

# **Draft Environmental Assessment**

## **Laupāhoehoe Forest Draft Management Plan**

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Hawai‘i Department of Land and Natural Resources  
Division of Forestry and Wildlife

USDA Forest Service  
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## Table of Contents

Summary.....	5
Section 1. Introduction and Background.....	5
Introduction.....	5
Purpose and Need for Action.....	7
Legal and Policy Guidance.....	10
Relationship to Other Planning Efforts.....	13
Environmental Assessment Process.....	16
Required Permits and Approvals.....	16
Public Involvement and Agency Coordination.....	17
Issues/Scope of Analysis.....	18
Documents Incorporated by Reference.....	19
Section 2. Alternatives.....	20
Alternatives Development.....	20
Alternative 1: No Action Alternative (Current management).....	20
Natural Resources.....	20
Research.....	22
Education and Outreach.....	24
Public Access and Recreation.....	24
Infrastructure.....	24
Alternative 2: Implement the Draft Management Plan.....	25
Natural Resources.....	26
Research.....	30
Education and Outreach.....	31
Public Access and Recreation.....	32
Infrastructure.....	34
Alternatives Considered but Dropped from Further Analysis.....	34
Section 3. Environmental Setting and Consequences.....	36
Overview of Effects Analysis.....	36
Topography, Climate, Geology, and Soils.....	37
Existing Conditions.....	37
Determination of Effects.....	38
Conclusion.....	39
Air Quality.....	39
Existing Conditions.....	39
Determination of Effects and Conclusion.....	40
Noise.....	40
Existing Conditions.....	40
Determination of Effects and Conclusion.....	40
Water Resources.....	41
Existing Conditions.....	41

Determination of Effects.....	41
Conclusion.....	43
Fauna.....	43
Existing Conditions.....	43
Determination of Effects.....	46
Conclusion.....	47
Flora.....	47
Existing Conditions.....	47
Determination of Effects.....	50
Conclusion.....	51
Hunting.....	52
Existing Conditions.....	52
Determination of Effects.....	54
Conclusion.....	55
Public Use: Recreation, Education, Illegal Use.....	55
Existing Conditions.....	55
Determination of Effects and Conclusion.....	56
Research.....	58
Existing Condition.....	58
Determination of Effects and Conclusion.....	58
Socioeconomic resources.....	59
Existing Condition.....	59
Determination of Effects and Conclusion.....	61
Cultural and Archaeological Resources.....	61
Methodology.....	61
Land Use History and Summary of Historic Features.....	64
Determination of Effects.....	70
Conclusion.....	73
Scenic resources.....	73
Existing Conditions.....	73
Determination of Effects and Conclusion.....	74
Summary of Effects.....	74
Section 4. Cumulative Impacts.....	75
Alternative 1.....	77
Alternative 2.....	77
Section 5. Consistency with Hawai‘i State Plan and Coastal Zone Management Act.....	78
Hawai‘i State Plan.....	78
Themes, Goals, and Objectives.....	78
Discussion.....	79
Coastal Zone Management Program.....	80
Objectives and policies.....	80
Discussion.....	80
Section 6. Anticipated Determination under HRS Chapter 343 and Supporting Findings and	

Recommendations.....	84
Section 7. References.....	87
Appendix A. List of Agencies and Persons Consulted.....	A-1
Appendix B. Public comments received during scoping period.....	B-1
Appendix C: Historic Properties Field Inspection Report.....	C-1
Appendix D: Laupāhoehoe Forest Draft Management Plan.....	D-1
Table 1.1 Related State, Federal, and County Planning Documents .....	13
Table 3.1 Summary of Hunting Opportunities within Laupāhoehoe Forest .....	52
Table 3.2 Summary of Effects .....	75
Table 4.1 Past, Present, and Foreseeable Future Actions Near Laupāhoehoe Forest .....	76
Figure 1: Laupāhoehoe Forest Landowner Designation .....	6
Figure 2: Laupāhoehoe Forest Existing Infrastructure .....	21
Figure 3: Laupāhoehoe Forest Habitat Protection and Management .....	27
Figure 4: Laupāhoehoe Forest Public Hunting Areas .....	53
Figure 5: Laupāhoehoe Forest Public Access Recreation and Infrastructure .....	57
Figure 6: Laupāhoehoe Forest Historic Properties and Planned Management .....	68



## Summary

Laupāhoehoe Forest (12,343 acres) is situated on the eastern, windward flanks of Mauna Kea in the North Hilo District on the island of Hawai‘i (TMK (3) 3-7-001:002, (3) 3-7-001:012). Laupāhoehoe Forest is composed of Laupāhoehoe Natural Area Reserve and the Laupāhoehoe section of the Hilo Forest Reserve and also is federally designated as part of the Hawai‘i Experimental Tropical Forest. Laupāhoehoe Forest is important watershed and valuable native habitat for many species of rare plants and animals. The Laupāhoehoe Forest Draft Management Plan proposes management actions to be implemented over the next 15 years to support long-term protection of the native forest and watershed. In addition to continuing existing management (e.g., invasive species control, rare plant restoration, research, etc.), the Management Plan also proposes the creation of new fenced conservation units (approximately 2,659 total acres), the maintenance and development of identified primitive trails within the Forest and the establishment of primitive camping at Shack Camp; increased opportunities for education and outreach visits; and the installation of management shelters and helicopter landing zones to support natural resources management, wildfire suppression, and emergency response. Best management practices and mitigation measures would be incorporated to minimize negative impacts to water, botanical, faunal, or archaeological resources. The creation of conservation units will decrease the acreage available for public hunting in Units C and K by approximately 2,659 acres; locations for proposed fencing were selected to protect intact forest and to minimize impact on hunting.

## Section 1. Introduction and Background

### Introduction

The 12,343 acre (ac) (5,134 hectare (ha)) Laupāhoehoe Forest area consists of two state-managed parcels of land on the eastern windward flanks of Mauna Kea in the North Hilo District on the island of Hawai‘i (Figure 1). Both parcels are managed by the Hawai‘i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW): 4,449 acres as Forest Reserve (FR) and 7,894 acres as Natural Area Reserve (NAR). In addition, the Laupāhoehoe Forest is designated as part of the Hawai‘i Experimental Tropical Forest (HETF).

## Laupāhoehoe Forest Landowner Designation

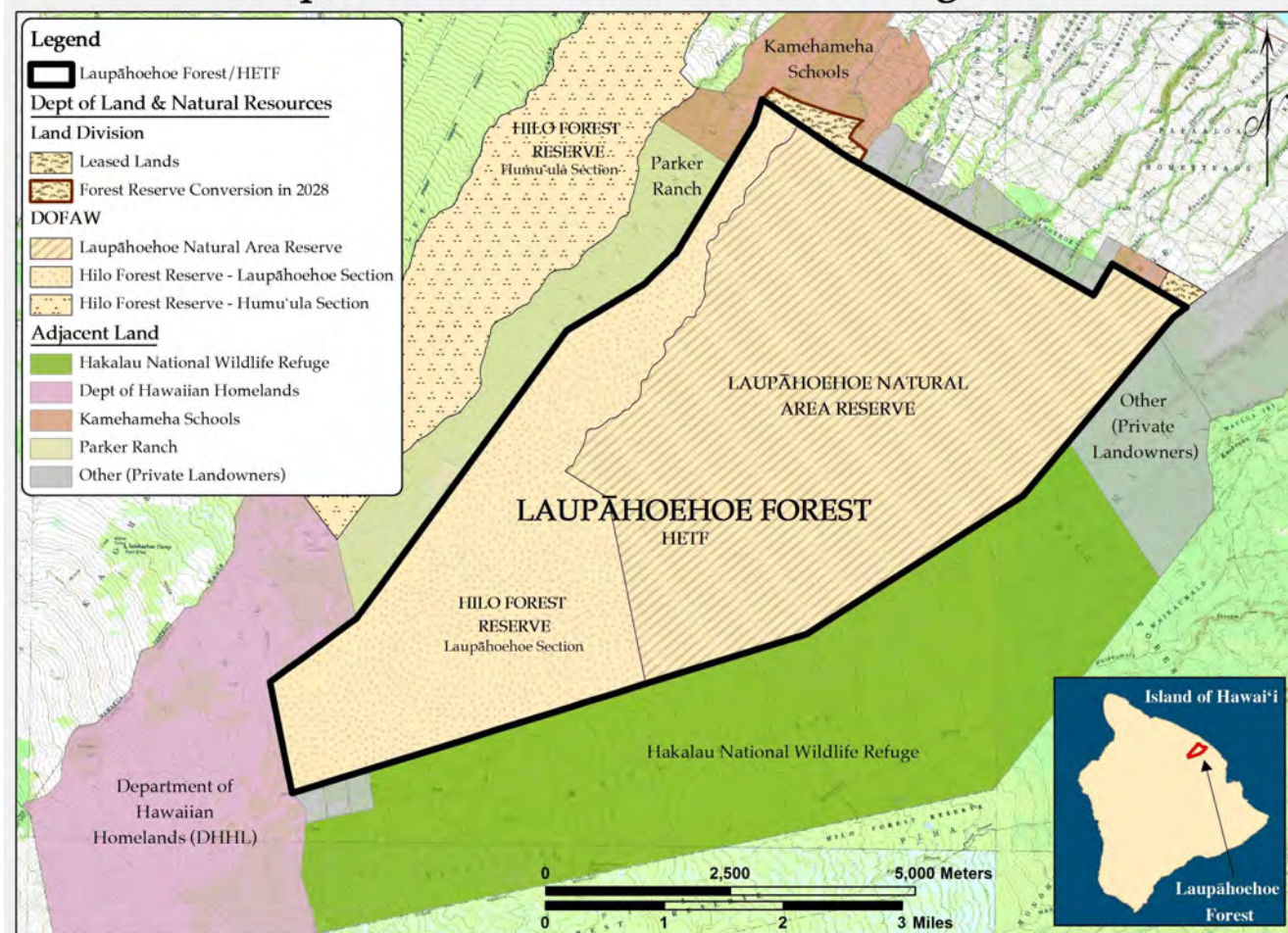


Figure 1. Laupāhoehoe Forest Landowner Designation

In 1992, the Hawai'i Tropical Forest Recovery Act authorized the establishment of the HETF to serve as a center for long-term research and a focal point for developing and transferring knowledge and expertise for the management of tropical forests. In 2007, the HETF was formally established. The HETF consists of two units, one of which is the Laupāhoehoe Wet Forest Unit located on the windward side of Hawai'i Island; the other is the Pu'u Wa'awa'a Dry Forest Unit located on the leeward side of Hawai'i Island.

The United States Forest Service (USFS), Pacific Southwest (PSW) Research Station's Institute of Pacific Islands Forestry (IPIF), based in Hilo, works cooperatively with the state of Hawai'i to coordinate research, management, and educational activities and to jointly develop and implement research and education and management plans for the experimental forest. Land management and protection responsibilities remain with DLNR-DOFAW and these lands are managed under relevant

state laws and regulations.

The Laupāhoehoe Forest contains native-dominated forested landscapes from lowland forest at 1,700 ft (700 m) extending through four life zones to almost 6,200 ft (1,890 m) in elevation, supports magnificent examples of tropical rain forest, and provides habitat for numerous endangered plant and animal species. The Draft Management Plan for the Laupāhoehoe Forest (Appendix D) is based on the overall vision for the area as part of the HETF, as State NAR, and as State FR, and proposes actions to maintain the integrity of the existing forest as watershed, forest, and native habitat. The plan incorporates the values and interests of community members and stakeholder groups and attempts to balance the need for increased forest protection and management with the desire for enhanced human use.

## **Purpose and Need for Action**

Laupāhoehoe Forest has long been recognized for its value as watershed and native habitat. The Laupāhoehoe section of Hilo FR (12,343 ac) was established in 1905 for the purpose of watershed protection. A portion of the FR was re-designated as Laupāhoehoe Natural Area Reserve (7,894 ac) in 1983 to protect unique natural resources, specifically the wet forests of koa (*Acacia koa*) and 'ōhi'a (*Metrosideros polymorpha*), wet grasslands and streams, and the associated rare species found within this area. In 2007, Laupāhoehoe Forest was selected to be part of the HETF (in combination with dry forest in Pu'u Wa'awa'a) to foster research and learning about Hawai'i's tropical forests. The Laupāhoehoe Forest ranked amongst the highest of the potential wet forest sites for all criteria considered (suitable size; encompass broad environmental gradients; land use history variation; access and proximity; potential to conduct long-term research projects; contain sites suitable to address many pressing land management needs).

There are many existing threats to the integrity of Laupāhoehoe Forest (detailed below) requiring management attention, while forest management is perennially underfunded in Hawai'i. Hawai'i ranks near the bottom (48<sup>th</sup>) in the nation for state spending on fisheries and wildlife, though the state forest reserve system ranks 11<sup>th</sup> in size (DLNR 2015). A conservative estimate of the amount of state funds dedicated solely to conservation of native wildlife and their habitats, statewide (including inland and marine waters), was approximately \$35 million for Fiscal Year 2015 (DLNR 2015).

Invasive non-native plants and animals constitute a severe threat to the native ecosystems and watershed resources in Laupāhoehoe Forest. Invasive plants can encourage fire by increasing the amount of available fuels or decreasing water input to streams and ground water. Invasive non-native plants can displace distinctive native flora, resulting in a loss of species diversity and eventually in changes to ecosystem function such as nutrient cycling. Many invasive non-native plants completely

replace native vegetation by preventing any regeneration of native species or by direct replacement of native trees, resulting in total loss of native habitats and negatively affecting native birds and invertebrates (Cuddihy and Stone 1990). The upper forested areas between 3,500 – 6,500 ft (1067 – 1981 m) elevation contain relatively low densities of invasive non-native plants. However, below 3,500 ft (1067 m), forests become heavily invaded by strawberry guava (*Psidium guava*), clidemia or Koster's curse (*Clidemia hirta*), yellow Himalayan raspberry (*Rubus ellipticus*), and kahili ginger (*Hedychium gardnerianum*). Above 4,500 ft (1372 m), forests are invaded in some areas by grasses, banana poka (*Passiflora tarminiana*), and tropical ash (*Fraxinus uhdei*). Other high-priority invasive non-native plants currently present in Laupāhoehoe Forest include Australian tree fern (*Sphaeropteris cooperi*), *Ficus* spp., Florida blackberry (*Rubus argutus*), cane tibouchina (*Tibouchina herbacea*), Himalayan ginger (*Hedychium gardnerianum*), mules foot fern (*Angiopteris evecta*), palm grass (*Setaria palmifolia*), passionfruit (*Passiflora edulis*), *Polygonum chinensis*, and German ivy (*Delairea odorata*).

There are additional invasive non-native plant species of serious concern present in adjoining areas, but not yet detected in Laupāhoehoe Forest: miconia (*Miconia calvescens*), faya (*Morella faya*), gorse (*Ulex europaeus*), firethorn (*Pyrocantha angustifolia*), *Cotoneaster pannosus*, and New Zealand flax (*Phormium tenax*).

Feral ungulates (hooved animals) pose a threat to native ecosystems, species, and watersheds because they eat and trample native plants (Cooray and Mueller-Dombois 1981) and disperse the seed of invasive non-native plants. The primary ungulate in Laupāhoehoe Forest is the feral pig (*Sus scrofa*), which is found throughout the forest except in the existing small fenced areas (35 total acres). The rooting and wallowing behavior of pigs can increase the inputs of pollutants to streams (i.e., animal waste) and stream water turbidity due to soil erosion (Stone 1985, Bruland et al. 2010), and wallows can result in breeding areas for disease carrying mosquitoes (Baker 1979, USGS 2005, USGS 2006). Pigs also eat some invasive plant fruits, such as strawberry guava, which they can transport and then defecate in new areas (Aplet et al. 1991). In addition, feral pigs have been shown to spread root-rot fungi (Baker 1979) and can carry parasites and diseases transmittable to humans and dogs, such as leptospirosis (Warner 1956-1969, Sasaki et al. 1993) and tuberculosis (Giffin 1978). All feral cattle (*Bos taurus*) were removed from the area by 2003; however they remain a potential future threat as they are still present in adjoining areas (Waipunalei and Humu‘ula) and occasionally get into the forest.

Introduced diseases and pathogens threaten native animals and plants, and given the lack of biosecurity in Hawai‘i, the introduction of new diseases and pathogens is highly likely. For example, rapid ‘ōhi‘a death, a newly identified disease killing thousands of acres of ‘ōhi‘a in forests and residential areas of the Puna and Hilo Districts, has emerged as a critical threat facing native ecosystems since the Draft Management Plan was developed. Climate change may affect the Laupāhoehoe Forest by altering rainfall patterns and amounts, which may then impact forest composition, growth and structure

(Iwashita et al. 2013). Rare ecosystems and species may be negatively affected by relatively rapid changes in precipitation, temperature and humidity that result from a rapid and drastic change in regional or local climate patterns (e.g., prolonged drought, higher temperatures). Detrimental invasive species may change their distribution and abundance due to changes in the climate (e.g., mosquitoes may be more frequently found at higher elevations due to warming temperatures). Although natural disturbances such as hurricanes, droughts, and flooding are regular occurrences in Hawai‘i, widespread insect-driven defoliation can also impact the forest (koa moth (*Scotorythra paludicola*)), and ‘ōhi‘a undergoes periodic declines where entire stands of ‘ōhi‘a die off at the same time (Akashi and Mueller-Dombois 1995, Anderson et al. 2001, Mueller-Dombois 1980). These types of natural disturbances may increase as a result of climate change.

Illegal human activity occurs on a small scale, primarily in the form of illegal camping, off-road all-terrain vehicle use, dumping, unpermitted harvesting (koa, maile (*Alyxia oliviformis*), hāpu‘u (*Cibotium* spp.), and other native trees and plants), poaching, marijuana cultivation, and vandalizing signs and fences. These activities destroy infrastructure and native species, and some illegal activities create openings in the forest that can be invaded by invasive non-native plants.

Fire poses a threat to Laupāhoehoe Forest, particularly in the drier upper elevation during times of drought and in areas adjacent to human activity. Hawai‘i’s flora evolved with infrequent, naturally occurring fires, so most native species are not fire adapted and are unable to recover quickly after wildfires. Wildfires leave the landscape bare and vulnerable to erosion and non-native weed invasions (D’Antonio et al. 2000, Dunkell et al. 2011, Smith and Tunison 1992). Continued feral ungulate damage to native ecosystems can convert native forest to non-native grasses and shrubs, which provide more fuel for fire (Ainsworth and Kauffman 2010, Cabin et al. 2000, Chynoweth et al. 2013, Cole et al. 2012, Nogueira-Filho et al. 2009, Scowcroft and Giffin 1983, Thaxton et al. 2010). Invasive non-native plants, particularly grasses, are often more fire-adapted than native species and will quickly exploit suitable habitat after a fire (D’Antonio et al. 2000, Mack and D’Antonio 1998). The principal human caused ignition threats are from catalytic converters and other hot surfaces of vehicles or heavy equipment and illegal campfires; the principal natural ignition source is lightning.

The purpose of developing the Draft Management Plan is to outline a 15-year management plan to address the threats to the Laupāhoehoe Forest as a unit. Specifically, it provides:

- guidance and recommendations to DLNR-DOFAW and USFS from stakeholders including the Laupāhoehoe Advisory Council (LAC);
- prioritized recommendations on how to preserve and protect the area, as well as continue and enhance human use;
- a compilation of natural and cultural history, resources, and research;

- documentation of current forest conditions and threats;
- a planning and management tool for DLNR-DOFAW and the USFS to use to determine priorities, work plans, staffing requirements, budget requests, and more; and
- funding guidance and a document that enables DLNR-DOFAW and USFS to ask for the resources necessary to protect Laupāhoehoe Forest.

The Laupāhoehoe Forest Draft Management Plan is based on the overall vision for the area as part of the HETF as an important research, education and demonstration forest, as well as the purpose of the State land designations as NAR and FR. Maintaining the integrity of the existing forest and the health and abundance of the native species is critical to the vision.

