fasl (0231310E, 2191370N). No archaeological sites were found within the area. Mr. Crowell and Ms. Kerr discovered three Palila during the placement of the noise monitor this day. Upon returning to the cantonment area at PTA, the natural resources section at PTA was notified of the discovery (figure 3).

5. Noise monitor #3 is located about 1250m west of Pu'unanaha at the approximate elevation of 7800 fasl (0230060E, 2196229N). No archaeological sites were discovered within the area (figure 4).

6. Noise monitor #4 is located within the Astronomy Precinct and was placed between the Subaru telescope and W.M Keck I at the approximate elevation of 13550 fasl (0240706E, 2194085N). There were no newly discovered archaeological sites within the area as Mr. Crowell and Ms. Kerr surveyed the area before the noise monitor was installed (figure 5).

7. Noise monitor #5 is located about 100m south of the Mauna Kea Ice Age Natural Area Reserve (NAR) also adjacent to *Pu'upōhaku* at the approximate elevation of 13,000 fasl (0239084E, 2193631N). There were no newly discovered archaeological sites with the area before the noise monitor was installed (figure 6).

8. Noise monitor #6 is located about 170m northeast of Lake Waiau at the approximate elevation of 13020 fasl (0240628E, 219669N). No newly discovered archaeological sites were found within the area (figure 7).

9. The project location is outside of the boundary of PTA. The Ka'ohe Game Management Area issued a permit to allow the environmental division at PTA, USAG-HI access to the area for the noise control study.

Kehaulani Kerr
Cultural Resource Specialist
Environmental Office, PTA

Godby, William and James Head

2003 Trip Report for the Archaeological Survey of Proposed Helicopter Landing Areas (LZ-5, LZ-5a, and LZ-6) for High Altitude Training from December 8, 2003 to December 12, 2003. On File at PTA.

Pacific Consulting Services, Inc.

2010 Office of Mauna Kea Management: Final Report. *Archaeological Inventory Survey of the Mauna Kea Science Reserve,* v. I.

Pacific Consulting Services, Inc.

2010 Office of Mauna Kea Management: Final Report. *Archaeological Inventory Survey of the Mauna Kea Science Reserve,* v. II.