The Draft Management Plan identifies five primary objectives as follows:

- Natural Resources – Protect, manage and restore native ecosystems and species;
- Research – Provide lands for conducting research that serves as a basis for the restoration, conservation, and management of tropical forest ecosystems;
- Education and Outreach – Serve as a center for forest education, training, demonstration, and outreach on tropical forests, conservation biology, and natural resource management for groups ranging from school children to land managers, scientists, and the general public;
- Public Access and Recreation – Improve appropriate public access and recreational opportunities consistent with maintaining native natural resources, cultural resources, and the wilderness character of these lands; and
- Infrastructure – Provide and maintain infrastructure and facilities to maintain forest goals.

## Legal and Policy Guidance

The following Federal, State, and county laws or policies were considered in the development of the Draft Management Plan and this EA.

*Hawai‘i Revised Statutes (HRS) Chapter 195:* This chapter establishes the Hawai‘i Natural Area Reserves System (NARS) to “preserve in perpetuity specific land and water areas, which support communities, as relatively unmodified as possible of the natural flora and fauna, as well as geological sites, of Hawai‘i” (HRS § 195-1).

*HRS Chapter 183:* This chapter establishes the state Forest Reserve System, for the preservation, protection, regulation, extension and utilization of forest resources and the protection of the springs, streams, and sources of water supply within the forests (HRS §§ 183-1.5, 183-2).

*HRS Chapter 183C*: This chapter recognizes “that lands within the state land use conservation district contain important natural resources essential to the preservation of the State's fragile natural ecosystems and the sustainability of the State's water supply” and identifies that these lands should be conserved, protected, and preserved “through appropriate management and use to promote their long-term sustainability and the public health, safety, and welfare” (HRS §183C-1).

*Endangered Species Act of 1973 (ESA)*: The purpose of the ESA is protection and recovery of imperiled species and the ecosystems upon which they depend. Under provisions of the ESA, Federal agencies are directed to seek to conserve endangered and threatened species and to ensure that actions authorized, funded, or carried out by the agencies are not likely to jeopardize the continued existence of any threatened or endangered species, or result in the destruction or adverse modification of designated critical habitats of such species.

*Migratory Bird Treaty Act (MBTA) of 1918 as implemented subject to Executive Order 13186*: The MBTA established an international framework for the protection and conservation of migratory birds. This act makes it illegal, unless permitted by regulations, to “pursue, hunt, take, capture, purchase, deliver for shipment, ship, cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird”.

*Federal Noxious Weed Act of 1975*: This law provides for the control and management of non-native weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.

*Cooperative Forestry Assistance Act*: This law authorizes the Secretary of Agriculture to cooperate on forest management issues with non-Federal forest lands.

*Federal Farmland Protection Policy Act (FPPA)*: The FPPA is intended to minimize the impact Federal agencies or Federal programs have on the irreversible conversion of farmland to nonagricultural uses. Federal agencies (or Federally funded projects) involved in proposed projects that may convert farmland to non-agricultural uses work with NRCS to establish a farmland conversion impact rating score on proposed sites, to be used as an indicator of when the potential adverse impacts on the farmland exceed allowable levels.

*Executive Order 13112*: This Executive Order requires Federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

*HRS Chapter 344*: HRS § 344-4 provides for the protection of endangered species of indigenous plants and animals and for the introduction of new plants or animals only upon assurance of negligible ecological hazards and encourages the planting of native vegetation. Any activities proposed must

analyze and evaluate effects to endangered species, their critical habitat, and native vegetation.

*Hawai‘i Administrative Rules (HAR) Chapter 13-124: Indigenous Wildlife, Endangered and Threatened Wildlife, and Introduced Wild Birds:* These regulations provide DLNR-DOFAW direction to conserve, manage, protect and enhance indigenous wildlife and manage exotic birds.

*HAR Chapters 13-121, 122, and 123: Rules Regulating Hunting, Game Bird Hunting, Game Mammal Hunting:* These rules provide general regulations regarding hunting in Hawai‘i and specify hunting units, seasons, bag limits and hunting methods for game birds and game mammals.

*HAR Chapters 11-54 and 11-55:* Any project and its potential impacts to State waters must meet the following criteria: (a) Anti-degradation policy (HAR § 11-54-1.1) which requires that existing uses and the level of water quality necessary to protect existing uses of the receiving State water be maintained and protected; (b) Designated uses (HAR § 11-54-3) as determined by the classification of the receiving State waters, and (c) Water quality criteria (HAR §§ 11-54-4 – 11-54-8). It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters.

*National Historic Preservation Act of 1966 (NHPA):* This act provides for the preservation of significant historical features (buildings, objects and sites) through a grant-in-aid program to the States. Federal agencies are directed to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register. The regulations of Section 106 of NHPA require Federal agencies to under a review process to determine whether the proposed action has the potential to affect cultural resources.

*Native American Grave Protection and Repatriation Act (NAGPRA):* This law provides a process for museums and Federal agencies to return certain Native American cultural items – human remains, funerary objects, sacred objects, or objects of cultural patrimony – to lineal descendants and culturally affiliated Indian tribes and Native Hawaiian organizations.

*HRS Chapter 6E:* HRS Chapter 6E affords protection to historic sites, including traditional cultural properties of on-going cultural significance.

*Hawai‘i Coastal Zone Management Act (HRS Chapter 205A):* Hawai‘i's Coastal Zone Management Act outlines objectives, policies, laws, standards, and procedures to guide and regulate public and private uses in the coastal zone management area, which is defined to be the entire state of Hawai‘i.

*Hawai‘i State Planning Act (HRS Chapter 226):* This chapter sets forth “the Hawai‘i state plan that shall serve as a guide for the future long-range development of the State; identify the goals, objectives, policies, and priorities for the State; provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources;



improve coordination of federal, state, and county plans, policies, programs, projects, and regulatory activities; and to establish a system for plan formulation and program coordination to provide for an integration of all major state, and county activities” (HRS § 226-1).

*Hawai‘i County General Plan:* The Hawai‘i County General Plan identifies goals, policies and standards for the protection of natural and scenic resources.

## Relationship to Other Planning Efforts

The goals and objectives of existing state, regional, national, and ecosystem plans and/or assessments were considered in the development of the Draft Management Plan and this EA. The Draft Management Plan attempts to be consistent, as much as possible, with existing plans and assists in meeting their conservation goals and objectives. This section summarizes some of the key related planning efforts.

Table 1.1 Related State, Federal, and County Planning Documents

Planning Document	Comment
Hawai‘i Statewide Wildlife Action Plan (DLNR 2015), updating the Hawai‘i Comprehensive Wildlife Conservation Strategy (Mitchell et al. 2005)	Statewide strategy for the conservation of native wildlife and plants. Identifies species of greatest conservation need. Recognizes Laupāhoehoe Forest as an existing management area important for forest birds, ‘io, koloa maoli, terrestrial invertebrates, and rare plants and identifies future needs “increase active management; implement fencing, feral pig control, weed control, and monitoring to assess management effectiveness”.
The Rain Follows the Forest – A Plan to Replenish Hawai‘i’s Source of Water (DLNR 2011)	Watershed initiative developed by DLNR in 2011 to ensure fresh water is available to the people of Hawai‘i in perpetuity by protecting the watershed forests, with a goal of doubling the amount of protected watershed areas in 10 years. Laupāhoehoe Forest is identified as a priority watershed area on the island of Hawai‘i.
DOFAW Statewide Assessment and Resource Strategy (SWARS) (DLNR 2010)	Statewide plan that identifies areas of greatest need and opportunity for forests in Hawai‘i and develops a long-term management strategy. Objectives include: 1.1 Identify and conserve high-priority forest ecosystems and landscapes; 2.2 Identify, manage and reduce threats to forest and ecosystem health; 3 Enhance public benefits

	from trees and forests; 3.1 Protect and enhance water quality and quantity; 3.5 Protect and enhance wildlife and fish habitat; 3.7 Manage and restore trees/forests to mitigate and adapt to global climate change.
Atlas of Hawaiian Watersheds and Their Aquatic Resources (Parham et al. 2008)	The on-line Atlas was created to provide an accounting of the information on watersheds, streams, and the animals that inhabit the streams, to make the data freely available and to create a continuously growing document that can easily be updated with new information.
Laupāhoehoe Natural Area Reserve Draft Management Plan (DLNR 1989)	Previous (1989) management plan for Laupāhoehoe NAR; identified priority management as protecting the forest from feral pigs, improving access for public hunting, and removing priority weed species from intact portions of natural communities.
Hawai‘i State Plan	The Hawai‘i State Plan establishes a set of themes, goals, and objectives that are meant to guide the State's long-term growth and development activities. More detailed discussion on the Consistency of the Laupāhoehoe Draft Management Plan with the State Plan provided in Section 5.
Mauna Kea Watershed Alliance Management Plan (Stewart 2010)	The Mauna Kea Watershed Alliance includes major landowners and partners on Mauna Kea (including DOFAW and USFS) working collectively to address watershed management issues of common interest and concern on Mauna Kea. The management plan identifies 8 goals to implement the vision “to protect and enhance watershed ecosystems, biodiversity and resources through responsible management, while promoting economic sustainability and providing recreational, subsistence, educational, and research opportunities”.
USFWS Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006)	Identifies recovery actions for Hawaiian forest birds, including “protect and manage ecosystems for the benefit and recovery of native forest birds”.
USFWS Final Designation and Non-Designation	Provides recommendations for habitat

<p>of Critical Habitat for 46 Plant Species from the Island of Hawai‘i, HI (USFWS 2003)</p>	<p>management for rare plants found within Laupāhoehoe Forest: <i>Cyrtandra giffardii</i>, <i>Cyanea platyphylla</i>, <i>Clermontia peleana</i>, <i>Clermontia pyrularia</i>, <i>Cyrtandra tintinnabula</i>, and <i>Phyllostegia warshaueri</i>.</p>
<p>USFWS Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster (USFWS 1998a)</p>	<p>Describes recovery actions needed for endangered plants found within Laupāhoehoe Forest: <i>Cyanea platyphylla</i>, <i>Phyllostegia racemosa</i>, and <i>Phyllostegia warshaueri</i>.</p>
<p>USFWS Recovery Plan for the Hawaiian Hoary Bat (<i>Lasiurus cinereus semotus</i>) (USFWS 1998b)</p>	<p>Describes recovery actions needed for the Hawaiian hoary bat including protecting and managing current populations.</p>
<p>USFWS Recovery Plan for the Big Island Plant Cluster (USFWS 1996)</p>	<p>Describes recovery actions needed for <i>Clermontia lindseyana</i>, <i>Clermontia peleana</i>, <i>Cyrtandra giffardii</i>, and <i>Cyrtandra tintinnabula</i>.</p>
<p>Hawai‘i Tropical Forest Recovery Action Plan (Hawai‘i Tropical Forest Recovery Task Force 1994)</p>	<p>Plan to develop consensus actions needed to recover, manage, and enhance Hawai‘i’s tropical forests; contributed to the establishment of the HETF in 2007.</p>
<p>Hāmākua Community Development Plan (under development)</p>	<p>County of Hawai‘i community-level plan <a href="http://www.hawaii-countycdp.info/hamakua-cdp">http://www.hawaii-countycdp.info/hamakua-cdp</a> Preliminary draft (September 2015) includes the objective to “protect and enhance natural and cultural resources”, including sub objectives to “expand the local system of preserves”, “protect mauka forests”, “preserve scenic areas and viewsheds”, “protect and enhance ecosystems and watersheds”, and “establish and manage public access and trails”.</p>
<p>County of Hawai‘i General Plan (County of Hawai‘i 2005)</p>	<p>General Plan for the island of Hawai‘i outlines several relevant goals and policies, particularly relating to historic sites and natural resources and shoreline, including 6.3 (e) “...Assure the protection and restoration of sites on other public lands through a joint effort with the State”; 8.2(c) “Protect and promote the prudent use of Hawaii’s unique, fragile, and significant environmental and natural resources”; 8.2(d) “Protect rare or endangered species and habitats native to Hawaii”; 8.3(b) “Encourage a program of collection and dissemination of basic data concerning natural</p>

	resources”; 8.3(e) “Coordinate programs to protect natural resources with other government agencies”; 8.3(i) “Encourage an overall conservation ethic in the use of Hawaii’s resources by protecting, preserving, and conserving the critical and significant natural resources of the County of Hawaii”; 8.3(j) “Encourage the protection of watersheds, forest, brush, and grassland from destructive agents and uses”; 8.3(o) “Encourage the continued identification and inclusion of unique wildlife habitat areas of native Hawaiian flora and fauna within the Natural Area Reserve System”; 8.3(s) “Establish a system of pedestrian access trails to places of scenic, historic, cultural, natural, or recreational values”.
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## Environmental Assessment Process

This environmental assessment (EA) process is being conducted in accordance with HRS Chapter 343 and the National Environmental Policy Act (NEPA) as a use of State lands and an action within the State Conservation District and as a major Federal action that may affect the environment due to the involvement of the USFS in administering the HETF. Because the State of Hawai‘i (DLNR) is the landowner of the two parcels comprising Laupāhoehoe Forest, DLNR is the lead agency for the preparation of the EA. After review of the public comment on the Draft EA, the Draft Management Plan will be finalized and Final EA prepared.

## Required Permits and Approvals

The Laupāhoehoe Forest Final Management Plan will require approval of the NARS Commission and the Board of Land and Natural Resources (BLNR).<sup>1</sup> In addition, before implementation of the Management Plan, the following are anticipated:

- Project review by the Hawai‘i Coastal Zone Management program to ensure consistency with Section 307(c) of the Federal Coastal Zone Management Act and its implementing regulations at CFR 15 § 930.33(b);
- Informal section 7 consultation with U.S. Fish and Wildlife Service (USFWS) and Determination of Not Likely to Adversely Affect (NLAA);

<sup>1</sup> The NARS Commission approved the Draft Management Plan in concept at its regularly scheduled meeting in April 2015.

- Consultation with the DLNR-State Historic Preservation Division pursuant to HRS § 6E-8 and NHPA § 106; and
- consultation with the DLNR-Office of Conservation and Coastal Lands regarding conservation district use permit requirements.

## **Public Involvement and Agency Coordination**

A brief history of the public involvement and agency coordination process used to develop the Draft Management Plan follows. The Laupāhoehoe Advisory Council (LAC) was formed in December 2010 to provide guidance and consultation to DOFAW and USFS on issues of management, research, and education in Laupāhoehoe Forest. DLNR-DOFAW and the USFS compiled resource information available for Laupāhoehoe Forest, reviewed current conditions and activities within the Forest, and developed draft management concepts. DLNR-DOFAW, USFS and the LAC then jointly developed the Draft Management Plan through a collaborative planning process. Eleven public meetings were held with the LAC between 2012 and 2014, developing and discussing different aspects of the draft management plan. The comments and suggestions made through this process helped further develop and refine the proposed management actions. The Draft Management Plan was released to the public in April 2015, announced on the HETF web page (<http://www.hetf.us/page/home/>) and on DOFAW's Laupāhoehoe NAR web page (<http://dlnr.hawaii.gov/ecosystems/nars/hawaii-island/laupahoehoe-2/>), and hard copies distributed to the Hilo and Laupāhoehoe public libraries. DOFAW Staff gave a presentation on the Draft Management Plan at the NARS Commission public meeting on April 27, 2015, and an informational poster session to introduce the Draft Management Plan to the public was held June 17, 2015 at the Laupāhoehoe Community Public Charter School.

In October 2015, DLNR-DOFAW mailed a pre-consultation letter regarding the Draft Management Plan to the individuals, governmental organizations, and other organizations listed in Appendix A, inviting comments and feedback on the Plan to be used in developing the Draft EA. A public notice was also published in the Hāmākua Times November 2015 issue.

Eight letters or emails were received during pre-consultation from: the State Department of Health – Environmental Planning Office, the State Department of Health – Clean Water Branch, Hawai‘i Office of State Planning, the State Department of Land and Natural Resources – Division of Aquatic Resources, the State Department of Transportation, the US Fish and Wildlife Service, Hawai‘i County Police Department, and the Hawai‘i County Cultural Resources Commission. Copies of the correspondence are included in Appendix B.

After the public review and comment period on this EA, the Draft Management Plan will be finalized to reflect public comments made during pre-consultation and during the comment period.

## Issues/Scope of Analysis

During the process of public involvement, agency coordination, and internal scoping, issues associated with management of Laupāhoehoe Forest were brought forward. An issue is a point of concern, debate or dispute with a proposed action based on some anticipated effect. Topics considered during development of the Draft Management Plan include:

Natural resources. Where are the most important forested watershed and intact native ecosystem areas within Laupāhoehoe Forest? What are the known threats to these resources? What are past and current management actions and what additional actions are needed to effectively address threats? What priority species are found within Laupāhoehoe Forest? What is the condition of their current habitat and can the populations of and habitats for these species be protected or expanded? How can management be linked to research and monitoring to improve management effectiveness?

Research. What type of research is needed to help effectively manage Laupāhoehoe Forest? What existing research is underway and what areas of research should be promoted or emphasized in Laupāhoehoe Forest? What conditions are needed to ensure that research is compatible with the desired management?

Education and outreach. How can Laupāhoehoe Forest contribute to greater understanding of tropical forestry, conservation biology, and natural resource research and management? What areas should be the focus of education and outreach within Laupāhoehoe Forest? What opportunities exist for increased outreach, education or training?

Public access and recreation. What is the current level of public use? What types of management action are necessary to encourage or enhance public access?

Infrastructure. What facilities and infrastructure are needed to support natural resources management, research, education and outreach, and public access?

Major issues brought up during internal and external scoping and addressed in this EA include:

***Issue:*** *The Management Plan may impact hunting practices. Fences proposed for the Laupāhoehoe Construction Project may directly affect the size of hunting areas and the quality of hunting activities.*

***Issue:*** *The Management Plan does not protect enough designated critical habitat of endangered plants currently or historically found within Laupāhoehoe Forest, enough of the recovery habitat needed for endangered forest birds located in the upper elevation areas of Laupāhoehoe Forest, or enough of the Natural Area Reserve through fencing and ungulate removal.*

***Issue:*** *Increased public access to the Laupāhoehoe Forest may impact adjacent landowners by increasing trespass, vandalism, etc.*

**Issue:** *Best management practices should be utilized during all phases of plan implementation to assure minimizing negative impacts to aquatic resources and stream habitat (due to erosion caused by stream bank alteration, improvements to infrastructure, fencing or trails, or surveys in proximity to streams).*

**Issue:** *The negative effects of storm water runoff originating from human land-based activities should be evaluated, including the potential impact to nearshore marine resources.*

**Issue:** *Any projects and its potential impacts to State waters must meet existing State water quality criteria.*

**Issue:** *The Management Plan should discuss permitting of research, and what types of research action are and are not allowed within Laupāhoehoe Forest.*

**Issue:** *The Management Plan should include discussion of the permit procedures for Native Hawaiian religious and customary gathering rights, include historic trails and features, identify planned archaeological surveys and/or historic preservation plans, and include any plans for the treatment and management of known historic properties.*

## **Documents Incorporated by Reference**

Previous Environmental Assessments prepared for the Laupāhoehoe Forest, and associated specialists' reports, are incorporated into the document by reference. These reports are:

1. Final Environmental Assessment: Hawai'i Experimental Tropical Forest Laupāhoehoe Construction Project and associated specialists' reports (Watershed and Soils; Wildlife; Botanical Survey; Scenery; Cultural Resources Site Reconnaissance (2009 and 2010)) (available for public review at the office at PSW-Hilo, or on-line at <http://www.hetf.us/page/resources/>);
2. Hilo Paliku-Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe Forest Section, Ahupua'a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai'i (available for public review at the office at PSW-Hilo, or on-line at <http://www.hetf.us/page/resources/>); and
3. Final Environmental Assessment Hilo Forest Reserve Reforestation Project (2006) (available on-line at [http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Hawaii/2000s/2006-10-08-HA-FEA-HILO-Forest-Reserve-Reforestation.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/2000s/2006-10-08-HA-FEA-HILO-Forest-Reserve-Reforestation.pdf)).

## Section 2. Alternatives

### Alternatives Development

During development of the alternatives for the Draft Management Plan, DLNR-DOFAW, USFS, and the LAC reviewed and considered a variety of resource, social, economic, and organizational aspects important for managing the HETF. These biological, physical, and socio-economic conditions are described more fully in Section 3 and the Draft Management Plan.

### Alternative 1: No Action Alternative (Current management)

Alternative 1 describes current management activities. This alternative assumes little to no change in current management programs and is the baseline from which to compare the other alternatives.

#### Natural Resources

To date, DOFAW staff has built small fenced exclosures to protect approximately 35 acres of native forest habitat and rare and endangered plant species from feral ungulates; three exclosures (Kilau Uka, Loulu, and Scowcroft) are each approximately 10 acres, and 10 unnamed exclosures are less than ¼ acre. These exclosures are also used for restoration of rare plants through outplanting (Figure 2).

DOFAW staff control priority non-native invasive plants within the exclosures, along roadsides, and in other priority areas. Staff spend approximately 30 person days per year working on weed control, with additional work scheduled in summer when Youth Conservation Corps (YCC) crews are available.

DOFAW staff work cooperatively with other organizations and agencies on rare plant recovery including the Hawai'i State Plant Extinction Prevention Program (PEPP) and the Volcano Rare Plant Facility (VRPF) of the University of Hawai'i. Management actions specific to rare plant recovery include rare plant surveys to locate wild individuals, protection of wild plants in fenced exclosures, collection of propagation and genetic storage materials and reintroduction through outplanting in fenced, protected exclosures. PEPP is focused on preventing the extinction of taxa with fewer than 50 individuals in the wild.

DOFAW staff follow rare plant collection and reintroduction guidelines recommended by the Hawai'i Rare Plant Restoration Group. DOFAW staff tag and map the locations of all outplanted plants and monitor their survival and growth. Rare plants reintroduced into Laupāhoehoe Forest in fenced protected exclosures include: *Anoectochilus sandvicensis*, *Clermontia lindseyana*, *Clermontia pyrularia*, *Cyanea platyphylla*, *Joinvillea ascendens*, *Ochrosia haleakalae*, *Phyllostegia macrophyllus*, *Phyllostegia warshaueri*, *Stenogyne macrantha*, and *Trematolobelia grandifolia*.



## Laupāhoehoe Forest Existing Infrastructure

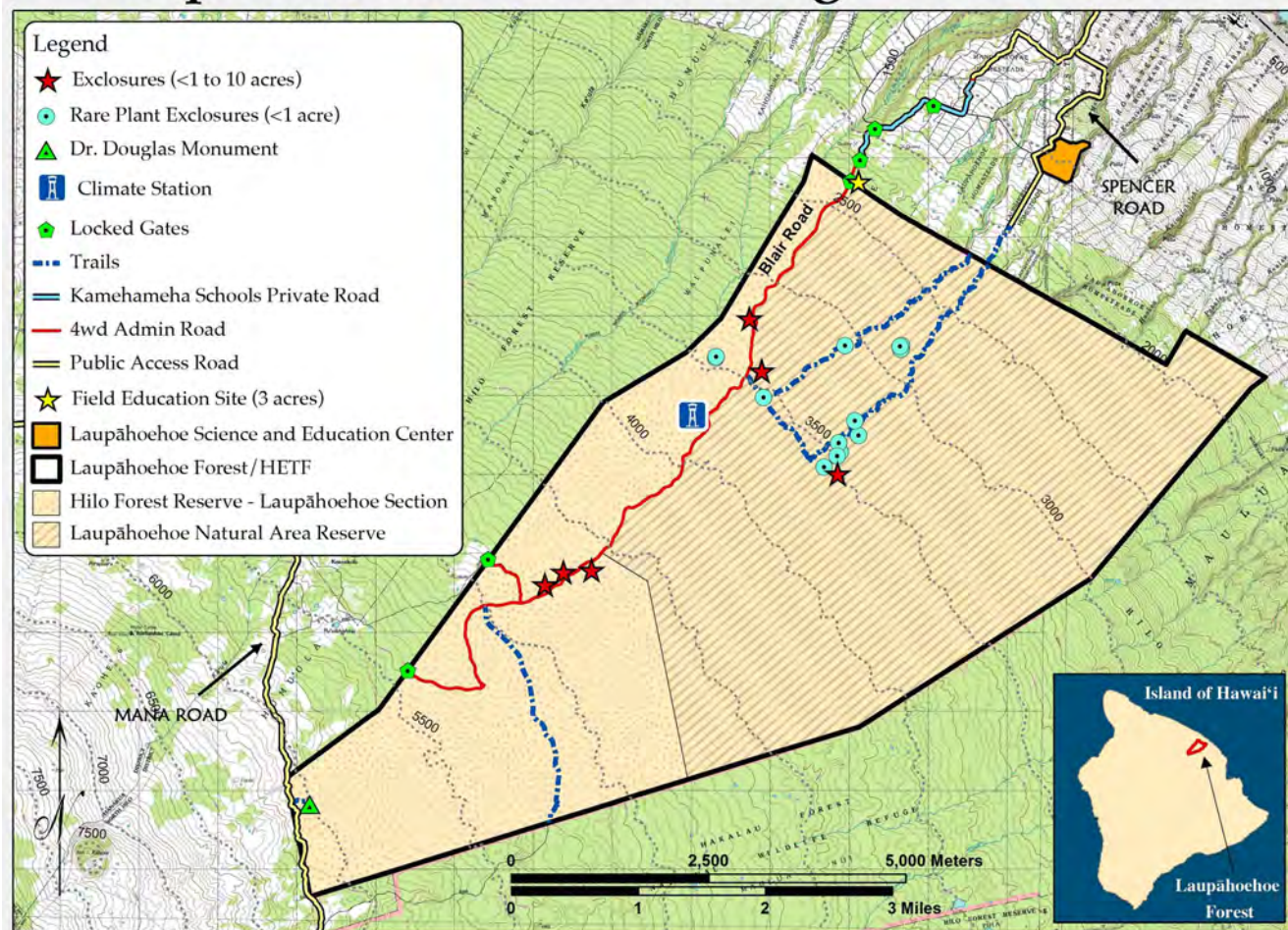


Figure 2. Laupāhoehoe Forest Existing Infrastructure

In 1982 a rare plant survey of the proposed NAR noted the presence or absence of certain priority invasive non-native plants (Cuddihy et al. 1982). More intensive invasive non-native plant monitoring was completed across 9 transects in the NAR portion of the Laupāhoehoe Forest in 1988, to gather information for the 1989 management plan. These transects were re-monitored in 1998. In 2008, NAR staff monitored vegetation plots along new transects which included invasive non-native plant monitoring.

Forest birds in Laupāhoehoe Forest were surveyed as part of the Hawai'i Forest Bird Survey (Hāmākua Study Area) from 1976-1983 (Scott et al. 1986). These same transects were re-surveyed in 1993. In 2013, additional surveys were conducted to assess the status of forest birds as part of the development of the Draft Management Plan.

## Research

Research conducted in the Laupāhoehoe Forest is a combination of long-term monitoring of environmental conditions and biotic responses, and directed research to address key questions about forest ecosystem function, health, and sustainability. Research in the Laupāhoehoe Forest is conducted by universities, government agencies including the USFS, and private organizations. Projects vary in focus, scope and length. Research projects proposed for the Laupāhoehoe Forest are subject to permitting requirements, which include review by a committee composed of DOFAW and USFS representatives, standard conditions, and additional project-specific conditions as needed. Approval is granted for one year at a time, so that long-term projects have to re-apply to continue. The HETF Annual Reports, found at <http://www.hetf.us/page/resources/>, provide summaries of each year's research.

All approved research must submit an annual report on project progress and a close-out plan that details dates for the removal of equipment or any-related research infrastructure. Standard conditions on research projects include the following conditions: provide GPS coordinates of the study area (including site and plots); use of precautions and measures to minimize inconveniences to surrounding residents and the public in general; no disturbance of cattle or cattle ranching and shutting and re-locking of any closed gates encountered to and from the research site; minimize use of flagging and identification materials, avoidance of permanent markers (such as nails in trees) where possible, and no use of rebar; and use of appropriate protocols to minimize the potential for the introduction of non-native plants and animals.

In the Laupāhoehoe Forest, long-term monitoring infrastructure has been established for vegetation, climate, and stream monitoring. The Hawai'i Permanent Plot Network (HIPNET), a collaborative project between the University of Hawai'i (UH), the USFS, and University of California Los Angeles, has established a co-located vegetation plot and climate station in the Laupāhoehoe Forest that is part of a worldwide study of tropical forests within the Smithsonian Tropical Research Institute's Center for Tropical Forest Science ([www.ctfs.si.edu](http://www.ctfs.si.edu)). Climate conditions in the forest are monitored by a weather station installed in 2009. The climate station extends 10 feet above the forest canopy and collects data on rainfall, temperature, relative humidity, wind-speed, solar radiation (sunlight), soil moisture, soil temperature, and wind direction. The Laupāhoehoe climate station is part of the EPSCoR-ENDER (Experimental Program to Stimulate Competitive Research – Environmental Dynamics and Ecosystem Responses) Climate Network, an island-wide network of climate stations at locations across the island of Hawai'i. Research conducted in the HIPNET will enable advancement in the studies of global change, ecohydrology, ecosystem services, remote sensing, restoration, community structure and organization, population genetics, comparative forest ecology and biogeochemical processes.

The Forest Inventory and Analysis Program (FIA) is a nationwide USFS program aimed at collecting,

analyzing, and reporting information on the status and trends of America's forests. The Laupāhoehoe Forest includes 29 FIA plots (12 in the FR and 17 in the NAR) which represent a portion of the approximately 600-700 plots proposed for all of Hawai‘i. Hawai‘i's FIA program collects additional information on the presence of invasive plants and other disturbances such as feral pigs to provide a baseline assessment of the current state of forests all over Hawai‘i. Plots are scheduled to be re-measured every 10 years to provide insights into changes in forest extent, composition, structure, and disturbances.

One stream gauge has been established in Manowai‘ōpai Stream below the forest boundary for monitoring Laupāhoehoe Forest and the gauge is currently maintained by the USFS.

In addition to long-term data collection, the HETF supports a range of research projects that contribute to the greater ecological understanding of Hawai‘i's forests and species. Research topics include species identification, monitoring, ecosystem services and life history studies, koa productivity, biodiversity and invasive species impacts and control. Representative examples of the diversity of topics include:

- Hawaiian hoary bat habitat occupancy, reproduction and diet
- Acoustic variability and loss of song complexity in Hawaiian honeycreepers
- Adaptive radiation in Hawaiian spiders
- *Drosophila* bar coding project as a method to determine species
- Native and non-native snail surveys
- ‘Ōhi‘a rust monitoring
- Assessing the *Scotorythra paludicola* (Lepidoptera: Geometridae) outbreak on koa: population abundance, rates of parasitism and patterns of spread
- Comparative nutritive values of traditional and exotic foraging substrates for upper elevation forest birds
- Quantifying the effects of ungulate and vegetation on the hydrology of Hawaiian tropical forests
- Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics.

## Education and Outreach

Educational activities associated with Laupāhoehoe Forest currently include support for internships that focus on restoration and education (AmeriCorps, YCC, and Pacific Internship Programs for Exploring Sciences (PIPES)), and securing national, regional, and local grants that fund educational programs. Further, IPIF staff collaborations with teachers at local, middles and high schools have resulted in classroom field trips into the forest to learn about botany, ecology, natural resources management, traditional ecological knowledge and cultural geography. Many of the educational activities involve substantial contributions from additional partners including Mauna Kea Watershed Alliance, the USFWS, UH-Hilo, and UH-Mānoa.

## Public Access and Recreation

Public access for recreational and cultural uses is ongoing in Laupāhoehoe Forest in accordance with existing rules and policies. Laupāhoehoe Forest is open to the public, but there are limited legal access points (via Spencer Road, Mana Road, and Maulua Nui/Uweki Road Access) and only a few minimally maintained and marked trails (see Figure 2).

## Infrastructure

Existing infrastructure within Laupāhoehoe Forest consists of trails, a 4WD administrative-use road (Blair Road) used for management, research and educational purposes (but not public access), existing fenced units of 10 acres or less, and various research-related equipment (e.g., climate station, stream gauges, etc.).

Existing trails within Laupāhoehoe Forest include the following:

- Kaluakauka Trail – The trailhead for this Nā Ala Hele designated trail is on the makai side of the Keanakolu-Mana Road, 17.7 miles from the junction with Mauna Kea access road. The trail goes downhill across forested pastureland to a foot gate in the FR boundary fence, then continues to the Dr. David Douglas monument erected in 1934 (approximate death site of Dr. David Douglas, the Scottish botanist for whom the Douglas Fir is named).
- Maulua Trail – A portion of this historic ranching era trail goes across the upper section of Laupāhoehoe Forest from the boundary near Shack Camp to Waipunalei. Access to this portion of the trail is via Blair Road. While small segments of the historic trail are visible, the trail is not currently maintained and most of the exact route of the historic trail is unknown due to weathering, erosion, and vegetation overgrowth.
- Laupāhoehoe-Waipunalei Trail – A portion of this historic trail is contained within the lower section of Laupāhoehoe Forest, generally following the boundary between Laupāhoehoe and

Waipunalei ahupua‘a. Like Maulua Trail, the trail is not currently maintained and the exact route of the historic trail is unknown.

- Other trails – Additional named and unnamed trails can be found within Laupāhoehoe Forest. These trails are not formally recognized as public access trails and are not marked or maintained. Many of these primitive trails were created by the hunting community from the Spencer Road access point. Trail conditions are hazardous, steep and muddy, and lower elevation portions of the trail within the strawberry guava belt may frequently be “tunneled” in by guava tree windfall. “Peneki” and “Spencer” trails are two of these existing trails that have been identified for future management attention.

Two facilities, located outside the forest boundary, support education and research activities. The Laupāhoehoe Science and Education Center was completed in 2015, consisting of a bunk house, toilet/showers, and meeting/classroom. The Center is located approximately 4 miles from the Forest boundary and can accommodate approximately 30 visitors for day-use and 15 visitors overnight. A Forest Pavilion (Field Education Site) was covered by a previous EA and has yet to be built. It will consist of a covered pavilion, toilet/comfort station, and parking area, located on a 3-acre parcel directly adjacent to Laupāhoehoe Forest along Blair Road, and will be used primarily as a staging area for research and education trips.

Finally, “Shack Camp”, containing the ruins of a historic structure associated with Kūka‘iau Ranch and an opening in the forest due to past cattle grazing, is located at approximately 5,200 ft (1,585 m) elevation near the intersection of the Laupāhoehoe Forest boundary and the historic Maulua Trail.

## **Alternative 2: Implement the Draft Management Plan**

The chief distinction of this alternative from Alternative 1 is increased protection and management of natural resources through the creation of new fenced conservation units (approximately 2,694 total acres); increased public recreational opportunities through trail improvement and creation and the establishment of primitive camping at Shack Camp; increased opportunities for education and outreach (such as field projects and workshops, field trips, professional development training, and increased communication of research findings); and the installation of management shelters and helicopter landing zones (in natural forest clearings) to support natural resources management, wildfire suppression, and emergency response. The Draft Management Plan combines new proposed actions with ongoing research, management and education projects; proposed management is discussed in the context of five areas: natural resources, research, education and outreach, public access and recreation, and infrastructure.

## Natural Resources

Four key areas of management are identified: Forest Protection and Management, Invasive Non-Native Plant Control, Rare Species Restoration, and Wildfire Prevention and Response.

### *Forest Protection and Management*

Background: The protection and management of forested watersheds and unique native Hawaiian ecosystems is a priority for Laupāhoehoe Forest. Effective management of forested watersheds provides fresh water for public use, improves water quality, reduces soil erosion, improves coastal water quality, and maintains native ecosystems. In addition, many native, threatened and endangered species rely on forested watersheds for their survival. These forested watersheds require active management to effectively address threats in order to persist for the benefit of current and future generations and to maintain forest health. Protecting and enhancing the integrity of the native forest makes them more resistant and resilient to intermittent threats like fire, hurricane, extreme weather events, extended droughts, and insect or disease outbreaks and more likely to adapt to climate change perturbations.

Objective: Protect, manage and restore ecosystems and species at Laupāhoehoe Forest by effectively managing conservation units and implementing forest restoration practices.

### Proposed actions:

1. Fence and remove feral pigs from conservation units (approximately 2,659 total ac) to protect the biological and water resources and limit damage to native Hawaiian ecosystems (Figure 3). Without fencing, damage from hooved animals cannot be stopped because of reproduction of existing populations and continued ingress from adjacent properties.
2. Maintain all fences through regular inspection and maintenance and replace fences when needed, including perimeter fencing to prevent cattle ingress from adjacent ranch lands.
3. Restore forested ecosystems in areas that have been disturbed (e.g., formerly logged areas, areas disturbed by cattle) through tree plantings and invasive non-native plant control.
4. Plant koa and other native trees to restore native forest. Priority areas include a) within the FR section along Mana Road and inward, b) Shack Camp, and c) section off Blair Road towards Waipunalei, but restoration is not limited to these areas.
5. Control non-native pasture grasses and other non-native invasive weeds in restoration areas to enhance the natural regeneration of native trees and shrubs and prevent fire. Conduct thinning or removal of trees (excluding commercial logging) where needed to maintain forest health or reduce fuel loads.



## Laupāhoehoe Forest Habitat Protection and Management

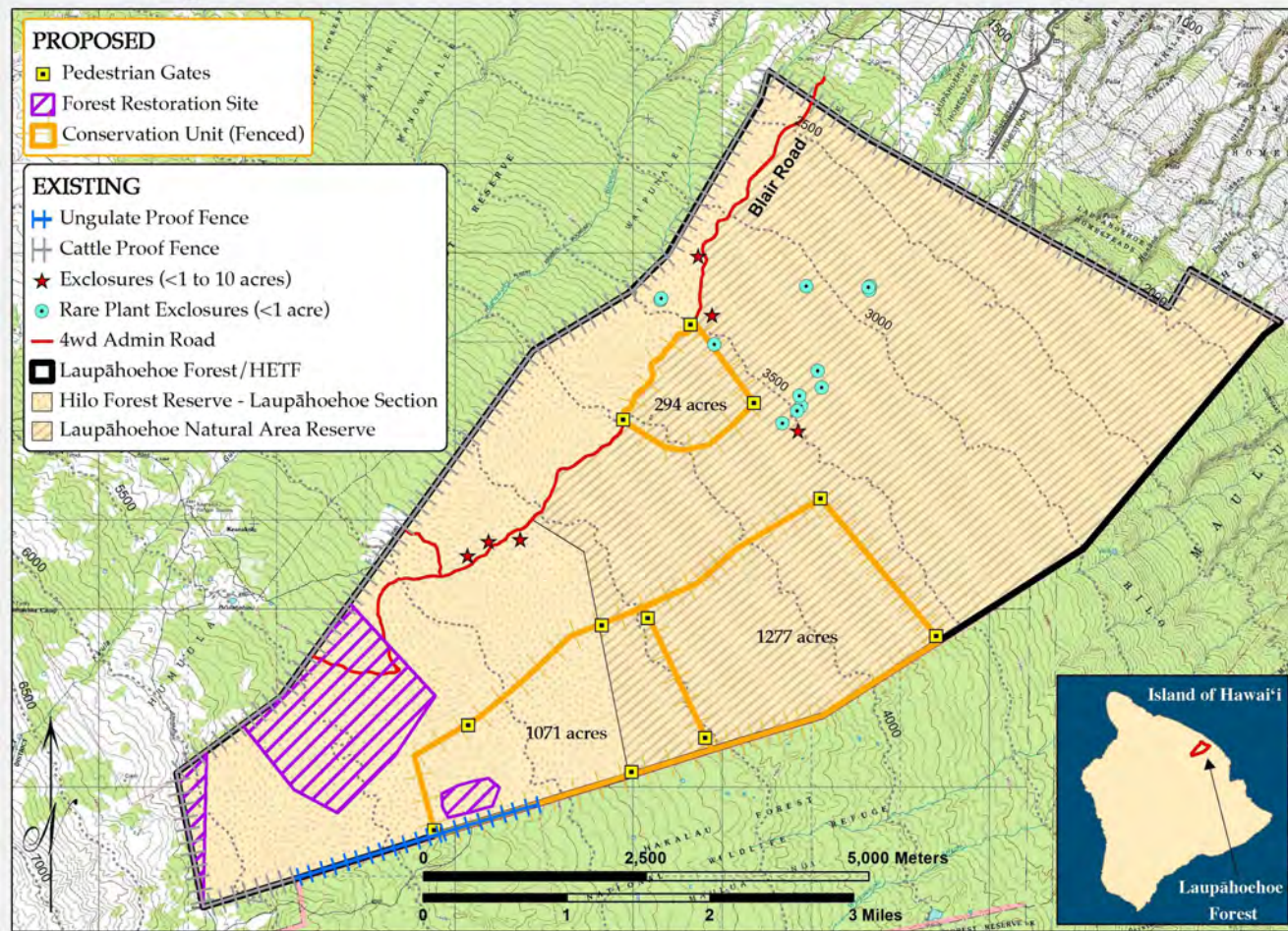


Figure 3. Laupāhoehoe Forest Habitat Protection and Management

6. Construct emergency rare plant exclosures between 1-5 ac in size when needed to protect individuals or populations of endangered plants.
7. Pursue potential land acquisitions of adjacent lands for protection and restoration of a large conservation landscape in cooperation with conservation partners (when applicable).