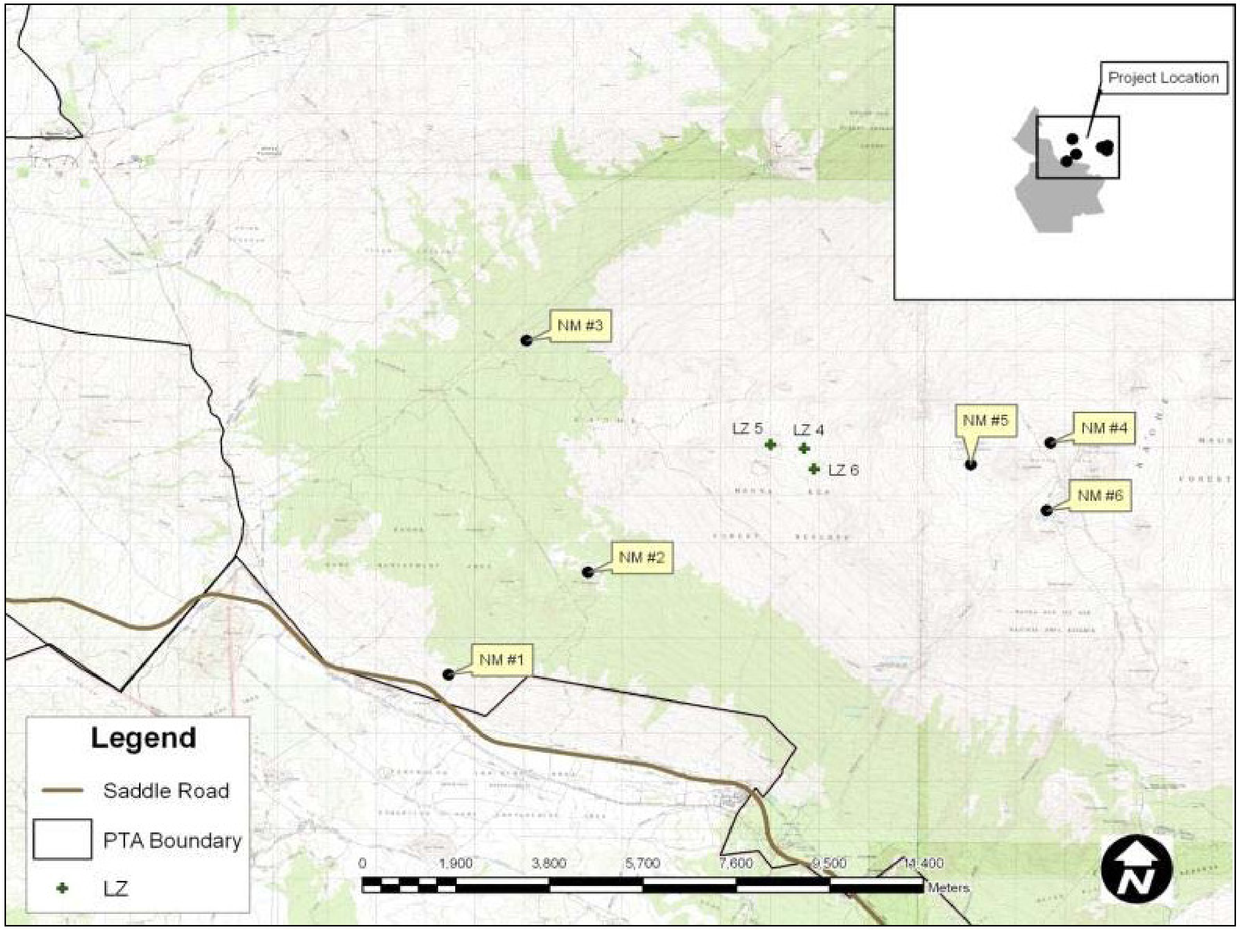


Figure 1. Location of noise monitors

Figure 2. Noise monitor #1

Figure 3. Noise monitor #2

Figure 4. Noise monitor #3

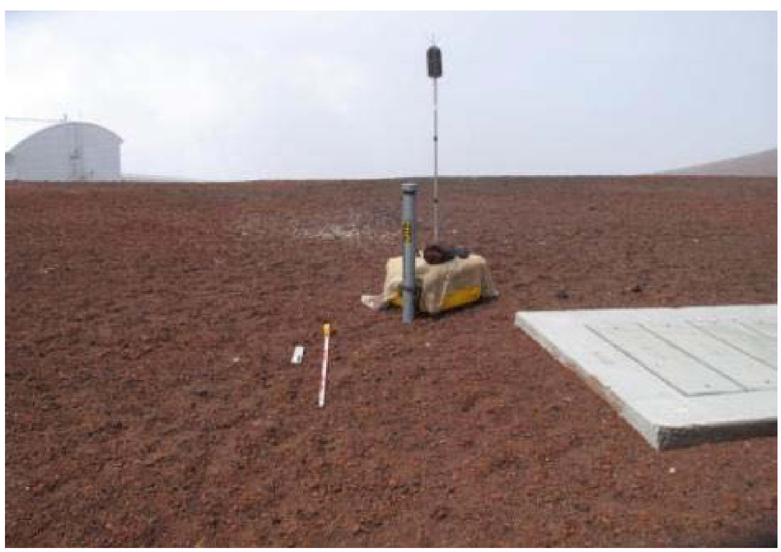


Figure 5. Noise monitor #4

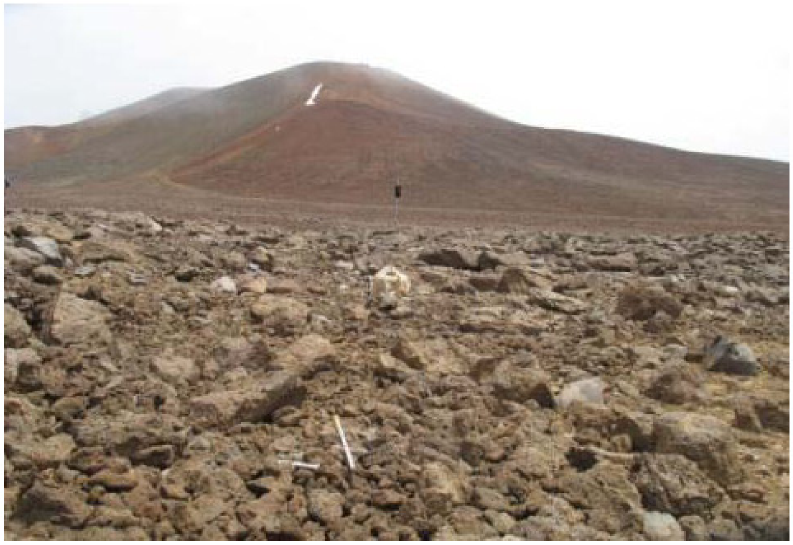


Figure 6. Noise monitor #5

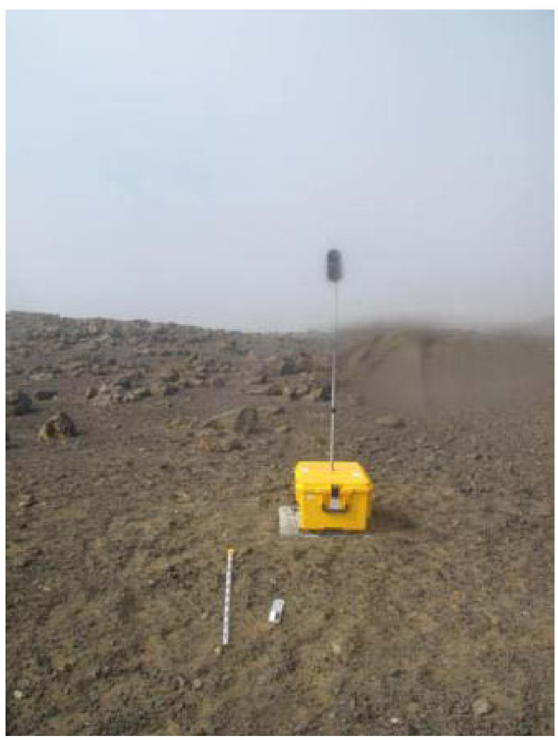


Figure 7. Noise monitor #6

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United States Department of the Interior

NATIONAL PARK SERVICE
Pacific West Region
300 Ala Moana Boulevard, Box 50165
Room 6-226
Honolulu, Hawaii 96850-0053

IN REPLY REFER TO
H4217

November 8, 2010

Department of the Army
U.S. Army Installation Management Command, Pacific Region
Headquarters, United States Army Garrison, Hawaii
Office of the Commander
851 Wright Avenue, Wheeler Army Airfield
Schofield Barracks, Hawaii 96857-5000

Attention: Dr. Julie M.E. Taomia
PTA Archeologist

RE: Section 106 consultation, proposed use of 6 previously disturbed, high elevation helicopter landing zones in the vicinity of the Pohakuloa Training Area (PTA), Island of Hawaii, for training operations.

Dear Dr. Taomia:

We are in receipt of your request for Section 106 consultation regarding the above-referenced undertaking. We understand that these areas are already used by State and private helicopters and will be used in future sporadic training sessions involving landings and takeoffs with no ground altering activities in the helicopter landing zone sites. We acknowledge that PTA cultural resource staff have visited and surveyed the proposed sites and no historic properties were identified in the immediate vicinity.

The National Park Service concurs with the determination that no historic properties will be affected by this project but are concerned with potential noise issues and overflights or flight paths that may affect protected properties and cultural landscapes. We note the proximity of the Mauna Kea landing zones in relation to the Mauna Kea Ice Age Natural Area Reserve and the Mauna Kea National Natural Landmark and the close proximity of the Mauna Loa landing sites to the Kipuka Ainahou Nene Sanctuary.

If you need additional information, please do not hesitate to contact me at (808)541-2693 ext. 723 or by email at Frank_Hays@nps.gov

Sincerely,

Frank Hays
Pacific Area Director

ccc: Elaine Jackson-Retondo, NPS, PWR-Oakland
Mark Rudo, NPS, PWR-Oakland

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DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND, PACIFIC REGION
HEADQUARTERS, UNITED STATES ARMY GARRISON, HAWAII
851 WRIGHT AVENUE, WHEELER ARMY AIRFIELD
SCHOFIELD BARRACKS, HAWAII 96857-5000

REPLY TO ATTENTION OF:

OCT 20 2010

Office of the Commander

Ms. Laura H. Thielen
State Historic Preservation Officer
Chairperson
Department of Land and Natural Resources Kakuhihewa Building, Room 555
601 Kamokila Boulevard
Kapolei, HI 96707

Dear Ms. Thielen:

On behalf of the Commander of the US Army Garrison, Hawaii, I am writing to begin consultation under Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations (36 CFR Part 800) on a project proposed on Hawaii State land in the vicinity of the Pōhakuloa Training Area (PTA) in Hawai'i County, Island of Hawai'i. There are two proposed project locations, the first within the ahupua'a of Humu'ula, district of North Hilo (TMK: (3) 3-8-001:001), and the second is within the ahupua'a of Ka'ohe, district of Hāmākua (TMK: (3) 4-4-015:001). Please see Enclosure 1 for a list of all consulting parties.

I have determined that this project constitutes an undertaking. The purpose of this undertaking is to utilize six Helicopter Landing Zones (HLZs) in order to conduct high-altitude helicopter training operations. Three of the HLZs are located on Mauna Loa, those in Humu'ula Ahupua'a, and three are on Mauna Kea, in Ka'ohe Ahupua'a. The area of potential effect (APE) consists of three discrete, discontinuous locations on each mountain (six total) that have been bulldozed previously, creating relatively open, level areas (see Enclosure 2). These areas are used by State and private helicopters. In addition, the locations on Mauna Loa are located on the historic 1899 lava flow. Training at the sites will consist of multiple helicopter landings and takeoffs. Of necessity, this helicopter activity will be constrained to the established level areas, as the surrounding terrain, made up of barren lava, is too rugged to accommodate helicopter landing. No ground altering activities will be conducted at the HLZ sites. PTA cultural resource staff have visited and surveyed the proposed HLZ sites and no historic properties were identified (Enclosure 3). Training will take place at these sites sporadically from this time forward.

I have determined that no historic properties will be affected by this project. Pursuant to Section 106 of the National Historic Preservation Act of 1966 as amended and 36 CFR Section 800.2(c), we are seeking your concurrence on this determination. If there is no response to this letter from your office after 35 days of the date of this letter we will assume that you concur with the determinations made herein and the proposed measures for avoidance and the project shall proceed, in accordance with 36 CFR § 800.3(c)(4). Should you require additional information about this project, the point of contact is Dr. Julie M. E. Taomia, PTA Archeologist, at telephone number (808) 969-1966.

Sincerely,

Robert Eastwood

Robert Eastwood
Director of Public Works

Enclosures

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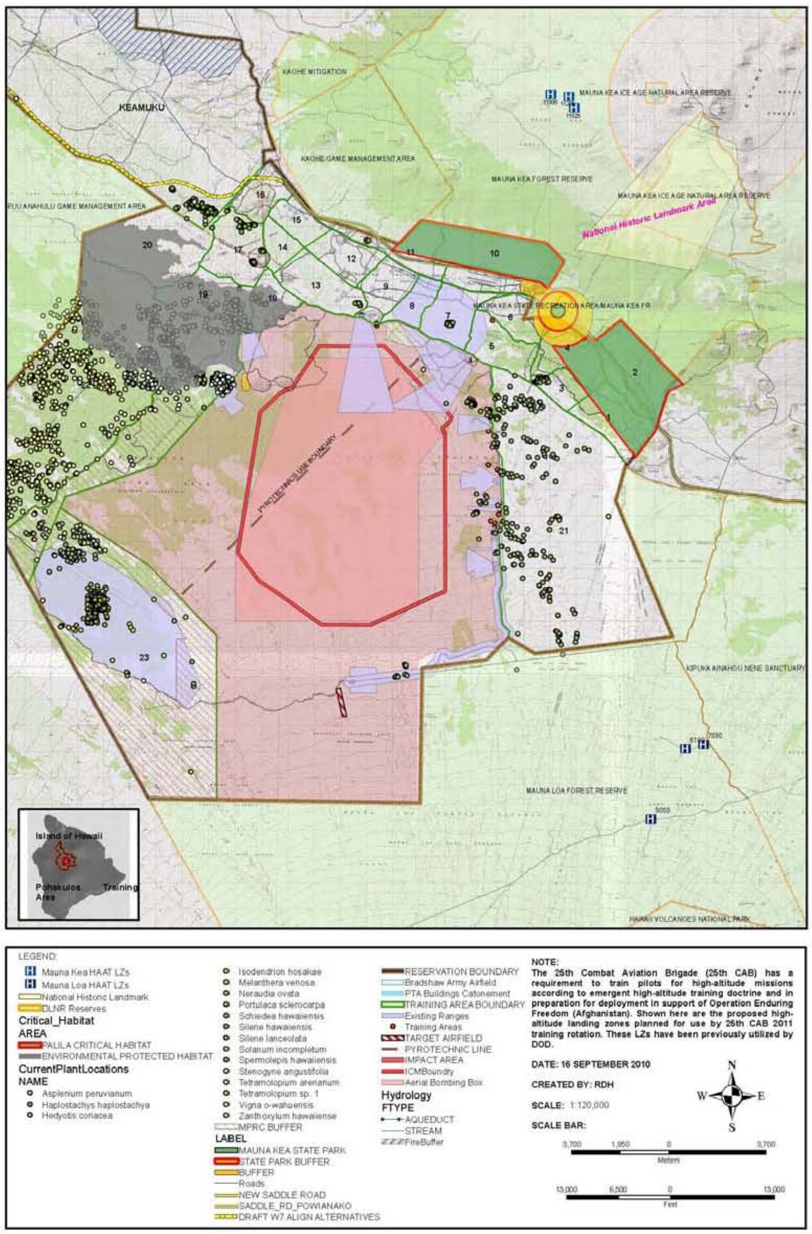
Pohakuloa Cultural Advisory Committee Attendees
Bi-Montly Meetings held at PTA Headquarters

Enclosure 1

25TH COMBAT AVIATION BRIGADE: HIGH-ALTITUDE ARMY AVIATION TRAINING



Enclosure 2

View of the location of a proposed landing zone, Mauna Loa.

View of a proposed landing zone, Mauna Loa (same location as previous photo).

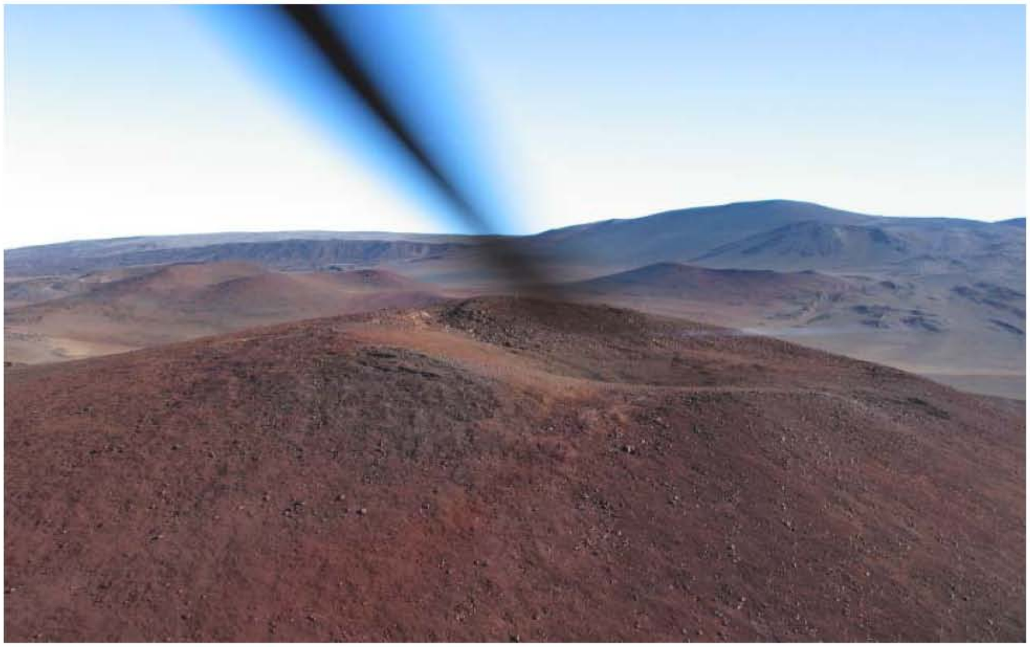
Enclosure 3

View of the location of a proposed landing zone, Mauna Loa.

View of the location of a proposed landing zone, Mauna Loa (same location as previous photo).

View of the location of a proposed landing zone, Mauna Loa.

View of the location of a proposed landing zone, Mauna Loa (same location as previous photo).