### *Invasive Non-Native Plant Control*

**Background:** Invasive non-native plants are a major threat to Laupāhoehoe Forest, and species with high potential for spreading and modifying habitat are a high priority for control. The overall approach includes preventing the establishment of new habitat modifying species that are either not currently present (e.g., miconia) or are still localized through biosecurity measures. For priority weeds already present, the goal is to identify control areas, eliminate all known occurrences within targeted control

areas, and/or contain further spread.

**Objective:** Protect intact native forest by preventing the establishment and/or removing high priority non-native, invasive plants and other invasive species.

**Proposed actions:**

1. Regularly monitor and map the distribution of high priority invasive non-native plants, develop a comprehensive control strategy and revised control strategy as needed based on monitoring data.
2. Control priority non-native invasive plants in identified areas using approved methods.
3. Monitor non-native invasive plants to determine whether weed control measures are effective and to detect changes in long-term distribution and abundance.
4. Maintain procedures to prevent introduction of new weeds.

*Rare Species Restoration*

**Background:** Landscape-scale habitat protection and management through management actions described in the Forest Protection and Management section are critical to the long-term integrity and recovery of native ecosystems including rare plants, forest birds, and other native species. Such management actions, along with invasive non-native plant management control, are the most critical actions needed to protect existing native habitat and rare species. However, in some instances, these actions are not enough to recover certain rare and endangered plants and animals. These species may have wild populations that are so small that the species cannot survive and recover without additional species-specific management.

**Objective:** Protect threatened and endangered plants and animals in Laupāhoehoe Forest and restore populations of these species in appropriate habitat to assist with the overall recovery of these species.

**Proposed actions:**

1. Maintain the integrity of high quality forest ecosystems to the extent possible through fencing, feral ungulate control, non-native invasive plant control and preventing the introduction and establishment of other habitat-modifying species and new threats.
2. Map, monitor and protect existing wild populations of rare and endangered species to contribute to their population recovery and stabilization. Identify and remove threats to these species and ensure their long-term survival in secure and self-sustaining wild populations.
3. Re-introduce certain species of rare and endangered plants in appropriate protected habitat through outplanting. Over the past decade, numerous species of rare plants have been



propagated and reintroduced into fenced, ungulate-free areas to contribute to their overall recovery in the wild.

4. Determine additional actions needed to protect rare invertebrates. Previously discussed habitat management will also benefit rare native invertebrates, as they are generally dependent on native plants for food and as host plants.
5. Enhance habitats for native species through small mammalian predator removal and other habitat management actions, including removal of larval habitats and reducing or eliminating vespid wasps.

### *Monitoring*

Background: DOFAW staff will continue to implement basic monitoring programs which are directly informing ongoing management. DOFAW staff regularly monitor ungulates, non-native invasive plants, rare plants and forest birds, and are planning to continue these monitoring programs. Additional monitoring is described under research and will primarily be implemented by USFS staff and other researchers.

Objective: Monitor current status and trends of natural resources throughout Laupāhoehoe Forest as part of a long-term monitoring program.

### Proposed actions:

1. Continue ongoing monitoring programs for feral ungulates, non-native invasive plants and rare plants to measure the success of management and detect changes in abundance and distribution.
2. Continue ongoing monitoring program for forest birds and provide monitoring data to the Hawai'i Forest Bird Interagency Database Project for analysis of bird population densities and trends.
3. Develop improved monitoring protocols, data management and analysis for existing monitoring programs and review and summarize past monitoring data and inventories.
4. Develop and/or identify appropriate monitoring protocols and implement monitoring for key community indicators that are not currently being monitored (e.g., native vegetation communities, invertebrates, etc.).

### *Wildfire Prevention and Response*

Background: Fire is a threat to the drier upper elevation portions of the Laupāhoehoe Forest. Many fires are caused by humans, so fire prevention measures will include increased educational efforts. It will also include clearing of fuel breaks and other similar fire pre-suppression actions to reduce fire

potential and minimize fire severity. DOFAW staff will respond to fires in Laupāhoehoe Forest using measures that result in the least amount of impact or disturbance to natural and archaeological resources. The method of suppression will be determined by the on-site situation, with special regard to the potential expansion of fire damage to natural resource. Minimum impact methods of suppression will be applied whenever such methods are sufficient. Bulldozing is justified when a fire cannot be otherwise controlled and potential bulldozing damage is outweighed by a probably greater loss of natural and archaeological resources.

Objective: Employ appropriate fire management strategies including pre-suppression, suppression, and post-suppression rehabilitation to reduce wildfire occurrence and minimize wildfire impacts.

Proposed actions:

1. Implement fire prevention measures, including educational outreach to neighbors and signage along roads and road or area closures in the event of extreme fire danger.
2. Control invasive plants, particularly non-native grasses and plant common native species to restore certain disturbed areas to prevent fire and/or following damage from fire.
3. DOFAW staff to suppress fires safely and aggressively using appropriate means to minimize wildfire impacts.
4. Continue DOFAW staff training and certifications for effective and safe fire response.
5. Maintain access and fuelbreaks for fire pre-suppression and suppression.

## Research

Background: The USFS and state of Hawai‘i, along with the consortium of institutions and agencies involved with the HETF, will continue to encourage and facilitate research in Laupāhoehoe Forest. Research projects that contribute to the greater purpose of the HETF, that are relevant to land management issues, and that are compatible with existing research and management will be encouraged. USFS will support facilities to enhance the ability of the experimental forest to meet its goals for research and science. In addition, the USFS will facilitate access to basic biological, physical, and climatological data for the experimental forest through readily accessible web-based platforms and tools for researchers and the public to provide a foundation on which research permits can be built. All research within the HETF requires a valid permit.

Objective: Provide lands for conducting research that serves as a basis for the restoration, conservation and management of tropical forest ecosystems in Hawai‘i and across the tropics.

Proposed Actions:

1. Promote applied research with direct relevance to land management issues such as effective management of invasive species, forest restoration and climate change impacts on Laupāhoehoe Forest.
2. Effectively administer and coordinate the research application process including review of applications, issuance of research permits, research compliance with permit conditions and relevant land designation statutes and rules.
3. Establish and maintain a system for archiving research data and reports to facilitate the exchange and transfer of information among agencies, scientists, and the community.
4. Improve dissemination of scientific research information and results to land managers and the local community.
5. Promote cultural research including information on traditional Hawaiian use/presence in the forest, oral histories, cultural impacts of management actions and archaeological studies.
6. Link ongoing research to education programs by encouraging researchers to work with local schools such as the Laupāhoehoe Community Public Charter School and universities.
7. Encourage basic research and monitoring to establish historical baselines of all natural resources.

## Education and Outreach

Background: Education and outreach are key components of the overall vision for Laupāhoehoe Forest. Education and outreach goals span six focal areas: formal training for professionals; community outreach; cultural training; demonstration for natural resources managers; student research; and academic education. Educational goals will be accomplished through a strong reliance on partnerships and will be integrated with other aspects of research and natural resource management.

Objective: Serve as a center for forest education, training, demonstration and outreach on tropical forests, conservation biology, and natural resource management for groups ranging from school children to land managers, scientists, and the general public.

### Proposed Actions:

1. Encourage appropriate educational and cultural uses of Laupāhoehoe Forest through the development of general criteria, priorities and rules to effectively manage multiple educational uses.
2. Provide general orientation and training (e.g., on-line videos) for all new research permittees and educational programs that includes recommendations on forest stewardship and invasive

species prevention protocols as well as cultural components.

3. Collaborate with universities and relevant non-governmental organizations to integrate classes, student research/internships and provide support via Center facilities.
4. Foster and support undergraduate and graduate student research opportunities and research internships through partnerships with UH, other universities and local research agencies and organizations.
5. Provide a connection to nature and promote forest stewardship through engagement activities that involve the public and through collaboration with K-12 education program partners and other community partners including but not limited to the Laupāhoehoe Community Public Charter School. Educational activities include educator workshops and programs; field projects geared toward kids; partnering with schools, educators, community and other non-governmental organizations to create and implement activities that facilitate forest stewardship.
6. Communicate research findings, land use, and management goals to the community via community field trips, informational materials suitable for non-professionals of all ages, participation in community events, service learning opportunities, interpretive trails and guided walks, and public participation in scientific research.
7. Provide work experience and formal professional development training to land management professionals in ecology, conservation, and restoration of natural and cultural resources.
8. Serve as a demonstration site for land managers by providing information, tools and techniques through demonstration research, conservation and restoration projects.
9. Provide readily accessible scientific information through web-based platforms and tools.
10. Encourage researchers to share research results with the local community through informational presentations to schools and community groups and popular articles.
11. Hire staff and/or establish volunteer positions to facilitate educational and outreach experiences (e.g., education staff, rangers).
12. Serve as a site for alternative educational activities for non-profit groups and organizations (e.g., search and rescue training, orienteering, survival skills, back-country travel, hunter education programs, forest stewardship, Junior Youth Council, recreational and/or life skills, cultural immersion and traditional ecological knowledge training).

## **Public Access and Recreation**

Background: Laupāhoehoe Forest is protected and managed by the state for the benefit of the people of

Hawai‘i and is open to the public for various recreational and cultural uses. While the public is allowed to access and hike or hunt in any portion of the forest, there are limited legal access points and only a few minimally maintained and marked trails. This area is a rough and remote rainforest wilderness and there are currently no amenities for recreational users. The access and recreational improvements proposed are intended primarily for local residents and to improve staff management access rather than for large-scale ecotourism. Large groups (over ten people) accessing the NAR will continue to require a HETF permit.

Objective: Improve public access and recreational opportunities in Laupāhoehoe Forest consistent with maintaining natural resources and the wilderness character of these lands.

Proposed Actions:

1. Improve public access through work with adjacent landowners for alternative access to the forest, work with the county to ensure all future subdivision plans in the area include public access to the forest, pursuit of potential land acquisitions to increase access, and consideration of adding trails and accesses (e.g., Maulua Trail) to the Nā Ala Hele Statewide Trails and Access System.
2. Trail maintenance (pedestrian) – Maintain existing trails (Spencer, Maulua, and Peneki) as primitive trails (minimally maintained and marked).
3. Trail improvement (pedestrian) – Improve existing and/or create and maintain new trails to the same level as the maintained trails mentioned above (Spencer, Maulua, and Peneki)(e.g., minimally maintained and marked). Identified trails include a new trail along the north fence line (upper boundary) from Mana Road to Blair Road; the improvement of Spencer trail to Peneki and Peneki to Blair; the improvement of Maulua Trail to the south boundary/fence line; a new trail from Mana Road to Maulua roughly parallel to the southern forest boundary; and a new trail at the FR/NAR boundary. Specific alignments for new trails have not yet been determined and may vary depending on the vegetation and terrain.
4. Hunting – Maintain and improve public hunting opportunities in Laupāhoehoe Forest, which would include securing and improving/creating access and trails as outlined above, facilitating additional hunter education classes in the Laupāhoehoe region, considering changes to the permitted hunting method for Unit C (currently rifle only) if desired by the hunting community, and working with DLNR-Division of Conservation and Resource Enforcement to address hunting community concerns about illegal activities at Laupāhoehoe Forest and elsewhere on the island.
5. Camping and Shelters – Establish designated camping area at Shack Camp with primitive camp

sites, which could include the construction of a shelter or cabin at Shack Camp and related infrastructure such as composting toilet, fire pits, and a helicopter landing zone.

## Infrastructure

Background: Infrastructure is needed to improve management, research and education and public recreational uses in Laupāhoehoe Forest. Infrastructure includes roads, facilities, helicopter landing zones and structures, cabins/shelters and equipment.

Objective: Provide and maintain infrastructure and facilities to enhance the ability of the Laupāhoehoe Forest to meet its goals for management, research, education, and demonstration.

### Proposed Actions:

1. Develop and maintain roads, cabins/shelters and campsites and helicopter landing zones for resources management actions, the functions of the HETF and for public recreational use and safety, specifically a) develop facilities at Shack Camp as outlined above, b) establish a forest management shelter and helicopter landing zone at 3,500 ft (1,066 m) elevation on the southeast side of the NAR for management (with the shelter also available for public use by reservation), c) establish approximately three other forest management shelters as needed to support natural resource management activities, at locations to be determined (with the shelters also available for public use by reservation), and d) establish additional helicopter landing zones to be used for management and search and rescue operations, in existing natural clearings within the Laupāhoehoe Forest boundary, at locations to be determined.
2. Ensure the development and maintenance of facilities and infrastructure has minimal impacts on the environment and natural and cultural resources.

## Alternatives Considered but Dropped from Further Analysis

During development of the alternatives, DOFAW, USFS, and the LAC considered the actions related to the topics below. All of these actions were ultimately eliminated from further consideration for the reasons provided.

*No Fencing/Fence entire Laupāhoehoe Forest:* During Management Plan development, feedback relating to conservation units in Laupāhoehoe Forest ranged widely from support for fencing the entire forest for protection to opposition to any additional fences. The protection and management of forested watersheds and unique native Hawaiian ecosystems is a priority for the state within Laupāhoehoe Forest, and currently only 35 acres are protected from feral ungulates. Across Hawai‘i Island, state land managers face tough choices when tasked with protecting valuable native resources while still

providing hunting opportunities. In particular with feral pigs, the negative impacts to the forest are well documented. The proposed conservation units identified in the Draft Management Plan attempt to meet conservation needs while considering hunting community desires.

The size and locations for conservation units were chosen in consultation with the LAC and high use hunting areas were avoided where possible. The selected conservation units have some of the highest quality, most intact native habitat in the Laupāhoehoe Forest, will protect existing populations of rare plants and animals, and can be used as restoration sites for rare species recovery.

Lower elevation areas (both in the NAR and FR) were not included, despite the historic records of endangered plants, because of the extent of the invasive weeds in this area that would increase the cost and reduce the effectiveness of future management. Known populations of existing endangered plants within the lower elevation area are already protected by small fenced enclosures, to protect the plants and allow for seed collection to support future reintroduction efforts within larger fenced units.

*Pedestrian Access:* Feedback ranged from current pedestrian opportunities are adequate, and no additional management actions are needed, to recommendations to consider the development of highly developed and maintained trails. A majority of comments recommended improving pedestrian access to allow a pedestrian to follow a recognized trail through the forest that would connect to Blair Road. Numerous options were considered during management plan development (including a trail from the top of Spencer Road to Blair Road). Due to the rugged terrain of Laupāhoehoe Forest, the heavy infestation of strawberry guava at lower elevations, and the financial resources needed to create and maintain trails (particularly in areas infested with non-native species), the Draft Management Plan primarily focuses on improving existing primitive trails at lower elevations to allow pedestrians to traverse the forest and enter and exit at existing legal access points and provides for the development of new trails at higher elevation areas with more intact native forest.

*Vehicular access to and within the forest:* Feedback ranged from recommendations to dismantle Blair Road to opening Blair Road to public vehicular access. Blair Road is an important access for management, research and education/outreach opportunities in Laupāhoehoe Forest and for these reasons dismantling Blair Road was not considered as a feasible action. Opening Blair Road to public vehicular access was not considered feasible on either a permanent or sporadic (e.g., an “annual open house”) because Blair Road is only accessible through private land. In addition, negative impacts associated with increased public use of Blair Road (e.g., road maintenance considerations and the possible transport of invasive species) contributed to removing this option from further consideration. However, both USFS and DOFAW currently offer agency chaperoned service learning/outreach opportunities, and these types of activities are proposed for expansion in the Draft Management Plan.

*Mountain biking:* Feedback ranged from mountain biking should not be allowed, to trails should be

maintained/created to accommodate mountain biking. Biking is legal on FR roads, including Blair Road, but currently the only way to reach Blair Road on a bike is through private property, which is not legal. An alternative considered was the development of multi-use trails that would allow for legal entry; however, this was not selected for inclusion in the Draft Management Plan because there were only a small number of trails proposed for pedestrian improvement, concerns about user conflicts, and bicycle damage to trails.

*Game enhancement:* Feedback included a desire for the state to pursue game management to increase game mammal populations in the unfenced areas of Laupāhoehoe Forest primarily to allow for closures to create recovery periods coupled with DOCARE enforcement. Game management to increase game mammal populations for hunting conflicts with DOFAW management priorities for Laupāhoehoe Forest, as well as with federally designated critical habitat for endangered species. The proposed fenced conservation units in the Draft Management attempt to meet conservation needs while also considering hunting community desires. High quality habitat that is less heavily used for public hunting due to remoteness was purposely selected for the fenced conservation units. The Draft Management Plan seeks to increase public hunting opportunities in more accessible areas outside the fenced conservation units through improvements in access, rather than using techniques (such as closures) to increase game mammals numbers.

## Section 3. Environmental Setting and Consequences

### Overview of Effects Analysis

This chapter assesses the potential effects to the physical and biological environment and to cultural and socio-economic resources as a result of implementing the Draft Management Plan. The qualitative terms moderate (intermediate), minor, and negligible are used to describe the magnitude of the effect. To interpret these terms, intermediate is a higher magnitude than minor, which is of a higher magnitude than negligible.

The terms below were used to describe the scope, scale and intensity of effects.

**Neutral or Negligible.** Resources would not be affected (neutral effect), or the effects would be at or near the lowest level of detection (negligible effect). Resource conditions would not change or would be so slight that there would not be any measurable or perceptible consequence to a population, wildlife, or plant community, recreation opportunity, visitor experience, or cultural resource. If a resource is not discussed, impacts to that resource are assumed to be neutral.

**Minor.** Effects would be detectable but localized, small, and of little consequence to a population, wildlife or plant community, other natural resources; social and economic values, including recreational



opportunity and visitor experience; or cultural resources. Mitigation, if needed to offset adverse effects, would be easily implemented and successful based on knowledge and experience.

**Intermediate or Moderate.** Effects would be readily detectable and localized with measurable consequences to a population, wildlife or plant community, or other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources within Laupāhoehoe Forest but not readily detectable or measurable beyond Laupāhoehoe Forest. Mitigation measures would be needed to offset adverse effects and could be extensive, moderately complicated to implement, and probably successful based on knowledge and expertise.

**Significant or Major.** Region-wide effects would be obvious and would result in substantial consequences to a population, wildlife or plant community, or other natural resources; social and economic values, including recreational opportunity and visitor experience; or cultural resources. Extensive mitigating measures may be needed to offset adverse effects and would be large-scale in nature, possibly complicated to implement, and may not have a high probability of success. In some instances, major effects would include the irretrievable loss of the resource.

Time scales are defined as either short-term or long-term.

**Short-term or temporary:** An effect that generally will last less than a year or season.

**Long-term:** A change in a resource or its condition that will last longer than a single year or season.

## Topography, Climate, Geology, and Soils

### Existing Conditions

Laupāhoehoe Forest is located on the eastern, windward flanks of Mauna Kea from about 1,700 to 6,100 ft (518 – 1860 m) elevation. As the trade winds off the Pacific Ocean strike the mountain, moist air is elevated and cooled, resulting in cloudy weather, high rainfall rates, and afternoon fog and mist in the area. Condensation from ground-level clouds (fog drip) contributes additional moisture at higher elevations. Average annual rainfall in the lower elevations is about 160 inches (in) (418 centimeters (cm)) and ranges from 60 to 100 in (157 – 261 cm) in the upper elevations (USFS 2007).