View of the location of a proposed landing zone, Mauna Kea.

View of the location of a proposed landing zone, Mauna Kea.

View of the location of a proposed landing zone, Mauna Kea.

View of the location of a proposed landing zone, Mauna Kea (same location as previous photo)

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NEIL ABERCROMBIE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
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CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

January 31, 2011

Log No. 2011.0099
Doc No. 1101TD09

MEMORANDUM

TO: Charlene Unoki, Assistant Administrator
Land Division
P.O. Box 621
Honolulu, Hawai`i 96809

FROM: Theresa K. Donham, Acting Archaeology Branch Chief

SUBJECT: **Chapter 6E-8 and National Historic Preservation Act (NHPA) Section 106 Review - Final Environmental Assessment and Draft Finding of No Significant Impact Proposed High-Altitude Mountainous Environmental Training (HAMET) Humu'ula Ahupua'a, North Hilo District (TMK: (3) 3-8-001:001) and Ka'ohe Ahupua`a, Hāmākua District (TMK: (3) 4-4-015: 001, Island of Hawai'i**

This is in response to your memo dated December 23, 2010 and received in our Kapolei office January 10, 2011 regarding the U.S. Army environmental Assessment and draft FONSI. We apologize for missing your response deadline of January 20, 2010. The NEPA Program Manager and Director of Public Works at Wheeler Army Airfield have also requested our comments regarding the EA and draft FONSI. They have also requested comments pursuant to NHPA Section 106. We assume that your office will be transmitting our comments to the appropriate Army officials. This letter addresses potential impacts to historic properties and to the extent possible, potential impacts to cultural practices. It appears that little consultation was conducted by the applicant regarding the second area of concern.

Project Description

The HAMET program will provide high-altitude helicopter training for military personnel prior to deployment to mountainous war zones. Six existing helicopter landing zones have been identified at elevations above 8,000 ft. on Mauna Kea (three in Ka'ohe) and Mauna Loa (three in Humu'ula). Three types of helicopters will be staged at the Bradshaw Airfield in the Pōhakuloa Training Area (PTA), for use during training (OH-58D Kiowa Warrior, UH-60 Black Hawk and CH-47D Chinook). Maneuvers will occur between February and August 2011, and could continue through February 2012 (EA, page 2-8). Training will include :Visual-meterological-conditions take-off, approach, hover and landing; abort and go-around procedures; 100-300 ft. reconnaissance over LZs; landing on a sloped or uneven surface; landing on pinnacles or ridges; navigating without modern technology; fuel management; and night operations. Training sessions will involve up to two aircraft per flight.

Area of Potential Effect

As identified in the Section 106 consultation correspondence, the area of potential effect (APE) for this undertaking "...consists of three discrete, discontinuous locations on each mountain (six total) that have been bulldozed previously, creating relatively open, level areas" (R. Eastwood letter to L. Thielen, October 20, 2010).

The EA for this project, prepared pursuant to NEPA, NHPA and ARPA identifies a continuous project area (ROI) that encompasses all six proposed LZs, Bradshaw Airfield, the eastern section of PTA, and a flight corridor between the Bradshaw Airfield and the LZs on Mauna Kea (EA Figure D-7). In addition, the project area extends *mauka* well beyond the identified LZs at both Ka'ohe and Humu'ula. We question why the APE identified in the Section 106 correspondence and the Project Area/ROI for the EA are so divergent. It appears that most of the project area as identified in the EA will potentially be subjected to low-elevation (100-300 ft) fly-over reconnaissance, as well as hovering and/or abort, go-around procedures. The EA states that no landings will occur outside the LZs; however, the proposed LZs are previously bulldozed, open, level areas that do not fit the requirements for landing on slopes, uneven surfaces, pinnacles or ridges, as indicated for this type of training. Based on a description of the project, we therefore believe that the Section 106 APE should minimally include the same geographic area as the project area identified in the EA, rather than six discontinuous locations. In situations where an LZ is at the boundary of the project area (i.e., LZ-3 in Humu'ula), it would appear that the APE would extend beyond the project area boundary as identified in the EA.

Identification of Historic Properties

Cultural resources staff at PTA conducted site inspections of the proposed LZ areas in Ka'ohe on October 22 and December 4, 2003; and in Humu'ula on May 20, 2009. Summaries of these inspections are reported in the EA. At the request of our office, copies of the memoranda describing these site inspections were forwarded for our records and for information purposes. Information provided in the PTA staff memoranda state that no historic properties were found within the LZ areas, which are described in the memos and in the EA as being previously bulldozed, leveled and cleared. The actual size of the LZs or area inspected is not provided in any of the documents reviewed. It is not certain how far the inspections extended beyond the previously graded areas, or whether a consistent perimeter zone was examined at all six locations. Nearby cultural features were located and briefly described in the Ka'ohe LZ area. One of these, a historic enclosure located approximately 450 meters south of LZ-5 (as determined by our GIS), was assigned SIHP Site 50-10-22-24004, and was described to a greater degree than a faced mound that was observed approximately 50 meters south of LZ-6. This latter feature may be within the area of rotor wash associated with training activities; its age, function and significance have not been determined, and no mitigation measures are proposed in the EA or in the Section 106 consultation correspondence. This feature is not mentioned in the EA, due to an error in correlating the field inspection memo with the final LZ numbers.

No additional field inspections or surveys were conducted within the project area; and it appears that no thorough records search was conducted to identify and locate known historic properties in relation to the project area. For example, Figure D-8 depicts the boundary of the Mauna Kea Summit Region Historic District and known historic properties within the project area; however there are no statements in the text acknowledging that a portion of the project area is within this Historic District and that LZ-6 is quite close to the district boundary. The EA discussions of archaeological/historic resources for the areas of Mauna Kea, Mauna Loa and the saddle area are less than one page for each area. In addition, as noted above, the information in the EA regarding historic properties for LZ-6 in Ka'ohe is not consistent with the information provided in the PTA staff memorandum regarding the archaeological inspection of this location, identified in the memo as LZ-5a (Godby & Head, December 4, 2003). Detailed comments regarding this topic and others are listed in the attachment.

Project Impacts and Proposed Mitigation Measures

A draft FONSI has been issued for this proposed training program. At this time, we are not confident that all of the historic properties have been identified within the areas of direct affect (in the near vicinity of LZs). We also find that no effort was made to identify, locate and assess historic properties that could be directly or indirectly affected by low flight/hover helicopter training in the project area. The only area designated for a minimum elevation of 2,000 ft is the flight corridor north of Bradshaw Airfield in Ka'ohe; a second zone with a 1,000 ft minimum elevation is noted for other forested areas; however this is not designated on maps. Other portions of the ROI and the areas surrounding all of the LZs have no stipulations on flight elevation.

Proposed mitigation measures for both direct and indirect impacts is to avoid the cultural resources. Avoidance is only effective when the locations of the historic properties and culturally sensitive areas are known and documented in work/flight plans. At this time, the locations of cultural resources within the project area are mostly not known. In addition, the previously identified sites and districts have not been integrated into a comprehensive plan for avoidance. For example, the boundaries of the project area could have been modified to avoid the Summit Region Historic District and the known sites in the vicinity. Due to the identification of multiple historic properties in the near vicinity of the LZs in Ka'ohe, it would stand to reason that there are multiple sites beyond the areas examined by PTA staff. There is a high likelihood that one or more of these unidentified sites will be impacted by the training activities, because they cannot at this time be marked for avoidance in the flight planning stage. We believe this is a major/critical flaw in the FONSI.

In connection with this issue, we could find no discussion of potential impacts from rotor wash. There is a brief discussion of fugitive dust resulting from take-off and landing, but there is no information on the areal extent or intensity of rotor-generated winds in connection with the other training exercises. We also believe that repeated use of areas for landing will result in cumulative impacts from rotor wash. The EA assumes that conditions at all six LZ are similar (page4-3); however, we believe that the cinder cones in Ka'ohe will be potentially affected to a greater degree than the lava flow areas in Humu'ula.

Finally, we believe that the consideration of noise impacts to cultural practices needs to take greater consideration of specific types of practices, and the expected timing and location of such. The noise model used assumes that minimum flight ceiling would be 2,000 ft in the designated flight corridor and 1,000 feet above other forested areas (page 4-24). This leaves the bulk of the project area open for low flights and hovering. There is no consideration of this type of noise impact in the model used to generate a finding of less than significant noise impacts to cultural practices.

ATTACHMENT

Comments and Questions, *Environmental Assessment for High-Altitude Mountainous Environmental Training (HAMET) Pōhakuoa Training Area, Island of Hawaii*, USAG-HI/DPTMS, December 2010

Introduction and Description of Proposed Action

1. The title of the EA, and statements found elsewhere (i.e. Section 2.6.2) create the impression that this training program will occur within/at the PTA. We understand that helicopters and trainees will originate from within the PTA, but the bulk of the actual training will occur outside the PTA.
2. We were not able to locate information regarding the acreage of the overall project area, or acreage of the project area beyond the PTA. This information is important and should be provided somewhere.
3. There is no discussion of the methods used to determine the boundaries of the project area. What is the reason for the two-pronged project area boundary to the south of LZ-1 and the crescent shape around LZs 4-6 in the Ka'ohe area?
4. There is no discussion regarding the practical application of the project area boundary in relation to the training activities. There are general statements indicating that the training flights will be confined to this area. How will this be achieved and monitored? This is important information given the close proximity of sensitive cultural and natural resource areas.

Affected Resources

5. The discussion of cultural beliefs and practices for Mauna Kea relies on only two sources. We believe that additional sources should be cited and discussed, particularly when they contain information relevant to the project area. For example, Maly's (1997) proposed Traditional Cultural Property designation encompasses all of the project area and the three LZs located in Ka'ohe.
6. The discussion of cultural beliefs and practices for Mauna Kea and Mauna Loa include no information derived from consultation with persons knowledgeable of the project area, or with Native Hawaiian Organizations. We note that the LZs here are located on the crests of cinder cones. There is no discussion/consideration of the cultural significance of these pu'u as indicated in prior cultural/ethnographic studies or in the context of the proposed TCP (cf. Maly 1997) for the mountain from its summit to the 6,000 ft elevation.
7. The discussion of cultural beliefs and practices for the Saddle region (Section 3.7.3.1)states that the "Oral history subjects did report the continuation of bird hunting using old trails and modified lava blisters to encourage nesting in the region" (p. 3-32). The EA does not indicate whether these practices occur within the project area, or if, based on the patterning of historic properties, they might be expected to occur.
8. Section 3.7.4.1 states that "Perhaps because it is an active volcano that erupted as recently as 1984, literature searches reveal much less information about Mauna Loa than either Mauna Kea or the Saddle region". Donham 2010 is cited as a reference for this statement. We wish to clarify that the email sent from Donham to Braun-Williams on October 27 2010 did not make a connection between Mauna Loa's volcanic activity and the presence of literature regarding cultural beliefs and practices. Common sense would indicate that there is less information for Mauna Loa because there have been fewer actions triggering the need for impact assessments on Mauna Loa, as compared to the PTA and Mauna Kea summit areas.
9. As noted above, Section 3.7.2.2 regarding archaeological/historic resources in the Ka'ohe portion of the project area contains an omission regarding the faced platform identified near LZ-5, and describes in error three mounds that are near LZ-6. LZ-6 as reported in the PTA staff memo was not selected for further consideration; LZ-6 as identified in the EA correlates

with LZ-5a described in the PTA staff memo. Information regarding LZ-5a is omitted from the EA in this section and in Section 4.8.5.1.

10. Section 3.7.3.2 states that nearly 350 archaeological sites have been identified within the Saddle region, presumably within the PTA. There is no discussion clarifying how many of these sites are within the project area. A map showing the distribution of known sites within the PTA section of the project area should be included. In addition, rurther discussion of types of sites expected to occur within areas beyond the PTA should occur. Normally, some level of fieldwork would be conducted in areas not previously surveyed to determine the frequency, distribution and types of sites expected to occur within the project area.
11. Section 3.7.4.2 includes a discussion of the Mauna Loa Solar Observatory in the context of archaeological/historic resources. Is this facility over 50 years in age? It is not clear why this facility and the NOAA observatory are included in a discussion of historic properties.
12. Section 3.7.4.2 references one historic sites review that was conducted on Mauna Loa, prepared for the Nature Conservancy (Dye 2005). There is no reference/discussion of resources known/inventoried by the National Park Service within the Hawaii Volcanoes National Park, which encompasses upper slopes and the summit of Mauna Loa.

Impacts to Cultural Resources

13. Section 4.8.1 states that SHPD "...was contacted to provide cultural resources surveys and survey results within the ROI. The latter contact resulted in the identification of no new resources" (page 4-18)." The referenced "contact" consisted of an email requesting essentially all the information we have on file for the subject area. We responded by stating that we do not do research for entities responsible for federal historic preservation compliance, and recommended that the preparers of the EA send someone to the SHPD libraries in Hilo and/or Kapolei to conduct their research; and that they contact CRM staff at Volcanoes National Park and the PTA as part of their research. To our knowledge, no one from the EA preparation staff visited our offices to research our files and report library.
14. Section 4.8.5 concludes that "No direct impacts would occur from project activities." This conclusion is based on a consideration of direct impacts from helicopter landings, and states that no landings would be allowed outside of LZ's. We believe that further consideration should be given to the potential for direct impacts as a result of rotor wash during hover and low elevation flight, and abort/go-around activities. If an abort/go-around drill exercise occurs over/near an LZ, there will be a certain amount of physical disturbance as a result. We are not certain of the expected extent, because this factor is not considered in the EA.
15. Section 4.8.5.1 discusses direct impacts to historic properties. Each LZ is considered, and a determination that no historic properties would be affected is offered. The discussion of the flight paths includes only the Ka'ohe section of the project area, and states that "Additionally, flight paths would be planned to avoid the majority of cultural resources" (page 4-21). How can this be achieved when there is no information as to where the cultural resources are located within the flight path areas? As stated above, no fieldwork was conducted within the project area/ROI to identify and inventory historic properties. We believe there is a potential for direct impacts to historic properties within the flight paths that are not designated for the 1,000 ft. or 2,000 ft. minimum elevation.
16. The description of LZ-6 in Section 4.8.5.1 states that five mounds were identified in the vicinity of the LZ; these mounds are not within the project area. LZ-6 as used in the EA correlates with LZ-5a as used in the field inspection memo.
17. Section 4.8.6 summarizes indirect and cumulative impacts; this section includes a bullet stating that "flights would avoid known cultural resources." Again, the Army does not know where the cultural resources are located, so it will not be possible to plan flights to avoid them.