Temperatures decrease with elevation. At sea level, the average monthly day time temperatures range from 79 to 82 °F (26-28 °C) and the night time temperatures range from 62 to 70 °F (17-21 °C). At highest elevations, the temperature could be more than 20 °F (13 °C) colder than in the lowlands.

There is a climate station (maintained by the USFS) at Laupāhoehoe Forest within the FR recording a variety of information including air temperature, relative humidity, solar radiation, soil moisture, and soil temperature.

Laupāhoehoe Forest is located on Mauna Kea, a dormant volcano and the second oldest volcano on the island. Substrate age ranges from 5,000 years before the present to 300,000 years before the present (Sherrod et al. 2007). The terrain and soils vary with the age and type of surface lava flows and the depth of volcanic ash deposited over these flows. The terrain in the highest elevation areas is the youngest and the roughest. Surface flows in this area are grouped with the youngest of Mauna Kea's post-shield formation flow series and are characterized as predominantly 'a'ā or blocky 'a'ā flows which are generally free of the wind-blown volcanic ash deposits that cover the older Mauna Kea flows. These younger 'a'ā flows form a series of pronounced ridges that give the upper areas of Laupāhoehoe Forest a distinct ridge and swale topography. Soils on these flows are described as very stony loam (DLNR and USFS 2015).

In the upper mid-elevation of Laupāhoehoe Forest, the surface lava flows are older but are still grouped with those erupted during the younger post-shield phase of Mauna Kea's development. These flows are also predominantly 'a'ā or blocky 'a'ā flows but are partially mantled by volcanic ash deposits. Soils on these flows are described as silt loam formed from volcanic ash. These ash-derived soils are more weathered in the lower elevations where rainfall is slightly greater. Some areas can also be rocky where volcanic ash deposits are discontinuous (DLNR and USFS 2015).

## **Determination of Effects**

### No-Action Alternative

Implementation of the no-action alternative would keep existing soil conditions static. There would be extremely limited disturbance to soils attributable to invasive species removal, outplanting of rare plants, and ongoing research (e.g., installation of monitoring equipment such as stakes to mark out a grid, trampling of soils by researchers). Soil disturbance associated with ungulate (specifically feral pig) activity would be anticipated to continue throughout the Laupāhoehoe Forest (except within the existing 35 fenced acres), potentially contributing to increased soil erosion over time. A long slow decline of ecosystem function would be likely to continue. Some areas may remain pristine and unaffected for several decades, but the effects of feral ungulates, weeds, and predators would be expected to eventually severely compromise forest function.

### Preferred Alternative

The impacts to soil resources associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. Construction of conservation fencing involves hand clearing a corridor of vegetation along the alignment, minor ground disturbance within the alignment associated with fence post installation, and attaching high tensile woven wire mesh to the posts. Maintenance and development of new (primitive) trails involves removal of vegetation along the trail

alignment as needed for single-file passage, estimated as approximately four to six feet horizontal clearance and seven to eight feet vertical clearance.

Development of primitive camping in the area of Shack Camp would likely involve the installation of a small open-sided shelter with roof catchment and fireplace/firepit, three to four self-contained composting toilets, delineation of up to ten sites for tent camping, installation of a management shelter that could also be utilized by the public by reservation, and identification of a helicopter landing zone to support maintenance of Shack Camp.

Maintenance and development of management shelters and helicopter landing zones would be sited in existing natural clearings within Laupāhoehoe Forest where possible, but may involve limited removal of shrubs and trees.

Soil disturbance would be limited in duration. No soils would be moved off-site, and no grading or grubbing would be involved. Best management practices would be incorporated to minimize impacts to soils and potential for erosion, including restricting vegetation clearing to the width necessary for fence construction or trail improvement, selecting fence and trail alignment to minimize the length of steep sections or the removal of trees, incorporating culverts and break-away fences where necessary (over streams or intermittent drainages) to allow water to pass through easily during heavy rain events, and siting Shack Camp facilities, management shelters and landing zones in open areas to minimize vegetation removal (DLNR 1996; Hawai'i Office of Planning 2010). A small section of ground (no greater than 400 square feet) at Shack Camp may be covered with concrete or gravel, for the open-sided shelter with fireplace/firepit, to reduce fire hazard.

After fence construction and associated ungulate removal, soil disturbance associated with ungulate activity within the fenced area would be anticipated to cease.

## **Conclusion**

The effects of the additional actions proposed under the preferred alternative would be anticipated to have a minor, short-term negative effect on soils within Laupāhoehoe Forest and a minor, long-term positive effect by reducing soil disturbance associated with ungulate activity within 22% of the Forest.

## **Air Quality**

### **Existing Conditions**

Air pollution on the Big Island is mainly impacted from volcanic emissions of sulfur dioxide, which convert into particulate sulfate and produce a volcanic haze (vog) that persistently blankets the north and south Kona areas. Depending on wind directions, the Hilo area can also experience some vog

conditions. The existing tradewinds in and near the Laupāhoehoe area provide excellent air movement. This, coupled with low density of population in the area, results in very good air quality.

## **Determination of Effects and Conclusion**

### No-Action Alternative

Implementation of the no-action alternative would keep existing air quality conditions static.

### Preferred Alternative

There would be negligible air quality impacts associated with the additional actions proposed under full implementation of the Draft Management Plan. Limited emissions associated with use of equipment such as chain saws to clear vegetation during fence construction, trail improvement, or invasive species control would not be expected to have any measurable direct or indirect effects on air quality and would not be expected to exceed State ambient air quality standards.

## **Noise**

### **Existing Conditions**

Noise levels within the Laupāhoehoe Forest are minimal. The only unnatural sounds discernible are caused by vehicles. All gates are locked and vehicular access is limited to State and Federal employees and individuals holding permits to conduct research or other activities in the HETF and landowners with right of entry agreements to access their privately owned parcels adjacent to the HETF.

## **Determination of Effects and Conclusion**

### No-Action Alternative

Implementation of the no-action alternative would keep existing noise conditions static.

### Preferred Alternative

There would be negligible noise impacts associated with the additional actions proposed under full implementation of the Draft Management Plan. Noise generated during fence construction, trail improvement, or some research or management activities that involve using equipment such as chain saws to clear vegetation may reach noise levels of 120 decibels, but would occur only during the day and be intermittent and localized. This noise would not impact private landowners nearby as proposed fences are not located adjacent to existing residential properties.

## Water Resources

### Existing Conditions

The Hilo FR (Laupāhoehoe section) was originally established in 1905 to protect the water supply of the district, and Laupāhoehoe Forest continues to provide important watershed services for the community. Native Hawaiians recognized the importance of forests in water production and water quality, as reflected in the Hawaiian proverb: “Haihai ka ua i ka ulu la au” (The rain follows after the forests). Early foresters also recognized the importance of Hawaiian forests as watersheds. Ralph Hosmer, the first Territorial Forester, stated “In Hawai‘i, the most valuable product of the forest is water, rather than wood” (DLNR and USFS 2015).

Laupāhoehoe Forest is an important source of fresh surface and ground water that supports downstream populations of humans and wildlife as well as supports healthy nearshore resources. Other watershed services provided by Laupāhoehoe Forest include: stream habitat for native waterbirds, fish and invertebrates; provision forest habitat for native plants, birds, and bats; flood control; mitigation of climate change impact; and economic, social, recreational and educational opportunities for the human communities in the area.

Numerous streams are found in the Laupāhoehoe forest, including Ka‘awali‘i Stream, Laupāhoehoe Stream, Kīlau Stream, Kaiwilahilahi Stream, Ha‘akoa Stream, and Pāhale Stream. The Atlas of Hawaiian Watersheds and Aquatic Resources (Parham et al. 2008) notes all these streams as perennial. However, the upper portions of these streams within Laupāhoehoe Forest are often intermittent. While the lack of surface water in these upper reaches makes it appear some of these streams within the forest may not necessarily be flowing year-round, subsurface groundwater flows from the forest maintain freshwater inputs to streams below Laupāhoehoe Forest. Stream gauges, used to measure natural stream flows, water quality and sediment in a non-destructive manner, are located in Manowai‘ōpai, Kaiwilahilahi, and Ka‘awali‘i streams below Laupāhoehoe Forest and are maintained by the USFS.

The 2014 State of Hawai‘i Water Quality Monitoring and Assessment Report (DOH 2014) was consulted to see if any of the project area streams are impaired based on the State of Hawai‘i water quality criteria. None of the streams within Laupāhoehoe Forest are identified within the report.

### Determination of Effects

#### No-Action Alternative

Implementation of the no-action alternative would keep existing water resource conditions static. There would be no management related disturbance to streams or floodplains. Invasive species control involves vegetation clearing and the use of herbicides and pesticides (toxicants). Temporary

disturbance of the soil can occur when plants are removed or planted, providing the opportunity for changes to water runoff patterns; inappropriate use of herbicides and pesticides can impact water quality. All herbicides and pesticides are used in compliance with State and Federal law in conformance with all label requirements. Negative impacts to water resources associated with ungulate activity (rooting and wallowing behavior of pigs contributing to stream water turbidity due to soil erosion and inputs of pollutants to streams (i.e., animal waste)) would be anticipated to continue throughout the Laupāhoehoe Forest (except within the existing 35 fenced acres). A long slow decline of watershed function would be likely to continue. Some areas may remain pristine and unaffected for several decades, but the effects of feral ungulates, weeds, and predators would be expected to eventually severely compromise the ability of the forest to capture and effectively store water.

### Preferred Alternative

The impacts to water resources associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. Proposed conservation fencing would be anticipated to cross 3 existing streams (Kaiwilahilahi, Ha‘akoa, and Pahale). Best management practices would be incorporated during design and construction to minimize the potential for erosion and to ensure that stream flow is not obstructed or compromised during heavy rain events. For example, fence alignments would be selected to avoid steep inclines where possible, and to cross streams at strategic natural barriers, such as waterfalls or steep slips, so that the waterway remains clear but animals cannot pass into the fenced unit. For areas with low flow or intermittent flow, fencing may cross the streamway, but incorporate features such as a rubber mat that hangs down to prevent animal access during periods of low or no flow, but raises up to allow free flow of water during periods of higher flow. Fence construction would not be anticipated to have a long-term negative impact on water quality or quantity or make changes to stream hydrology. While minimal short-term soil disturbance would be unavoidable during fence construction, no lasting changes to existing patterns of runoff or percolation would be expected.

Trail improvement, development of the Shack Camp camping area, installation of management shelters, and development of landing zones would involve minor vegetation clearing using hand tools. The development of Shack Camp camping area would involve the installation of self-contained composting toilets to address the human waste associated with public recreational use of the area. The Shack Camp camping area, management shelters and landing zones would be sited away from existing streams. No impacts to existing streams are anticipated, and no lasting changes to existing patterns of runoff or percolation would be expected from these activities.

Due to the distance from the ocean, the limited footprint used by fencing and primitive trails, the underlying soil characteristics, the existing patterns of runoff, and the incorporation of best management practices, impacts to marine water quality related to implementation of the Draft

Management Plan is anticipated to be negligible.

## Conclusion

Both alternatives are in compliance with all laws, regulations, and policies associated with water resources, and implementation of any action alternative will follow applicable Federal, State and County regulations and policies. The effects of the additional actions proposed under the preferred alternative would be anticipated to have a minor, short-term negative effect on water resources within Laupāhoehoe Forest and a moderate, long-term positive effect by reducing soil disturbance associated with ungulate activity in forest around the upper reaches of three streams. No significant changes to the quality or quantity of existing discharges would be anticipated, and existing uses (aquatic habitat for native species) and the level of water quality necessary to protect those existing uses would be maintained or improved under both alternatives. No impact to marine water quality is anticipated under either alternative.

## Fauna

### Existing Conditions

#### Birds

Laupāhoehoe Forest was surveyed for forest birds as part of the Hāmākua Study area during the Hawai‘i Forest Bird Survey (1976-1983). This survey and several subsequent surveys of the area have provided information on the bird species present and their distribution.

The forest provides habitat for six honeycreepers (Subfamily Drepanidinae) endemic to the Hawaiian Islands. These include three endangered species: Hawai‘i ‘ākepa (*Loxops coccineus*), Hawai‘i creeper (*Oreomystis mana*), and ‘akiapōlā‘au (*Hemignathus munroi*). The non-endangered honeycreepers found in the project area include: ‘apapane (*Himatione sanguinea*), Hawai‘i ‘amakihi (*Hemignathus virens*), and ‘i‘iwi (*Vestiaria coccinea*). The USFWS is currently reviewing the status of ‘i‘iwi to determine whether it should be listed as endangered or threatened. Other native forest birds reported from the project area include ‘elepaio (*Chasiempis sandwichensis*), ‘ōma‘o or Hawaiian thrush (*Myadestes obscurus*), and pueo (*Asio flammeus sanwichensis*). Native forest birds are primarily found in the upper elevations (above 4,000 ft (1,219 m)) where lower numbers of mosquitoes and the effects of cooler temperatures on plasmodium parasite reduce the incidence of diseases such as avian malaria and pox. Hakalau Forest National Wildlife Refuge (NWR), where these species are seen regularly along with many other native species, is adjacent to Laupāhoehoe Forest.

Other native bird species listed as endangered by the USFWS have been reported from the Laupāhoehoe Forest area including the koloa maoli or Hawaiian duck (*Anas wyvilliana*) and the ‘io or

Hawaiian hawk (*Buteo solitarius*). Koloa maoli are generally found in a wide variety of natural and artificial wetland habitats including freshwater marshes, flooded grasslands, streams, montane pools, irrigation ditches, reservoirs, etc. 'Io are found only on Hawai'i Island, from sea level to about 5,600 ft (1,707 m) elevation; these birds of prey feed on rodents, insects, and small birds and typically nest in 'ōhi'a trees (Gorreson et al. 2008). The USFWS is currently reviewing the status of 'io to determine whether to delist it as endangered.

A variety of non-native birds are also found within Laupāhoehoe Forest; the most widespread include hwamei (*Garrulax canorus*), Japanese white-eye (*Zosterops japonicus*), red-billed leiothrix (*Leiothrix lutea*), northern cardinal (*Cardinalis cardinalis*) and kalij pheasant (*Lophura leucomelana*). A list of the birds known from Laupāhoehoe Forest is provided in Table 4 of the Draft Management Plan.

### Mammals

Laupāhoehoe Forest is considered important habitat for Hawai'i's only native land mammal, the 'ōpe'ape'a – the endemic and endangered Hawaiian hoary bat, which uses the area for roosting, reproduction, and foraging. U.S. Geological Survey (USGS) Biological Resources Division Hawaiian Hoary Bat Project has monitored bats for five years and has found high levels of bat activity and occupancy within Laupāhoehoe Forest.

The 'ōpe'ape'a is a medium-sized, nocturnal, insectivorous bat with short, thick, rounded ears and a furry tail. "Hoary" refers to the white-tinged, frosty appearance of the bat's grayish brown or reddish brown fur. The 'ōpe'ape'a is a major predator of night-flying insects such as moths, beetles, and termites. Bats forage in open and wooded landscapes and linear habitats such windbreaks and riparian zones, and roost in trees with dense foliage and with open access for launching into flight. Females are believed to give birth to twins May – August and rear pups May – September (Menard 2001, Bonaccorso et al. 2008).

A variety of non-native mammals such as feral pigs, rats (*Rattus* spp.), mice (*Mus musculus*), cats (*Felis catus*), wild dogs (*Canis lupus familiaris*), and mongoose (*Herpestes auropunctatus*) have also been observed within Laupāhoehoe Forest.

### Invertebrates

A wide range of endemic, native, and non-native invertebrate species are likely to be found within Laupāhoehoe Forest. Detailed invertebrate survey information for the entire Laupāhoehoe Forest is not available, but native invertebrate composition is presumed to be higher in native-dominated areas and lower in areas previously disturbed by grazing or the prevalence of non-native plant species. Challenges to better information regarding invertebrate distribution and abundance include the cryptic nature of invertebrates, limited research interest or funding, and the fact that many species' life cycles



are influenced by rainfall and other environmental variables, making invertebrate survey results difficult to compare over time and across sites.

Native invertebrates known from Laupāhoehoe Forest include numerous species of *Drosophila*. *Drosophila* are true flies (Order: Diptera); numerous adaptive shifts and unusual evolutionary developments characterize the species found in Hawai‘i. *Drosophila* are specialized microbivores that rely on over 40 families of native plants, and recent declines in the genus are associated with the loss of these native plants. *Drosophila* species including *D. sproati*, *D. murphyi*, *D. tanythrix*, and *D. yooni* are relatively common within Laupāhoehoe Forest. One notable finding was of a female specimen believed to be *D. papala*, collected at 4,800 ft (1,463 m) elevation (DLNR and USFS 2015). In 2012, a researcher cataloging *Drosophila* species noted a small patch of pāpala kēpau (*Pisonia brunoniana*) at about 4,000 ft (1,219 m) elevation within the FR as the most diverse site sampled. Although too small to support any picture-wing species, this disjunct grove of mesic trees has a community of smaller *Drosophila* species not found elsewhere in Laupāhoehoe Forest (DLNR and USFS 2015). Some of these are associated with *Pisonia* in particular (*D. kambysellisi*, *D. nr. dissita*), while others are associated with other plants but seem to be attracted to the site. Several picture-wing species that breed in *Charpentiera*, *Pisonia*, and *Urera* were formerly known from lower elevations (~ 2,500 ft (762 m)), but this area within Laupāhoehoe Forest now appears to be composed largely of non-native plants, and no flies were found there on later surveys.

Laupāhoehoe Forest also contains habitat for four endemic species of pinao or Hawaiian damselfly. *Megalagrion calliphya* and *Megalagrion hawaiiense* breed in small pools or seeps in the forest, whereas *Megalagrion blackburni* breeds in streams. *Megalagrion xanthomelas* is a candidate for listing as an endangered species and is known from Kaiwilahilahi Stream below the lower boundary of Laupāhoehoe Forest (Parham et al. 2008).

### Aquatic Species

The streams within Laupāhoehoe Forest provide habitat for endemic waterbirds, four gobies, two crustaceans, one snail, and several aquatic insects (e.g., damselflies, chironomids) that are noted in the Atlas of Hawaiian Watersheds and their Aquatic Resources (Parham et al. 2008). There are also two species of invasive amphibians that have been observed in or near streams in Laupāhoehoe, American bullfrog (*Rana catesbeiana*) and cane toad (*Rhinella marina*). Both of these species lay eggs in water and have a tadpole stage to their lifecycle.

Surface and groundwater that originate from the Laupāhoehoe Forest also support healthy populations of native nearshore fish assemblages. Many of these fish are an important component of the subsistence based economy in the region.

## Determination of Effects

### No-Action Alternative

Implementation of the no-action alternative would keep existing wildlife resource conditions static. There would be minimal short-term management related disturbance to wildlife habitat, associated with invasive species control and outplanting. Temporary disturbance can occur when plants are removed or planted. Negative impacts to wildlife resources associated with ungulate activity (e.g., rooting and wallowing resulting in breeding areas for disease carrying mosquitoes, uprooting native vegetation that acts as host plants for native invertebrates) would be anticipated to continue throughout the Laupāhoehoe Forest (except within the existing 35 fenced acres). Native animal species would be likely to continue their slow decline in the Forest. Some areas may remain pristine and unaffected for several decades, but the effects of ungulates, weeds, and predators would be expected to eventually severely degrade habitat.

### Preferred Alternative

The impacts to wildlife resources associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. Noise and activities associated with the construction of fencing, reforestation and outplanting, small mammal predator control, research, or trail improvement activities may affect, but are not likely to adversely affect, listed species (‘ōpe‘ape‘a, endangered honeycreepers, koloa maoli, or ‘io), native birds, native invertebrates, or native aquatic species, based on observations during conservation management in other areas statewide, including Hakalau NWR. Fencing design specifically does not incorporate barbwire, which has been shown to hook bats, to eliminate the possibility of harm after fence construction. Existing native species could be disturbed by fence construction and trail improvement activities, but because the total acreage to be disturbed by these activities is low and the habitat in the surrounding area (e.g., adjacent to the fence or trail corridor) is similar and could host any displaced populations, the short-term negative impacts would be expected to be minor. Additional planned mitigation measures include field surveys before finalizing fence or trail alignments or construction to prevent disturbance to native species (e.g., roosting bats or nesting birds), avoiding where possible the removal of native plants known to serve as habitat for native invertebrates or birds, and minimizing the removal of native vegetation. Reforestation of upper elevation portions of Laupāhoehoe Forest previously impacted by grazing and feral cattle would be anticipated to provide a long-term benefit to native wildlife, including ‘ōpe‘ape‘a, forest birds, ‘io, and native invertebrates; information from the adjacent Hakalau NWR indicates that in areas that were pasture in 1987 but were the focus of ongoing reforestation, ‘amakihi, ‘apapane and ‘i‘iwi show strong evidence of increasing densities (USFWS 2012). Implementing small mammal predator control in forest bird habitat would be anticipated to benefit endangered birds by reducing predation rates. Over the long-term, moderate positive impacts would be anticipated due to forest restoration and

the increased acreage of forested habitat protected from ungulate disturbance.

## Conclusion

Both alternatives comply with all Federal and State laws, regulations and policies associated with wildlife, and a section 7 consultation with the USFWS will occur as necessary. Implementation of the Draft Management Plan is anticipated to result in little to no impacts to wildlife and no adverse effects to listed species. The effects of the additional actions proposed under the preferred alternative would be anticipated to have a minor, short-term negative effect on wildlife within Laupāhoehoe Forest and a moderate, long-term positive effect by protecting important forested habitat from ungulate disturbance.

## Flora

### Existing Conditions

Laupāhoehoe Forest contains native-dominated forested landscapes from lowland forest at 2,300 ft (701 m) above sea level extending to almost 6,500 ft (1,981 m) in elevation. It is part of the largest remaining native dominated forest in Hawai‘i and largely dominated by ‘ōhi‘a and koa, the two most widespread tree species in native forest remaining in Hawai‘i. Laupāhoehoe Forest contains five primary native communities, as well as significant areas between 1,700 ft (518 m) elevation and ~ 3,000 ft (914 m) of highly altered, non-native dominated vegetation cover. Forestry plantings along the lower boundary and in the lower east corner include non-native trees such as toon (*Toona ciliata*) and *Ficus rubiginosa*, and in the upper north corner, tropical ash. The tropical ash has invaded significant portions of higher elevation areas of the Laupāhoehoe Forest. Other non-native species occupy large areas. Banana poka, an introduced vine, occurs throughout the mid to high elevation areas and forms thickets in the swales. At the lower edge of this community type, below 3,000 ft (914 m) elevation, the understory is heavily invaded by several non-native plants including strawberry guava, thimbleberry (*Rubus rosifolius*), clidemia or Koster's curse, Himalayan ginger, various grasses, and three species of parasitic strangler fig. A number of these species occur into mid or even high elevation areas of the Laupāhoehoe Forest. Non-native grasses and herbs are primarily pasture species (e.g., kikuyu grass (*Pennisetum clandestinum*), *Holchus lanatus*, and *Ehrharta stipoides*) and the vine German ivy.

Native plant communities include the Koa/‘Ōhi‘a Lowland Wet Forest, the Koa/‘Ōhi‘a Montane Wet Forest, the ‘Ōhi‘a/Hāpu‘u/Uluhe Montane Wet Forest, the *Carex alligata* Montane Wet Grassland, and the Koa/‘Ōhi‘a Montane Forest. The Koa/‘Ōhi‘a Lowland Wet Forest dominates in the lowest elevation area up to about 3,000 ft (914 m) elevation, with portions badly invaded by invasive non-native species. Under the 80 ft (24 m) tall closed to open canopy of koa and ‘ōhi‘a is a secondary tree layer in which olomea (*Perrottetia sandwicensis*), mehame (*Antidesma platyphyllum*), ālani (*Melicope*

*clusiifolia*), and kōpiko (*Psychotria hawaiiensis*) are common. Other trees, such as ‘ōlapa (*Cheirodendron trigynum*) and kāwa‘u (*Ilex anomala*) are present, but not as common. Hāpu‘u (*Cibotium glaucum*) is present, but of lower stature than in the Koa/‘Ōhi‘a Montane Wet Forest and forms a discontinuous layer. Common shrubs include manono (*Hedyotis terminalis*), kanawao (*Broussaisia arguta*), ‘ōhelo (*Vaccinium calycinum*), and saplings of kāwa‘u and ‘ōlapa. The vines ‘ie‘ie (*Freycinetia arborea*) and maile (*Alyxia stellata*) are present, and ‘ie‘ie is sometimes abundant. Native ferns include wahine noho mauna (*Adenophorus* spp.), *Lycopodium cernuum*, *Athyrium* spp., *Elaphoglossum* spp., *Sphenomeris chinensis*, and others. Rare plants observed in this forest type during surveys in the 1980s include *Cyrtandra giffardii*, *Cyanea tritomantha*, *Gardenia remyi*, and *Platydesma remyi*.

The Koa/‘Ōhi‘a Montane Wet forest distributes in areas from about 3,000 ft (914 m) elevation up to 4,500 ft (1372 m) elevation. It differs from the Koa/‘Ōhi‘a Lowland Wet Forest in its subcanopy species composition. Koa and ‘ōhi‘a form an open to closed canopy (about 100 ft (30 m) in height) with a very well-developed subcanopy of tree ferns (*Cibotium glaucum*, *C. chamissoi*, and *C. hawaiiense*). Trees in the secondary tree layer include ‘ōlapa, kāwa‘u, kōlea (*Myrsine lessertiana*), and pilo (*Coprosma rhynchocarpa* and *C. pubens*). In the understory, native shrubs include ‘ōhelo, ‘ākala (*Rubus hawaiiensis*), *Cyrtandra* spp., *Clermontia parviflora*, māmaki (*Pipturus albidus*), manono, and saplings of ‘ōlapa, ‘ōhi‘a, pilo and kāwa‘u. Ferns are often the prevalent ground cover, including *Asplenium* spp., *Dryopteris wallichiana*, ‘ākōlea (*Athyrium microphyllum*), *Ophioglossum pendulum* subsp. *falcatum*, and *Lepisorus thunbergianus*. The rare mint, *Stenogyne macrantha*, is known from the area between Kaiwilahilahi Stream and the NAR's western boundary.

The ‘Ōhi‘a/Hāpu‘u/Uluhe Montane Wet Forest occurs on the east side between 3,500 and 4,500 ft (1067 – 1372 m) elevation, almost bisecting the upper area of Koa/‘Ōhi‘a Montane Wet Forest. A tall (approximately 80 ft (24 m)) open to scattered canopy of ‘ōhi‘a with a secondary layer or native trees such as olomea, mehame, ‘ōlapa, and pilo and hāpu‘u grow over a layer composed largely of uluhe fern (*Dicranopteris linearis*). Under the hāpu‘u, there is a mix of native shrubs, such as manono, young ‘ōlapa, pilo, *Cyrtandra* spp., and *Clermontia parviflora*. Hō‘i‘o (*Athyrium sandwichianum*) is the most abundant native fern, although *Asplenium* spp., *Vandenboschia davallioides*, wahine noho mauna, *Elaphoglossum* spp., and *Lepisorus thunbergianus* are also present.

Much of the mid elevation area in Laupāhoehoe Forest, between about 4,000 and 4,500 ft (1220 – 1370 m) elevation is poorly drained and several low-lying, very wet sections are dominated by *Carex alligata*. Species from the surrounding natural communities, such as scattered ‘ōhi‘a, ‘ōlapa, and ‘ōhelo are also found in this community type.

The Koa/‘Ōhi‘a Montane Forest has been significantly altered by past land uses, including ranching and logging, and has also been heavily impacted by feral cattle. Compared to the Montane Wet Forest,

the Montane Forest receives less rainfall; the annual rainfall is about 39.3 – 74.7 in (100-190 cm). The forest consists of scattered to open uneven canopy of 115 ft (35 m) tall koa emergent above 82 ft (25 m) tall ‘ōhi‘a. The tall stature trees tend to grow along the ridge formations. Swales between the ridges and open areas are dominated primarily by thick patches of ‘ākala. The understory has many species in common with the Koa/‘Ōhi‘a Montane Wet Forest, but the distinct hāpu‘u tree fern layer of the latter is absent. Species more characteristic of drier areas may also be components here. Ground cover is often dominated by native ferns, especially laukahi (*Dryopteris wallichiana*). Species found in this forest type include ‘ōlapa, pilo, manono, kāwa‘u, *Myoporum sandwicense*, kōlea, alani, *Ranunculus hawaiiensis*, *Sophora chrysophylla*, pūkiawe (*Styphelia tameiameiae*), and ‘ōhelo.

A diversity of native plants, including rare species, are found within Laupāhoehoe Forest. At least 30 different rare plant taxa, including 16 listed as endangered (6 of these with designated critical habitat: *Clermontia peleana*, *Clermontia pyrularia*, *Cyanea platyphylla*, *Cyrtandra giffardii*, *Cyrtandra tintinnabula*, and *Phyllostegia warshaueri*), are known from Laupāhoehoe Forest or the adjacent areas, including one newly described or resurrected species (*Cyanea fernaldi*). A list of the rare plants with habitat in or near Laupāhoehoe Forest is provided in Table 3 of the Draft Management Plan.

Human activity associated with management action, research, outreach and education, hunting, or recreational use could potentially spread invasive species into or across Laupāhoehoe on vehicles, gear, and equipment. Existing biosecurity measures are in place for all HETF associated activities (research, outreach) and for natural resource management actions by DOFAW to minimize the potential for introduction of new species and prevent the movement of established and incipient species, including plants, invertebrates, and soil-borne organisms, etc. These biosecurity measures include: 1) inspect and clean field gear and equipment before going into the field; 2) prepare a checklist of items to be inspected before any extended field operations or camping trip; 3) avoid carrying weed seeds from an infested part of the forest to the pristine areas; 4) keep vehicles clean; 5) pack out trash and unused food; 6) become acquainted with invasive species and their status in the area; 7) educate visitors to these protocols; and 8) report sightings of new invasive species or of existing high risk species in previously un-infested areas (DLNR and USFS 2015, Appendix B).

Fire is a threat to the drier upper elevation portions of the Laupāhoehoe Forest. Many fires are caused by humans, so increased human activity associated with management action, research, hunting, improved public access and the development of additional recreational amenities (new trails, Shack Camp) could increase the potential for fire in Laupāhoehoe Forest. Existing fire prevention measures will remain in place for all HETF associated activities (e.g., all permitted researchers shall possess a fire extinguisher at all times), and additional measures such as signage and the incorporation of fuel breaks around Shack Camp, would be integrated as additional recreational amenities are developed.

## Determination of Effects

### No-Action Alternative

Implementation of the no-action alternative would keep existing botanical resource conditions static. There would be minimal short-term management related disturbance to native habitat, associated with invasive species control and outplanting. Temporary disturbance can occur when plants are removed or planted. Negative impacts to botanical resources associated with ungulate activity (e.g., uprooting vegetation, eating and transporting invasive plants through defecation, and spread of root-rot fungi) would be anticipated to continue throughout the Laupāhoehoe Forest (except within the existing 35 fenced acres). The trend towards continued spread of invasive species, degrading native vegetation, and declining numbers of rare plants throughout the Forest would be anticipated to continue. Although DOFAW would continue to undertake efforts to protect and promote populations of rare plant species on a piecemeal basis, and some areas may remain unaffected for several decades, the effects of ungulates, weeds, and predators would be expected to eventually severely degrade habitat and contribute to a severe net loss of these species over the long-term.

### Preferred Alternative

The impacts to botanical resources associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. Construction of fencing, improvement of trails to primitive condition, and installation of camping sites at Shack Camp, management shelters and helicopter landing zones necessarily involves the removal of vegetation. Planned mitigation measures include field surveys before finalizing fence or trail alignments or locations for campsites, management shelters and landing zones and before construction to prevent damage or harm to rare plants, the incorporation of rare species protocols (e.g., flagging plants, identifying buffer zones), the avoidance where possible of the removal of large native plants and shrubs, and the minimization of the overall removal of native vegetation. Tent camping, management shelters, and landing zones would be sited, to the extent possible, in existing natural clearings or openings in the forest, to minimize the need for vegetation removal. Because of these mitigation measures, the short-term impact of fencing, trail improvement, and installation of camping sites, management shelters and landing zones on rare plants is expected to be negligible and the short-term impact on native vegetation is anticipated to be minor because the total acreage to be disturbed by these activities is low. Over the long-term, moderate positive impacts would be anticipated to rare plants and native vegetation in general because of the acreage of existing habitat protected from ungulate disturbance and the availability of these units as reintroduction sites to support new populations of rare plants.

While the proposed fenced conservation units do not enclose large percentages of designated critical habitat, much of the existing critical habitat overlaps with low-elevation areas with significant invasion

by non-native plants. Known populations of existing rare plants in these areas have already been protected with small fences (to protect the plant and allow for seed collection). To maximize the benefit of large-scale fencing to rare plant populations (and avoid the expensive and potentially unfeasible weed control that would be required with large-scale level fencing in the lower elevation), proposed fence alignments were largely selected to overlap with intact native forest that may serve as better quality reintroduction sites for the rare plants of Laupāhoehoe Forest than the degraded lower-elevation forested area currently designated as critical habitat.

Increased human activity associated with management action, research, outreach and education, hunting, or recreational use could result in further spread of existing or introduction of new invasive species into or across Laupāhoehoe. Existing biosecurity measures will remain in place for all HETF associated activities (research, outreach) and for natural resource management actions by DOFAW, and monitoring of invasive species presence and distribution will continue. Additional sanitation protocols, species-specific protocol, and protocols for other user groups (e.g., hunters, hikers) may be developed and adopted in the future as necessary to contain problem species or prevent their introduction or spread in Laupāhoehoe Forest.

Increased human activity associated with management action, research, hunting, improved public access and the development of additional recreational amenities (new trails, Shack Camp) could increase the potential for fire in Laupāhoehoe Forest. Existing fire prevention measures will remain in place for all HETF associated activities (e.g., all permitted researchers shall possess a fire extinguisher at all times), and planned measures such as signage and the incorporation of fuel breaks around Shack Camp, would be anticipated to prevent or minimize the impact of human-caused fire on botanical resources.

## Conclusion

Both alternatives comply with all Federal and State laws, regulations and policies associated with botanical resources. Implementation of the Draft Management Plan is not anticipated to result in a short-term adverse impact to listed plants. With the incorporation of best management practices, a moderate long-term positive impact on rare plants would be anticipated because of the increased habitat protected from ungulate disturbance and available as protected reintroduction sites. The effects of the additional actions proposed under the preferred alternative would be anticipated to have a minor, short-term negative effect on native vegetation within Laupāhoehoe Forest and a moderate, long-term positive effect by protecting existing native ecosystems.

## Hunting

### Existing Conditions

Laupāhoehoe Forest is open to the public for game mammal and game bird hunting and is included within State Hunting Units B (FR – lower section between NAR and boundary), C (FR – upper section), and K (NAR) (Figure 4).

Table 3.1. Summary of Game Mammal Hunting Opportunities within Laupāhoehoe Forest

Hunting Unit	Method	Game animals	Bag limits	Season	Open Hunting Days
B	Rifle, muzzleloader, shotgun, handgun, archery, spears and knives. Dogs permitted.	Feral pigs, wild sheep, and feral goats	2 pigs, 1 goat, and 1 sheep per day; no season limit.	Year-round	Daily
C	Rifle, muzzleloader, handgun, shotgun, archery. Dogs not permitted.	Feral pigs and wild sheep	2 pigs and 1 sheep per day; no season limit	Year round	Saturday, Sunday, and state holidays
K	Rifle, muzzleloader, handgun, shotgun, spear, knife, or archery. Dogs permitted.	Feral pigs, feral goats, and wild sheep.	No daily or season limit.	Year round	Daily

There are limited legal access points and only a few minimally maintained and marked trails. Mauka and makai public access to Laupāhoehoe is primarily via two main access points off Spencer Road and Mana Road respectively, and there is a hunter check station at the Spencer Road access. These roads provide vehicle access to approximately the forest boundary.

- Spencer Road access – The state has an easement through private pasture lands at the top of Spencer Road to allow for public pedestrian access to the lower boundary of Laupāhoehoe Forest. Spencer Road is a paved county road passable in a two-wheel drive vehicle. There is a small grassy area where vehicles may park mauka of where Spencer Road terminates. A primitive minimally user-maintained trail provides pedestrian access from the parking area to the forest.
- Mana Road access – Mana Road is four-wheel drive county road approximately 40 miles long that roughly traverses a contour along Mauna Kea. Mana Road is accessed via Mauna Kea Access Road (off Saddle Road) on the Hilo side or from the town of Waimea. The road



intersects the top of Laupāhoehoe Forest. A Nā Ala Hele designated trail, Kaluakauka Trail, is accessed via this route.

In addition, the County of Hawaii recently acquired public access to the NAR from Uweki Road (“Maulua Nui/Uweki Road Access”) along the northern property boundary of TMK (3) 3-4-002:004 as a part of a subdivision action. The public access agreement creates a public parking easement to accommodate not less than three vehicles and public pedestrian access to the NAR within a 10-foot wide corridor.

### Laupāhoehoe Forest Public Hunting Areas

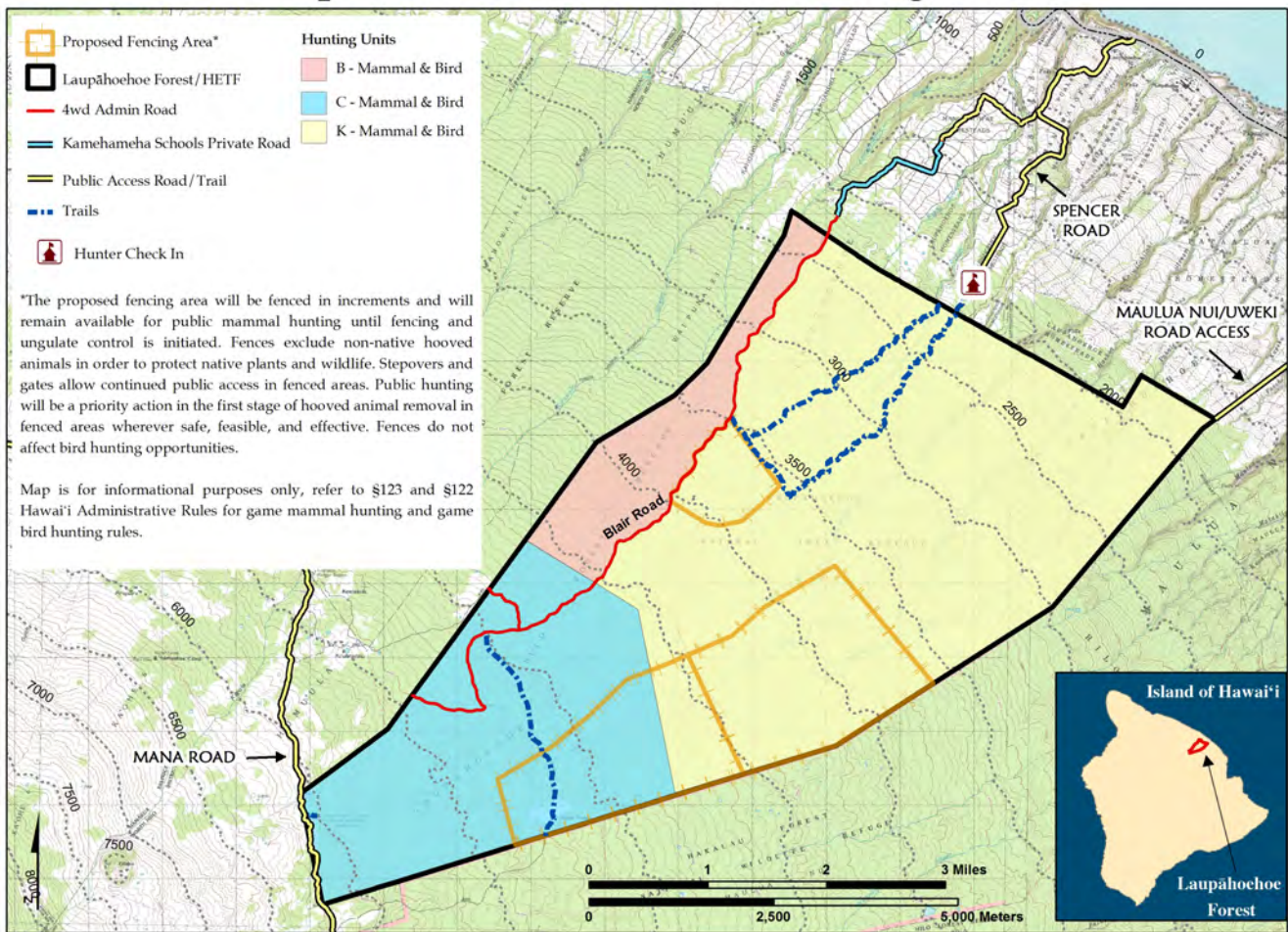


Figure 4. Laupāhoehoe Forest Public Hunting Areas

It is unknown how many people use Laupāhoehoe Forest for hunting. Detailed hunter use data is not available, and information from the Spencer Road check station would provide an incomplete picture of hunter use at best as it is self-reported and would not reflect the usage or success by hunters accessing Laupāhoehoe Forest from Mana Road or Maulua Nui/Uweki Road Access. Discussions with

local residents and land managers indicate that feral pigs are the primary game for hunting in the Forest, although wild sheep and goat may also be present within the Reserve. All hunting in the State requires a hunting license; 10,673 hunting licenses were sold statewide in 2014 (DBEDT 2015); approximately 30% of the statewide total are Hawai'i Island residents. An unknown number of people without hunting licenses hunt illegally within Laupāhoehoe Forest.