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Appendix C

Aircraft for Use in High-Altitude Mountainous Environment Training

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Appendix C

Aircraft for Use in High-Altitude Mountainous Environment Training

C-1. UH-60L BLACK HAWK

Since October 1989, Sikorsky has been producing the UH-60L Black Hawk helicopter with 24% more power than the UH-60A model. The T700-GE-701C turbine engines enable the UH-60L to take advantage of the new 3,400 shp improved durability main gearbox (Global Security 2010a).

The UH-60L was further modified with Seahawk® flight control components and an increase in tail rotor pitch. These modifications allow the aircraft to take full advantage of available engine power while extending the flight control component fatigue lives in excess of 5,000 hours.

As an example of the benefits of this upgrade, a modified UH-60L Black Hawk is capable of airlifting a 9,000-lb (4,082-kg) external payload, 60 nautical miles under hot day conditions, an increase of 3,000 lb (1,360 kg) over the UH-60A model.

In response to the growing weights of external loads such as weaponized M1036 High Mobility Multipurpose Wheeled Vehicles (HMMWV), the U.S. Army increased the external hook capacity to 9,000 lb (4,082 kg) for a gross weight of 23,500 lb (10,433 kg). This improvement, for example, allows organic UH-60L aviation resources to more closely match the lift requirements within the Light Infantry Divisions.

The world's most advanced twin-turbine military helicopter, the UH-60L is powered by twin General Electric T700-GE-701C turboshafts rated 1,890 shp each, plus the 3,400 shp Improved Durability Gearbox and heavy-duty flight controls developed for the naval S-70B Seahawk. It is cleared to 22,000 lb (9,979 kg) gross weight and can carry 9,000 lb (4,082 kg) external loads. New wide-chord composite main rotor blades and further engine upgrades are available for future performance requirements.

An External Stores Support System (ESSS), consisting of removable four-station pylons, multiplies Black Hawk roles. With the ESSS, the UH-60L can carry additional fuel tanks for extended range in self-deployment up to 1,150 nautical miles. For anti-armor missions, it can carry 16 Hellfire missiles on the pylons or a variety of other ordnance, including guns and rockets.

C-2. UH-60A BLACK HAWK

The UH-60A Black Hawk is the primary division-level transport helicopter, providing dramatic improvements in troop capacity and cargo-lift capability compared to the UH-1 Series “Huey” it replaces. The UH-60A, with a crew of three, can lift an entire 11-man fully-equipped infantry squad in most weather conditions. It can be configured to carry four litters, by removing eight troop seats, in the medical evacuation role (Global Security 2010).

Both the pilot and co-pilot are provided with armor-protective seats. Protective armor on the Black Hawk can withstand hits from 23-mm shells. The Black Hawk has a cargo hook for external lift missions. The Black Hawk has provisions for door mounting of two M60D 7.62-mm machine guns on the M144 armament subsystem and can disperse chaff and infrared jamming flares using the M130 general-purpose dispenser. The Black Hawk has a composite titanium and fiberglass four-bladed main rotor, is powered by two General Electric T700-GE-700 1622 shp turboshaft engines, and has a speed of 163 mph (142 knots).

The UH-60, first flown in October 1974, was developed as result of the Utility Tactical Transport Aircraft System (UTTAS) program. The UTTAS was designed for troop transport, command and control, medical evacuation, and reconnaissance, to replace the UH-1 Series “Huey” in the combat assault role. In August 1972, the U.S. Army selected the Sikorsky (Model S-70) YUH-60A and the Boeing Vertol (Model 237) YUH-61A (1974) as competitors in the UTTAS program. The Boeing Vertol YUH-61A had a four-bladed composite rotor, was powered by the same General Electric T700 engine as the Sikorsky YUH-60A, and could carry 11 troops. In December 1976, Sikorsky won the competition to produce the UH-60A, subsequently named the Black Hawk.

Elements of the U.S. Army Aviation UH-60A/L Black Hawk helicopter fleet began reaching their service life goal of 25 years in 2002. In order for the fleet to remain operationally effective through the time period 2025–2030, the aircraft will need to go through an inspection, refurbishment, and modernization process that will validate the structural integrity of the airframe, incorporate improvements in subsystems so as to reduce maintenance requirements, and modernize the mission equipment and avionics to the levels compatible with Force XXI and Army After Next (AAN) demands.

A Service Life Extension Program (SLEP) for the UH-60 began in Fiscal Year 1999. The UH-60 modernization program identifies material requirements to effectively address known operational deficiencies to ensure the Black Hawk is equipped and capable of meeting battlefield requirements through the 2025–2030 timeframe. Primary modernization areas for consideration are increased lift, advanced avionics (digital communications and navigation suites), enhanced aircraft survivability equipment (ASE), increased reliability and maintainability (R&M), airframe SLEP, and reduced operations and support (O&S) costs. Suspense date for the approved Operational Requirements Document (ORD) was December 1998.

C-3. CH-47D/F CHINOOK OVERVIEW

The Chinook is a multi-mission, heavy-lift transport helicopter. Its primary mission is to move troops, artillery, ammunition, fuel, water, barrier materials, supplies, and equipment on the battlefield. Its secondary missions include medical evacuation, disaster relief, search and rescue, aircraft recovery, fire fighting, parachute drops, heavy construction, and civil development. Chinook helicopters were introduced in 1962 as the CH-47 Chinook, and models A, B and C were deployed in Vietnam.

As the product of a modernization program, which included refurbishing existing CH-47s, the first CH-47Ds were delivered in 1982 and were produced until 1994. A central element in the Gulf War, they continue to be the standard for the U.S. Army in the global campaign against terrorism. Since its introduction, 1,179 Chinooks have been built (Boeing 2010).

C-3.1 CH-47F Chinook

To extend the service life of the CH-47 beyond 2030, Boeing developed the CH-47F in the mid-1990s and began production in 2003. Boeing is conducting major cost reduction initiatives, which improve manufacturing processes and affordability (Boeing 2010).

The program features improvement aimed at reducing operating and support costs; improving reliability, availability, and maintainability (RAM); and providing digital battlefield compatibility in communications and navigation. The program included modernization of 394 existing CH-47Ds and production of 17 new helicopters. The CH-47F Chinooks possess the following capabilities and characteristics:

- Improved airframe structure to reduce vibration effects
- Structural enhancements in the cockpit, cabin, aft section, pylon, and ramp – flexible paint system with corrosion preventive compounds
- Integrated cockpit control system – Common Aviation Architecture System
- Improved electrical, avionics, and communication systems
- Improved Avionics with Digital Advanced Flight Control System – situational awareness and improved digital map display
- More powerful engines with digital fuel controls – two turbine engine hubs, each with a Textron Lycoming T55-L714 engine and each with 4,900 shp
- A maximum payload capacity of 21,500 lb (9,752 kg) (based on U.S. Army requirements for the CH-47F)

- An operating range up to 329 nautical miles
- Modularized hydraulics and triple cargo hooks
- Composite, manual-folding, tandem-rotor blades with three blades per hub.