## Determination of Effects

### No-Action Alternative

Implementation of the no-action alternative would keep existing hunting conditions within Laupāhoehoe Forest static. DOFAW would likely continue to undertake efforts to increase hunter access on a piecemeal basis, as funding and staffing allowed.

### Preferred Alternative

The impacts to hunting associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. The Draft Management Plan proposes the construction of fencing of conservation units (approximately 2,659 total acres) to protect intact native forest from feral ungulates. Public hunting will be incorporated into the first phase of ungulate removal after fencing is complete, but because the goal is to remove all hooved animals, over the long term, the total acreage available for public hunting of game mammals would be reduced by approximately 2,659 acres (22%). The acreage available for public hunting of game birds under existing regulations would remain constant.

The siting of conservation units reflect an attempt to avoid areas of high hunter activity while concentrating on areas with high-quality intact native forest. Most of the proposed fencing is located at some distance from existing access points into Laupāhoehoe, on the forested area bordering Hakalau NWR. While some public comment on the Draft Management Plan related to impacts on hunting in general (e.g., loss of acreage, objections to fencing in general), there have been no specific objections raised to the location of the proposed conservation units.

The Draft Management Plan also supports improvement of public access and recreational opportunities within Laupāhoehoe Forest that may positively impact hunters. Specifically, the Plan proposes that the State work with adjacent landowners to work on alternative access to the forest, pursue potential land acquisitions through fee simple purchase (which could eliminate private land barriers), and consider acquisition of long-term leases of state or private land adjacent to the forest when current leases expire. In addition, the Draft Management Plan identifies other actions to maintain or improve public hunting opportunities in Laupāhoehoe Forest: facilitate additional hunter education classes in Laupāhoehoe region, consider changes to the permitted hunting method for Unit C if desired by the hunting

community, and work with DOCARE to address hunting community concerns about illegal activities.

The impact on hunting is anticipated to be minor to moderate. While there may be a moderate negative impact on individuals who travel distances within Laupāhoehoe Forest, off-trail and away from established access points, to preferred hunting locations within the proposed conservation units, the surrounding 78% of Laupāhoehoe Forest will remain an accessible alternative to them, as will hunting areas elsewhere on the island of Hawai‘i. To the general hunting community, the negative impact is anticipated to be minor, because the majority of Laupāhoehoe Forest will remain available for hunting (78%), and because game animals will remain able to move freely from mauka to makai portions of Laupāhoehoe Forest.

## Conclusion

Implementation of the no-action alternative would keep existing hunting conditions static; implementation of the Draft Management Plan is anticipated to have a minor to moderate negative impact on hunting.

## Public Use: Recreation, Education, Illegal Use

### Existing Conditions

Laupāhoehoe Forest is open to the public for various recreational and cultural uses. While the public is permitted to access and hike or hunt in any portion of the forest, as noted previously, there are limited legal access points and only a few minimally maintained and marked trails. This area is rough and remote rainforest wilderness and there are currently no amenities for recreational users. There is no data available on individual use (e.g., unguided hiking, wildlife viewing, gathering) within Laupāhoehoe Forest, but the numbers are thought to be extremely low (less than 50 visits a year).

Laupāhoehoe Forest is also accessible through organized education and outreach programs. USFS is a partner with Laupāhoehoe Community Public Charter School to develop ways to integrate curriculum with hands-on experience; other recent outreach programs have involved a service component (e.g., invasive species removal). One hundred and nine participants on nine trips visited Laupāhoehoe Forest in 2014 for education/outreach activities, up from 13 participants on two trips in 2013, and three participants on one trip in 2012. In addition, with the completion of the Laupāhoehoe Science and Education Center, another 133 people visited the Center for service learning, work on the ‘Ōhi‘a Common Garden (restoration of land adjacent to the Center with ‘ōhi‘a seedlings), and a staff/volunteer retreat.

Illegal human activity occurs on a small scale, primarily in the form of poaching, illegal camping, off-road all-terrain vehicle use, dumping, unpermitted harvesting (koa, maile, hāpu‘u, and other native

trees and plants), marijuana cultivation, and vandalizing signs and fences. Due to the remoteness and limited access, however, illegal use (besides poaching) is not currently a major problem.

## **Determination of Effects and Conclusion**

### No-Action Alternative

Implementation of the no-action alternative would keep existing conditions static. Access to the Forest would continue as is but would not be improved for either the general public or residents.

### Preferred Alternative

The impacts to public use associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. The Draft Management Plan proposes improvement of public access and recreational opportunities within Laupāhoehoe Forest that may positively impact recreational users. Specifically, the Draft Management Plan identifies existing trails (Spencer, Maulua and Peneki) for maintenance as primitive trails, and proposes the development of additional primitive trails 1) along the north fence line (upper boundary) from Mana Road to Blair Road, 2) connecting Spencer to Peneki, 3) from Mana Road to the Maulua Road, roughly parallel to the southern forest boundary and running through the proposed camping area at Shack Camp, and 4) from Blair Road to the south boundary, roughly following the FR and NAR boundary (between the 4,500 and 5,000 ft elevation) (Figure 5). The Draft Management Plan also identifies the development of primitive camping in the area of Shack Camp, consisting of up to ten tent sites, a management shelter that would be available for public use by reservation, self-contained composting toilets, and a covered open-sided shelter for cooking. No vehicular access to the Shack Camp area would be provided; users would hike in from Mana Road.

In addition, the Draft Management Plan proposes that the State work with adjacent landowners to work on alternative access to the forest, pursue potential land acquisitions through fee simple purchase (which could eliminate private land barriers), and consider acquisition of long-term leases of state or private land adjacent to the forest when current leases expire. While additional trails, primitive camping, and improved access could lead to increased visitation by individuals, it is uncertain how much of an increase could realistically be expected given that in the context of Hawai'i Island, Laupāhoehoe is relatively remote rainforest wilderness. However, the increased hiking and camping opportunities would be anticipated to provide a minor long-term positive impact on recreational use. A minor long-term positive impact on public use (both recreational and cultural) would be anticipated from increased access to Laupāhoehoe Forest.



## Laupāhoehoe Forest Public Access, Recreation & Infrastructure

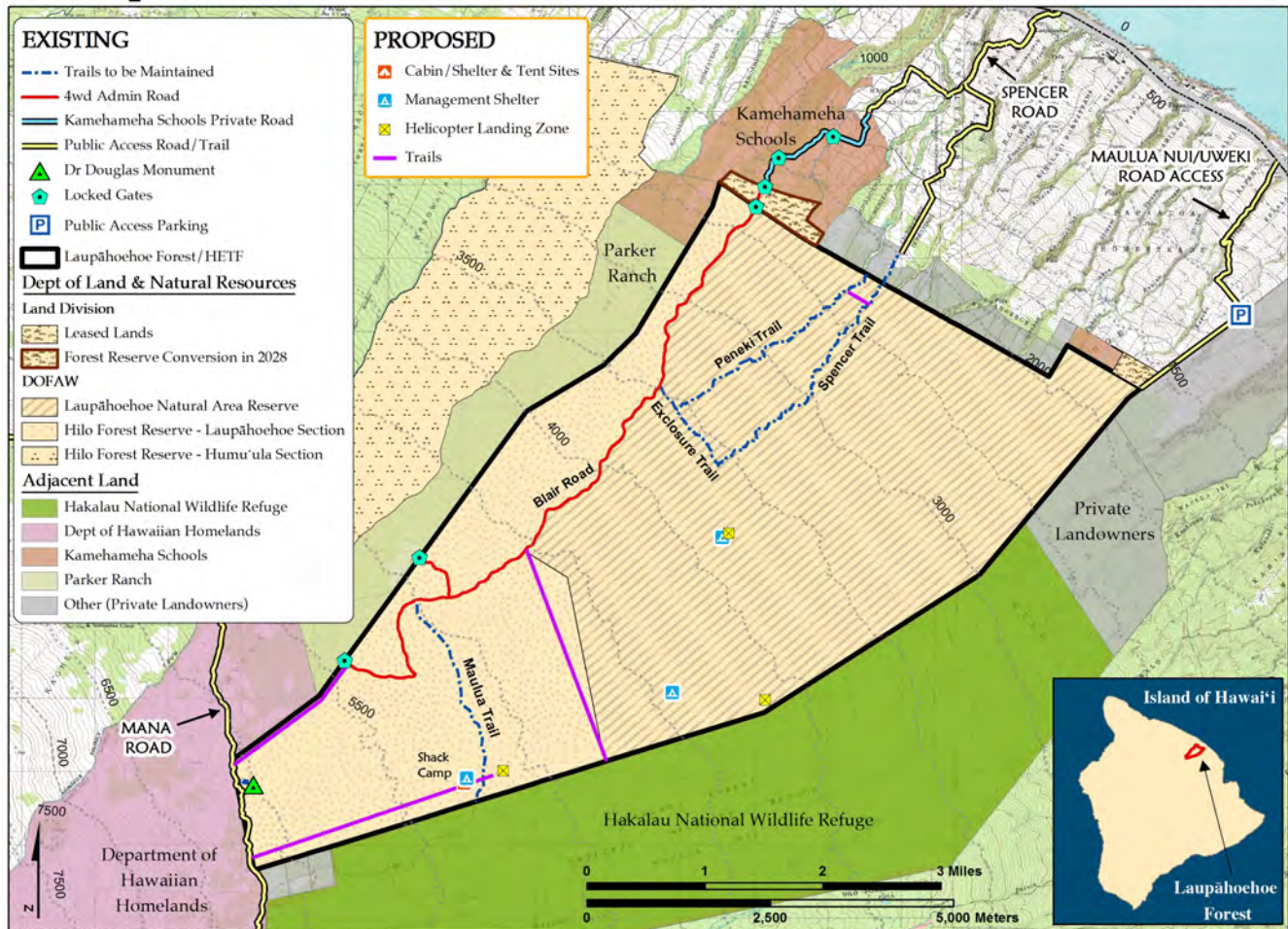


Figure 5. Laupāhoehoe Forest Public Access, Recreation & Infrastructure

Increased human activity associated with improved public access and the development of additional recreational amenities (new trails, Shack Camp) could increase the potential for fire in Laupāhoehoe Forest. Fire prevention measures would include increased educational efforts, including signage, and the incorporation of fuel breaks around Shack Camp and other similar fire pre-suppression actions to reduce fire potential and minimize fire severity as a result of recreational activities.

Increased visitation associated with the maintenance or improvement of trails could increase the potential for trespassing or unauthorized camping on adjacent land. Because Laupāhoehoe is relatively remote rainforest wilderness, trespassing is not anticipated to become a significant problem, and signage would be incorporated along trails as necessary.

The Draft Management Plan proposes several actions to encourage training, demonstration, and outreach within Laupāhoehoe Forest. Increased support (in terms of staff time and funding) could be

expected to increase total participation and more opportunities to visit. Because no changes to the existing review and permitting system are proposed, which includes review of the type of activity and incorporates best management practices to minimize impacts from group use, no measurable impacts to the Forest associated with increased education or outreach efforts would be anticipated.

The Draft Management Plan does not identify any actions that would impact illegal use; thus, no changes from the existing condition are anticipated.

As such, the anticipated impact on public use as a result of implementation of the Draft Management Plan is anticipated to be long-term, minor and positive.

## **Research**

### **Existing Condition**

Research within Laupāhoehoe Forest requires a permit; permit applications are reviewed by a subset of the HETF Planning Group, which includes representatives from both the USFS, DOFAW, and the LAC. All research permits are valid for one year. Visitation related to research varies from year to year, depending on the number of active research projects and the specific needs of the particular research project. There were 14 active research projects in Laupāhoehoe Forest in 2014 (7 renewals and 7 new); 26 active projects in 2013 (13 renewals and 13 new); and 19 active projects in 2012 (12 renewals and 7 new). Approved research must provide GPS coordinates of the study site and include a closeout plan that details how and when infrastructure related to the project (e.g., flagging, markers, etc.) will be removed. Infrastructure related to historic research is considered trash, and when reported and verified as abandoned (as opposed to related to ongoing research with a valid permit), the remaining items are removed.

### **Determination of Effects and Conclusion**

#### No-Action Alternative

Implementation of the no-action alternative would keep existing conditions static.

#### Preferred Alternative

The Draft Management Plan proposes to promote and encourage basic and applied research; however, no substantive changes to the existing review and permitting system are proposed, so no change from the existing condition is anticipated with regard to impacts associated with research.

## Socioeconomic resources

### Existing Condition

The population of Hawai‘i Island has grown from 120,317 persons in 1990, to 185,079 persons in 2010, and to an estimated 194,191 persons in 2014. The Laupāhoehoe Census Designated Place (CDP) encompasses the community makai of Laupāhoehoe Forest; the estimated total population in 2010 was 581 persons residing in 214 housing units. Median household income in 2014 was estimated at \$63,333 (up from \$30,000 in 2000), with an estimated 11.7% of the population below the poverty level (down from 28.4% in 2000). Median age of residents rose from 42.9 to 44.6 years between 2000 and 2010. The 2010 census found that Laupāhoehoe CDP was comprised by three dominant ethnic categories (reported alone or in combination with one or more other races): White, Asian, and Native Hawaiian and other Pacific Islander (US Census Bureau 2015).

The draft Hāmākua Community Development Plan describes the people of the region as follows:

“For some, Hāmākua is a place where their ancestors flourished for centuries and for others, agricultural employment drew their ancestors to emigrate from foreign lands. Here they raised their children and learned to love the land and sea as their own. Still others have come in search of a simpler way of life, drawn by the beauty of the land and a host of personal stories that testify to the magical attraction that draws people to places where they feel at home. Together, these groups form the modern communities of Hāmākua.

Regardless of their background, the people of Hāmākua share a deep appreciation for the historical heritage of their small towns and highly value preserving an ‘ohana-centered community that emphasizes quality of life, neighborhood cooperation, and the aloha spirit. The people of Hāmākua recognize that their future is tied to the preservation of their way of life and the natural and cultural resources that have sustained them for generations” (County of Hawai‘i 2015).

Tourism, agriculture and government services are the main economic drivers on Hawai‘i Island. For a century, the sugar industry dominated the economics of the Hāmākua region, until sugarcane production ended in 1996. Some former sugar lands were converted to lands for forestry products, ranching/grazing, and specialty agricultural crops such as orchid farms, tropical fruit and macadamia nut. Employment by industry in 2000 demonstrated a wide variety of fields; the top four were arts, entertainment, recreation, accommodation, and food services (21%); educational, health, and social services (19%), retail trade (13%) and agriculture, forestry, fishing, and mining (8%).

Employment associated with Laupāhoehoe Forest includes on-site natural resources management by the State DLNR (DOFAW staff), administration of the HETF by USFS (primarily permitting, planning

and coordination, and communication between USFS, DLNR and advisory council), and coordination of education/outreach efforts. NAR staff for the island of Hawai‘i work in all 8 NAR on the island, including Laupāhoehoe and currently consist of 6 State employees, 6 UH contractors, and 2 year-round interns. Forestry staff work in all 19 forest reserves on the island, including Hilo Forest Reserve Laupāhoehoe Section, and currently consist of 8 State employees. USFS staff works across the Hawaiian Islands and the Pacific, and staff dedicated to the HETF currently include two full-time administrative staff and the IPIF Director.

The resident population of Hawai‘i Island is supplemented by an average daily visitor population of about 29,255. Part of the visitor experience includes visits to natural areas or wildlife viewing: over 1,600,000 people visited Hawai‘i Volcanoes National Park and over 220,000 people visited Pana‘ewa Rainforest Zoo and Gardens in 2014 (DBEDT 2015). In 2011, the number of people that reported participated in wildlife viewing as a primary form of recreation totaled 358,000 in Hawai‘i (US Department of Interior et al. 2014). Spending associated with wildlife viewing in Hawai‘i totaled \$669 million, of which 94 percent (\$628 million) was trip-related expenditures and \$41 million was spent on other expenses such as equipment. However, with limited legal access points to Laupāhoehoe Forest and only a few minimally maintained trails and no commonly available visitor information, Laupāhoehoe Forest is not currently an attraction to tourists and spending associated with wildlife viewing in Laupāhoehoe Forest, if any, would likely be quite small.

The economic value of Laupāhoehoe Forest encompasses more than just the impacts on the regional economy. The Forest provides substantial non-market values (values for items not exchanged in established markets) such as maintaining endangered species, preserving wetlands, educating future generations, and adding stability to the ecosystem (Carver and Caudill 2007). One reported study estimated the total value of ecosystem services provided by natural habitats (forests, shrubland, grassland, and wetlands) in the National Wildlife Refuge System in the contiguous states and estimated these services totaled \$32.3 billion/year (Southwick Associates 2011). While wetlands were found to provide the most services, forests were estimated to provide approximately \$1.1 billion/year, or \$1,014/acre/year (Southwick Associates 2011). Using these numbers, the ecosystem services provided by Laupāhoehoe Forest could be estimated at \$12.5 million per year. Similarly, various studies have found that people would pay an average anywhere from \$8 (striped shiner) to \$186 (monk seal) and \$269 (humpback whale) to preserve populations of various rare, endangered or useful species; the amount people were willing to pay varied depending on whether they were residents or visitors to an area where the species exists, the rarity of the species, the charisma of the species, and a variety of other factors (Southwick Associates 2011). While none of the included studies estimated willingness to pay for Hawai‘i's terrestrial species, it gives some idea of the existence value people place on the wildlife around them.



The non-market values of Laupāhoehoe Forest are recognized and valued by the local community, as identified during the outreach phase for the Community Development Plan. Specifically, the Hāmākua community identified the value of the mauka forests, rich in biodiversity and critical habitat, the abundant rainfall, streams, and watershed resources, and the existing protection of these mauka areas as assets for the region.

## Determination of Effects and Conclusion

### No-Action Alternative

Implementation of the no-action alternative would keep existing socioeconomic resource conditions static. Over the long-term, native ecosystems and watershed integrity would be likely to continue their slow decline as a result of continued ungulate activity, weeds, and predators, negatively impacting the community-recognized assets of Laupāhoehoe Forest.

### Preferred Alternative

The impacts to socioeconomic resources associated with the additional actions proposed under full implementation of the Draft Management Plan are as follows. Increasing the acreage of protected ungulate-free native habitat could be expected to encourage related conservation spending associated with rare plant reintroduction, research, or other conservation projects. Full implementation of the Draft Management Plan is estimated to cost \$10,212,500 over 15 years, which could generate secondary benefits by providing jobs in other industries where monies are spent. The preferred alternative is not expected to have any negative economic impacts. Positive economic impacts would result from the release of project funds into the State economy and the encouragement of additional related conservation spending. However, given that funding required for full implementation of the Draft Management Plan has not been secured, and given the size of the proposed actions relative to the overall State budget or to other economic inputs into the local economy, effects on economic resources would be anticipated to be minor.