C-3.2 CH-47D and Cargo Helicopter Airframe Procurement Support (CHAPS)

Currently, the U.S. Army and international countries operate more than 600 CH-47D Chinooks. This model will be operated and supported through 2018 by the U.S. Army and Boeing until the CH-47F is in full production. The CHAPS program provides for the sale of flight-ready CH-47D Chinooks under "Exchange and Sales" regulations. Under this program, select D-Model Chinooks from the U.S. Army fleet are available to military users and service organizations worldwide, providing them affordable aircraft fully capable and easily upgradable to include any future system provided in the CH-47D. CHAPS provides countries affordable alternatives to more advanced aircraft and enables users to support military operations, medical and disaster relief, search and rescue, fire fighting, and civil support with reliable, cost-efficient helicopters (Boeing 2010). Chinook CH-47Ds possess the following capabilities and characteristics:

- Two turbine engine hubs, each with a Textron Lycoming T55-L714 engine
- Heavy payload capable
- Fully supportable and upgradable.

C-4. REFERENCES

Boeing, *Defense, Space, and Security*, http://www.boeing.com/rotorcraft/military/ch47d/index.htm, Web page visited November 2, 2010.

Global Security, 2010a, UH-60L/S-70A Black Hawk, http://www.globalsecurity.org/military/systems/aircraft/uh-60l.htm, Web page visited November 2, 2010.

Global Security, 2010b, *UH-60A Black Hawk*, www.globalsecurity.org/military/systems/aircraft/uh-60a.htm, Web page visited November 2, 2010.

Appendix D

Spatial Data References

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Appendix D

Spatial Data References

Table D-1 shows the data sources used to generate the maps and figures not otherwise referenced for the High-Altitude Mountainous Environment Training (HAMET) environmental assessment. The information is presented in alphabetical order according to map legend title.

Table D-1. Spatial data references for HAMET maps.

Legend Item	Data Source
N/A: 100-ft elevation contour	*Elevation Contours, 100 foot interval*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
N/A: 500-ft elevation contour	*Elevation Contours, 500 foot interval*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
N/A: Recreation polygons (Figures 3-20, 4-5, and 4-6)	*Reserves*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 4, 2011.
1-5 km proposed trail buffer	*Historic Sites Review of a Proposed Mauna Loa Trail System*, T. S. Dye & Colleagues, Archaeologists, Inc., Figure 2 (p. 10), March 25, 2005.
Access road	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Adze quarry (location marked with text label only)	*Mauna Kea Science Reserve Master Plan*, State of Hawai‘i Department of Land and Natural Resources Historic Preservation Division, Institute for Astronomy, University of Hawai‘i, Appendix F, Figure 1 (p. 2), March 2000.
Airport	*Geographic Place Names*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
‘Akiapola‘au habitat (bird)	*Bird Habitat (Version 2)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Astronomy Precinct	*Mauna Kea Comprehensive Management Plan: UH Management Areas*, Figure 5-1 (p. 5-21), University of Hawai‘i, January 2009.
Bradshaw Army Airfield	*BradshawAirfield*, Pōhakuloa Training Area Integrated Training Area Management Geodatabase 2010, U. S. Army 25th CAB, as provided to Portage, Inc., on October 7, 2010.
Burned area (Summer 2010)	Mauna_Kea_33_Perimeter_082510.shp, U.S. Army 25th CAB, as provided to Portage, Inc., on October 21, 2010.
City or town	*Cities*, ESRI Data and Maps 10 [CD-ROM], Environmental Systems Research Institute, Redlands, CA, June 2010.
County of Hawai‘i General Plan District	*Judicial Districts*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 31, 2011.
Cultural feature	*Historic Sites Review of a Proposed Mauna Loa Trail System*, T. S. Dye & Colleagues, Archaeologists, Inc., Figures 2 and 3 (pp. 10-11), March 25, 2005.
Cultural feature identified during 2011 PTA survey	“Memorandum for the Record: Cultural Resources Reconnaissance Survey of Existing High Altitude Mountainous Environmental Training (HAMET) Landing Zones (LZ) on Mauna Kea, [TMK (3) 4-4-015:001], Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island,” D. M. Crowell, Department of the Army, February 24, 2011.
Cultural site (large)	*Historic Sites Review of a Proposed Mauna Loa Trail System*, T. S. Dye & Colleagues, Archaeologists, Inc., Figures 2 and 3 (pp. 10-11), March 25, 2005.

Table D-1. (continued).

Legend Item	Data Source
Existing trail	*Historic Sites Review of a Proposed Mauna Loa Trail System*, T. S. Dye & Colleagues, Archaeologists, Inc., Figure 3 (p. 11), March 25, 2005.
Federal land	*Large Landowners*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Forest reserve	*Reserves*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 4, 2011.
Glider activity area	*Hawaiian Islands 83.tif*, Sectional Raster Aeronautical Chart of the Hawaiian Islands, Federal Aviation Administration (http://avn.faa.gov/index.asp?xml=aeronav/applications/VFR/chartlist_sect), 83rd Edition, effective 10/21/2010 to 05/05/2011.
Haleakalā National Park	*Reserves*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 4, 2011.
Haleakalā Wilderness	wilderness_1997.shp, National Park Service Natural Resource-GIS Data Server (http://nrdata.nps.gov, “hale” directory), as published April 13, 2011.
HAMET flight path, Alternative 2: Mauna Kea only	Kea_flightpaths_from_Army_07mar11.shp, Portage, Inc., HAMET Project Geodatabase, March 8, 2011. Coordinates for the flight paths and associated check points were provided to Portage, Inc., via e-mail by the U.S. Army 25th CAB on March 8, 2010.
HAMET flight path, Alternative 3: Mauna Loa only	Loa_flighpath_corrected_with_Army_email_07mar11.shp, Portage, Inc., HAMET Project Geodatabase, March 8, 2011. Coordinates for the flight paths and associated check points were provided to Portage, Inc., via e-mail by the U.S. Army 25th CAB on March 8, 2010.
HAMET flight path checkpoint	Kea_waypoints_from_Army_07mar11.shp & Loa_waypoints_corrected_with_Army_email_07mar11.shp, Portage, Inc., HAMET Project Geodatabase, March 8, 2011. Coordinates for the flight paths and associated check points were provided to Portage, Inc., via e-mail by the U.S. Army 25th CAB on March 8, 2010.
HAMET flight path, Preferred Alternative: Mauna Kea and Mauna Loa	Kea_flightpaths_from_Army_07mar11.shp & Loa_flighpath_corrected_with_Army_email_07mar11.shp, Portage, Inc., HAMET Project Geodatabase, March 8, 2011. Coordinates for the flight paths and associated check points were provided to Portage, Inc., via e-mail by the U.S. Army 25th CAB on March 8, 2010.
HAMET landing zone (proposed)	*MV-22 Site Evaluation Report for US Army Garrison Hawai‘i*, The Boeing Company; Department of the Navy, Figures 1-213, 1-218, 1-223 (pp. 1-325, 1-331, and 1-337), November 30, 2009. Coordinates for Mauna Kea landing zones were provided to Portage, Inc., via e-mail by the U.S. Army 25th CAB on October 14, 2010.
HAMET noise model (42 day, 18 night)	HAMET_NoiseContours_01apr11_60FPD_42day_18night.shp, Portage, Inc., HAMET Project Geodatabase, April 1, 2011. These data were exported from NMPlot, the output portion of the DoD’s NoiseMap modeling software, to ESRI ArcGIS format on April 1, 2011. Parameters used to develop noise contours included seven daytime and three nighttime flights to each of the six LZs per day, for a total of 42 daytime and 18 nighttime flights per day.
Hawai‘i Volcanoes National Park	havo_parkboundary.shp, National Park Service Natural Resource-GIS Data Server (http://nrdata.nps.gov, “havo” directory), as published March 15, 2011.

Table D-1. (continued).

Legend Item	Data Source
Hawai‘i Volcanoes Wilderness	HAVO_Wilderness.shp, National Park Service Natural Resource-GIS Data Server (http://nrdata.nps.gov, “havo” directory), as published March 15, 2011.
Highway	*Roads – Major (USGS)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 14, 2011.
Historic District boundary	*Preliminary Draft Report: A Cultural Resources Management Plan for the University of Hawai‘i Management Areas on Mauna Kea, Ka‘ohe Ahupua‘a, Hāmākua District, Hawai‘i Island, State of Hawai‘i - A Sub-Plan for the Mauna Kea Comprehensive Management Plan*, Pacific Consulting Services, Inc.; Office of Mauna Kea Management, University of Hawai‘i at Hilo, Figure 2-4 (p. 2-32), July 2009.
Historic property	*Mauna Kea Comprehensive Management Plan: UH Management Areas*, Figure 5-1 (p. 5-21), University of Hawai‘i, January 2009.
‘Io habitat (bird)	*Bird Habitat (Version 2)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Lake Waiau	LakeWaiau_fromDOQQ.shp, Portage, Inc., HAMET Project Geodatabase, interpreted from U.S. Army Corps of Engineers DOQQ, Mauna_Kea_SW, (Honolulu District, Technical Integration Group, 1/9/2002), October 20, 2010.
Land ownership	*Large Landowners*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Local road	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Mauna Kea Science Reserve	MK_Science_Reserve.shp, Office of Mauna Kea Management (University of Hawai‘i), as provided to Portage, Inc., on March 10, 2011.
Mauna Kea Visitor Center	MaunaKea_VisitorCenter.shp, Portage, Inc., HAMET Project Geodatabase, interpreted from Google Maps (TM) and mosaicked United States Department of Agriculture image, ortho_big_island (USDA-FSA Aerial Photography Field Office, 06/14/2004, http://hawaii.wr.usgs.gov/hawaii/data.html), March 22, 2011.
Mauna Loa Observatory	MaunaLoa_Observatory_Point.shp, Portage, Inc., HAMET Project Geodatabase, interpreted from Google Earth (TM), November 5, 2010.
Na Ala Hele Trail System	*Na Ala Hele Trails and Access System*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 1, 2011.
Natural reserve	MK_NAR1.shp, Office of Mauna Kea Management (University of Hawai‘i), as provided to Portage, Inc., on March 10, 2011.
Nēnē habitat (bird)	*Bird Habitat (Version 2)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/); as published October 1, 2010.
Nēnē sanctuary	*Reserves*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 4, 2011.
Noise monitoring location	HAMET_FinalNoiseMonitoringLocsGPS_03212011.shp, Portage, Inc., HAMET Project Geodatabase, March 23, 2011. Noise monitoring locations were surveyed by Portage, Inc., personnel using a Trimble GeoXT GPS unit during field activities on 03/19/2011 through 03/21/2011.
NPS trail from TIGER Roads	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010. Extracted based on interpretation of imagery from Google Earth (TM) and: trail.shp, National Park Service Natural Resource-GIS Data Server (http://nrdata.nps.gov, “havo/nrdata/water/baseline_wq/gis” directory), as published March 15, 2011.

Table D-1. (continued).

Legend Item	Data Source
Other cultural resource	*Mauna Kea Comprehensive Management Plan: UH Management Areas*, Figure 5-1 (p. 5-21), University of Hawai‘i, January 2009.
Other trail	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Palila critical habitat	*Critical Habitat*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Park or reserve	*Reserves*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published March 4, 2011. MK_NAR1.shp, Office of Mauna Kea Management (University of Hawai‘i), as provided to Portage, Inc., on March 10, 2011. (Used for Mauna Kea Ice Age Natural Area Reserve boundary only.)
Plant location	*All_listed_plants*, Pōhakuloa Training Area Integrated Training Area Management Geodatabase 2010, United States Army 25th CAB, as provided to Portage, Inc., on October 7, 2010. *Biological Assessment for Section 7 Consultation on High Altitude Aviation Training (HAATs) on Mauna Kea*, Hawai‘i Department of Public Works, Environmental Division, Aviation Brigade 25th Infantry Division Aviation, Figure 3 (p. 16), December 2007.
Pōhakuloa Training Area	*mil_restricted_access_area*, Pōhakuloa Training Area Integrated Training Area Management Geodatabase 2010, U.S. Army 25th CAB, as provided to Portage, Inc., on October 7, 2010.
Primary road	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Private land	*Large Landowners*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Proposed trail	*Historic Sites Review of a Proposed Mauna Loa Trail System*, T. S. Dye & Colleagues, Archaeologists, Inc., Figure 2 (p. 10), March 25, 2005.
Restricted air space	*RestrictedAirSpace*, Pōhakuloa Training Area Integrated Training Area Management Geodatabase 2010, U.S. Army 25th CAB, as provided to Portage, Inc., on October 7, 2010.
Saddle Road, new section	*Placemarks_line*, Portage, Inc., HAMET Project Geodatabase, interpreted from Google Earth (TM), March 14, 2011.
Secondary road	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Soil type	*Soils*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
State land	*Large Landowners*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
State land (Dept. of Hawaiian Homelands)	*Large Landowners*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Threatened and endangered plants	*Threatened and Endangered Plants*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Traditional cultural property	*Mauna Kea Comprehensive Management Plan: UH Management Areas*; Figure 5-1 (p. 5-21), University of Hawai‘i, January 2009.
Trail (TIGER roads)	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.
Vehicular trail	*TIGER Roads (2002)*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 5, 2010.

Table D-1. (continued).

Legend Item	Data Source
Viewpoints	*Geographic Place Names*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.
Waiki‘i (settlement)	*Geographic Place Names*, Hawai‘i Statewide GIS Program Online Server (http://hawaii.gov/dbedt/gis/), as published October 1, 2010.

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