## Cultural and Archaeological Resources

### Methodology

The following steps were taken to determine the cultural and historical significance of Laupāhoehoe Forest and assess the potential impact on these resources: (1) the development of the Draft Management Plan through a collaborative planning process with the Laupāhoehoe Advisory Council (LAC), including members with cultural resources expertise and involving at least eleven public meetings; (2) general literature review, including review of the cultural impact assessment *Hilo Palikū – Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe*

*Forest Section, Ahupua‘a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai‘i* (Maly and Maly 2006); (3) field inspections of known or suspected historic features within Laupāhoehoe Forest by State Parks archaeologists; and (4) the sending of pre-consultation letters to a variety of agencies, organizations, and individuals that might be interested or have relevant information, including the County of Hawai‘i Cultural Resources Commission, the State Department of Hawaiian Home Lands, the Office of Hawaiian Affairs, the State Historic Preservation Division, Kamehameha Schools, the Hawai‘i County Native Hawaiian Chamber of Commerce, the Hawaiian Civic Club of Hilo, and others.

### *Cultural Impact Assessment*

In 2006, Kumu Pono Associates prepared *Hilo Palikū – Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe Forest Section, Ahupua‘a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai‘i* (Maly and Maly 2006), in conjunction with the proposal to designate Laupāhoehoe Forest as part of the HETF. The research conducted as part of the study is consistent with Federal and State laws and guidelines for such studies, including the November 1997 guidelines for cultural impact assessment studies adopted by the Environmental Council; the NHPA; the Advisory Council on Historic Preservations “Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review”; National Register Bulletin 38, “Guidelines for Evaluating and Documenting Traditional Cultural Properties”; and the Hawai‘i State Historic Preservation Statute (HRS Chapter 6E) and associated administrative rules. The study involved both review of archival-historical literature and field visits and interviews with elder kama‘āina. The report serves as an important reference for cultural resources management in the Laupāhoehoe Forest and provides invaluable information on the cultural context of the area. It references the ethnographical and historic uses of the region, and identifies several historic, ethnographic and archaeological site types and features that may be found in the area. The report is the primary source for the information in this section; the complete study is available online at <http://www.hetf.us/page/resources>).

### *Field inspections*

In 2015, three archaeologists from the DLNR-Division of State Parks conducted field inspections of four selected areas within Laupāhoehoe Forest that could be impacted by actions proposed in the Draft Management Plan: 1) a transect running roughly along the 3,500 ft elevation contour (general location of proposed conservation fencing); 2) a transect running almost the entire width of Laupāhoehoe Forest roughly along the 5,000 ft elevation contour, corresponding with historic location of Maulua Trail and including the area known as Shack Camp (location of trail improvement and development of primitive camping); 3) the intersection of surveyed boundaries for the lands of Laupāhoehoe, Waipunalei, and Humu‘ula (location of proposed forest restoration); and 4) the area of the monument commemorating

David Douglas (report attached as Appendix C). The inspections were conducted to assess the probability of historic properties within these potentially affected areas and to provide a basis for recommending any further steps needed to identify and appropriately manage historic properties within the project area. Ground visibility varied among the areas inspected; ground visibility was best along most of the Maulua trail route and at the boundary intersection where tropical ash restricts growth of understory species and feral pig rooting helps eliminate ground cover. Visibility was worst in the Shack Camp area and at or near the David Douglas monument due to the thick cover of kikuyu grass. Visibility was moderate along the lower elevation (3,500 ft) transect, with immediate ground surfaces mostly visible due to pig damage disrupting ground cover.

### *Pre-consultation*

Of the various stakeholders receiving the pre-consultation letter, only the County of Hawai‘i Cultural Resources Commission provided comments (full letter included in Appendix B). The Commission identified potential historic features within Laupāhoehoe Forest, including Waipunalei Trail, Shack Camp, Maulua Trail, the Dr. David Douglas monument, requested archaeological surveys for these areas and evaluations for inclusion on the State and National Register of Historic Places, provided recommendations for inadvertently discovered cultural resources, and identified a newly created public access into Laupāhoehoe Forest (Maulua Nui/Uweki Road Access). The Commission's comments have been incorporated into the summary below and will be incorporated into the Final Management Plan.

The Cultural Resources Commission also noted that the Draft Management Plan mentions that gathering for Native Hawaiian religious and customary gathering rights requires an HETF permit and requested additional information on the permit process. Small-scale non-commercial harvesting or salvage is allowed in the FR section of Laupāhoehoe Forest, including materials for cultural uses. Non-timber forest products such as ferns, maile, flowers, fruits, and lei-making materials, etc. for cultural or personal use may be collected from within the FR and is permitted and regulated by DOFAW through the FR System permit procedures (HAR § 13-104). Permit applications for gathering plant material in the FR can be obtained from the DOFAW office in Hilo and permits are available, upon approval, free of charge (for common, personal use items) or for a fee, depending on the purpose. Gathering of materials from listed endangered species is not permitted. Gathering (including Native Hawaiian religious and customary gathering rights) within the NAR section of Laupāhoehoe Forest is regulated by NAR rules and procedures (HAR § 13-209) and is more limited, in recognition of the unique natural resources found within the individual NARs and the requirement of HRS § 195-1 (“to preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawaii”). Special use permit applications for activities in the NAR can be obtained from the DOFAW office in Hilo. DOFAW's permit process is not intended to restrict constitutionally protected cultural practices, but is in place to

ensure protection of unique natural resources and avoid over-collection of a particular resource, minimize the potential for user conflict (e.g., to ensure that approved research is not sited in areas commonly used by cultural practitioners), and to provide safety or resource information (e.g., provide notification during periods of high fire threat or provide recommended protocols to reduce the spread of invasive species, etc.). The Draft Management Plan does not recommend changes to the current permitting procedure; however, DOFAW and USFS will evaluate its policies and permitting procedure to ensure protection of Hawaiian rights as identified under judicial decisions.

## Land Use History and Summary of Historic Features

The Laupāhoehoe Forest and surrounding areas have a rich history that has shaped the way the landscape looks today. The surrounding Hāmākua region was historically known as a powerful religious, economic, and demographic center of Hawai‘i Island and from early times, the region was known for its agriculture (County of Hawai‘i 2010). Laupāhoehoe Forest is situated in the upper lands of what is now generally called the ahupua‘a of Laupāhoehoe, situated within a larger traditional district of Hilo Palikū (Hilo of the upright cliffs). The history of Laupāhoehoe is tied to the history of its neighboring lands, and over the generations, residents from a number of land areas accessed the Laupāhoehoe forest region for religious purposes, to acquire prized natural resources, and for cultural practices (Maly and Maly 2006).

As stated by Maly and Maly, “[t]he forest lands of this region represent significant native (endemic and indigenous) resources, and are part of a unique cultural landscape – in that the native flora, fauna, mist, rains, water, natural phenomena and resources, are all believed to be *kino lau* (the myriad body-forms) of gods, goddesses, and lesser nature spirits of Hawaiian antiquity. Knowledge of the environment and respect for the resources, ensured a sustainable life upon the land. And in their evolving relationship with natural resources such as those of this region, Hawaiians came to consider everything about them as godly manifestations. Care for, and respect of the earth, meant that in-turn, the earth would care for the *kānaka* (people)” (Maly and Maly 2006). Travel through the forest was undertaken with prayer, caution and respect, and damage to living forests was punished by acts of nature such as heavy rains to wash out the path or dense mists or vegetation growth to hide the trail.

To elaborate, “[i]n 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 plateau lands, watered valleys and lava plains, and to the shoreline and ocean depths are believed to be embodiments of Hawaiian gods and deities” (Maly and Maly 2006). In the traditional context, the mountain landscape, its native species, and the intangible components therein, are a part of a sacred Hawaiian landscape. Thus, the landscape itself is a highly

valued cultural property. Its protection and the continued exercise of traditional and customary practices in a traditional and customary manner, are mandated by native custom, and State and Federal laws (Maly and Maly 2006).

The importance of the Laupāhoehoe region to the Native Hawaiians, particularly the koa forests, mountain bird habitats, and the traditional trails which connected the lowlands with the mountain lands and neighboring districts, were frequently mentioned in traditions and historical accounts (Maly and Maly 2006). “Practices such as trapping birds and collecting feathers, or hunting selected species of birds for food; felling koa for canoe making; travel to the region where the forests end, and on to the summit of Mauna Kea; the interment of remains and deification of family members on the mountain lands have been recorded” (Maly and Maly 2006). In addition, battles fought on the Laupāhoehoe lands were among those that established the kingdom of chiefs between the early 1500s to the late 1700s (Maly and Maly 2006).

There are also a number of ancient named sites, including trails within the forest area and along its boundaries with other land, including:

- Ha‘akoa (an area associated with the chief, ‘Umi, and location of an important heiau);
- Keauhua‘ai (a hillock at the top of Laupāhoehoe – place where David Douglas died);
- Kūlanihāko‘i (an area at the top of the Laupāhoehoe-Waipunalei boundary, where a mountain shelter once existed);
- Kulipalapala (an old shelter in the forest, along the Kaiwilahilahi – Kapehu – Maulua boundary);
- Ninika (a boggy region in the Laupāhoehoe – Maulua forest);
- Pu‘ukole (an ancient site of a shrine for bird catchers, and shelter for those who traveled to the upper forest zone);
- Pu‘ukoa (a koa covered hill on the upper boundary of Kaiwilahilahi and Kapehu); and
- Pu‘ulehu (a shelter of canoe makers and bird catchers on the Laupāhoehoe – Maulua boundary) (Maly and Maly 2006).

Based on the report by Kumu Pono Associates, the following types of archaeological sites associated with the pre-contact era would be found in the Laupāhoehoe Forest:

- trails extending from the shore to the mountain lands;
- shelters and resting places along trail sides;

- shrines used by travelers, bird catchers, canoe makers, and other practitioners;
- battle sites and hiding places; and
- possible burial sites.

Traditional features would include several forms, ranging from stone platforms, terraces, cairns, and walls; and shelter features – called pāpa‘i by the ancient Hawaiians – generally made of wood, leafy branches and ferns. Many of the features would naturally deteriorate and evidence of them would return to the earth. Other features of stone might still be visible in the understory, though only found upon careful search. Finally, there could be stone filled fractures or crevices, and caves, which were sometimes used for shelters over generations, or as burial sites, and as places in which to hide valued cultural artifacts (Maly and Maly 2006).

The lowland region in places like Waipunalei, Laupāhoehoe, and Maulua, extending from the shore to around the 3,000 ft elevation, supported residential and agricultural activities; the upper forest regions were frequented by travelers, collectors of natural resources, and for a wide range of cultural practices. By the time of westerners recording travel between the shore of Laupāhoehoe and the upper mountain lands, the Laupāhoehoe-Waipunalei trail had become the primary route of travel, with other trails only known to native residents of the land (Maly and Maly 2006).

For much of the post-contact period to the mid-1800's, the land use within Laupāhoehoe would not have changed significantly, but indirect impacts to the forest would have begun as cattle and goats introduced by George Vancouver in the 1700s spread across the island. In the mid-1800s, the lower elevation forest up to about the 2,000 ft elevation was cleared for sugar cultivation, the development of flumes and water resources, and homestead lots (Maly and Maly 2006). Wild cattle were in great numbers and fairly wide-ranging across the slopes of Mauna Kea, impacting the upper elevation forest. In the early 1800s, base camps and huts were built in the Keanakolu area (within the nearby Humu‘ula section of Hilo FR) for bullock hunting, which developed into formal ranching operations in the 1850s for both cattle and sheep (Maly and Maly 2006). As ranching developed, similar infrastructure (shelters, fenced pens, trails) was built along the routes used to drive cattle to steamer landings or other markets; forest was cleared and timber harvested to support these operations. Grazing continues to this day in the general region surrounding Laupāhoehoe Forest.

Sites associated with the ranching era identified in the larger Laupāhoehoe region include:

- Maulua Trail, established as an old pack trail, first appearing on a 1916 map, running roughly north from Shack Camp.
- Shack Camp, a 125 acre fenced area leased from the Territory of Hawai‘i by Kūka‘iau Ranch, located on the Maulua-Laupāhoehoe boundary. There remain on the land in the present-day, the

ruins of small house (or shack), deteriorated feeding and watering troughs, scattered fruit trees, a pole for the telephone line installed by Kūka‘iau Ranch in 1922, and a large pond.

- Noted places such as Keanakolu (not the same location of the present-day cabin of that name), Lahohinu, and Keahua-ai (Douglas Pit) are considered significant features of the historical landscape.
- David Douglas Monument, an eight-foot tall stone monument constructed in 1934 to honor the botanist.
- Laupāhoehoe-Waipunalei trail, a historic trail which appears on maps as far back as 1875 (Maly and Maly 2006), and generally follows the boundary between Laupāhoehoe Forest and adjacent privately owned land in Waipunalei.
- The sheep ranch station at Keanakolu (in the original place of that name, near the Laupāhoehoe-Humu‘ula boundary). There remain on the land in the present-day, the ruins of stone shelters, pens and foundations.

The Hilo FR was established in 1905 to protect the remaining forest resources and the watershed, with the lower boundaries of the FR lands marking the edges of the homestead lots. A FR monument was placed at a place named Kulanihakoi (also transcribed as Kulanikakoi and Kulanikekoi) to mark the mauka boundary of the FR between Waipunalei and Laupāhoehoe; remnants of the post was found during the field inspection at this site. The Civilian Conservation Corps (CCC), established by the Federal government in the 1930s, constructed fences to control feral sheep and limit their entry into forested watershed areas and participated in tree planting and road and trail maintenance around the island, including at Laupāhoehoe.

In the 1970s, a Hawaiian woodcraft manufacturer, Blair Woods Hawai‘i, was granted permission to access Laupāhoehoe Forest to harvest koa and ‘ōhi‘a within upper Laupāhoehoe under certain conditions; the State determined that the invasive banana poka, impacts from cattle, and the death of trees made salvage of lumber viable and that logging would encourage koa regeneration. The 4 WD road known as “Blair Road” was constructed to access the acreage approved for harvesting activities; harvesting ceased in 1979 and the road has been used by DOFAW for management purposes since that time.

Four areas were selected for field inspections because observations by DOFAW staff or historic records indicated a higher probability of historic properties in these areas and because planned management actions that could affect these properties were planned in the general area. No field inspection was conducted in the vicinity of the Laupāhoehoe-Waipunalei historic trail because no evidence of the historic trail was observed during previous visits to the area by DOFAW staff, and no new management



activity was proposed in this area (Figure 6).

## Laupāhoehoe Forest Historic Properties and Planned Management

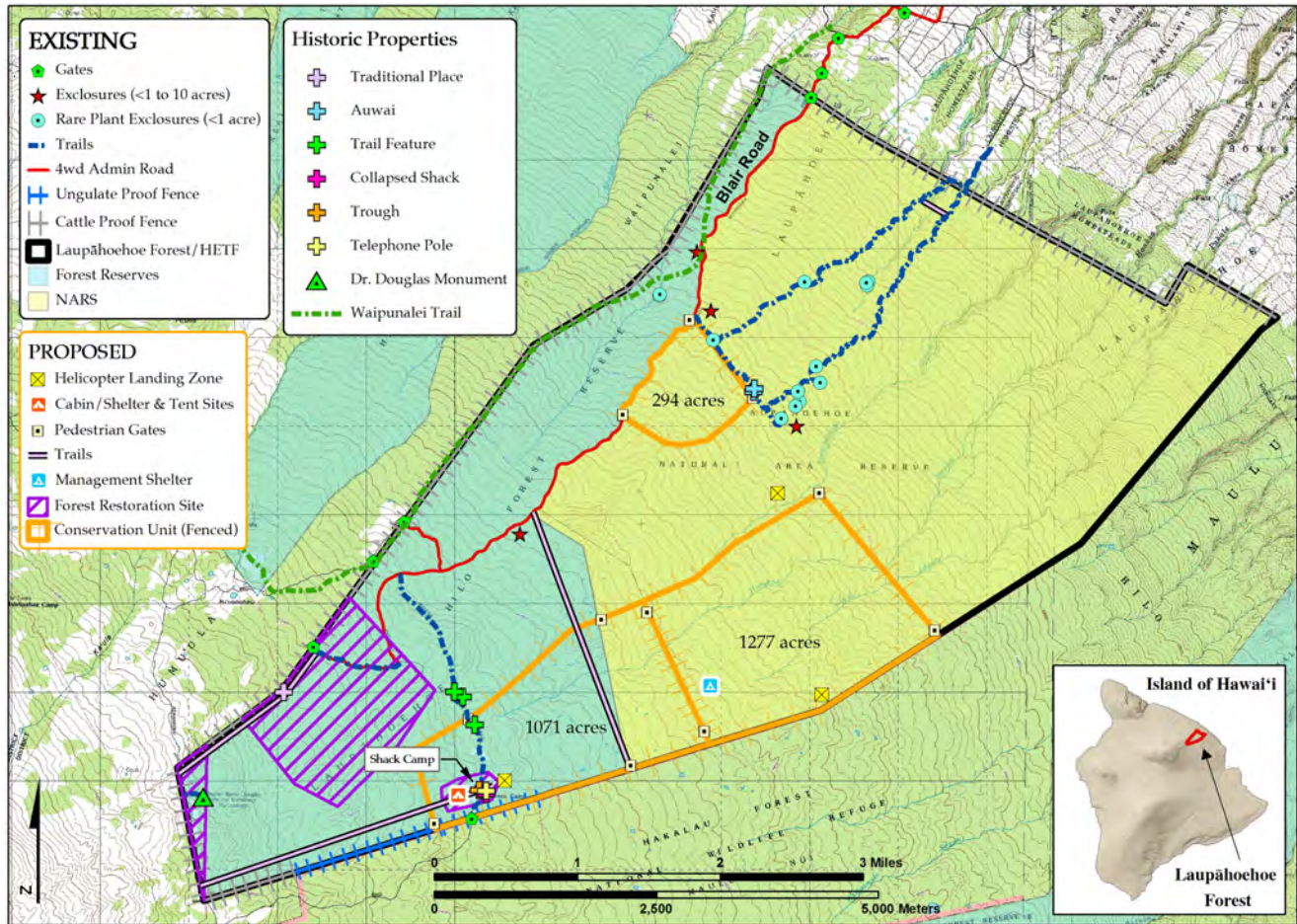


Figure 6. Laupāhoehoe Forest Historic Properties and Planned Management

The following five potential historic properties were identified during the 2015 field inspections (see Appendix C).

- 1) Maulua Trail section (transect roughly at 5,000 ft elevation) – Segments of the historic Maulua trail had been identified previously by NARS staff along the trail's route shown on USGS topographic maps. Cattle were presumably driven from the fenced complex at Shack Camp along the trail or the trail became a shortcut for ranch hands moving to and from the coast or other ranch lands. The trail was recognizable when the edges were defined by stone alignments or curbing, cuts in embankments or slopes when the trail crossed ridges or uneven terrain, or leveled segments of stone and soil in flatter areas. State Parks archaeologists mapped a trail segment 154 ft (47 m) long that included a distinct ramp feature cut into a sloping ridge face and a retaining wall feature near its base; trail width varied



from four to 11 ft (1.4 to 3.5 m), with most sections eight feet (2.5 m) wide. Attempts to follow the trail beyond the mapped segment were unsuccessful.

2) Shack Camp Ranching Complex (along transect roughly at 5,000 ft) – Known as Shack Camp as early as 1916, this 125 acre fenced area had at least two water sources, a pond and spring. State Parks archaeologists found a collapsed and badly deteriorated small house (or shack), deteriorated feeding and watering troughs, scattered fruit trees, a small orchard of fruit trees on the rise above the house, a pole for a telephone line, and the large pond shown on maps. The spring shown on a 1916 map was not located.

3) Traditional Place at Ahupua‘a Boundaries – The Boundary Commission was established in 1862 to certify the boundaries for the ahupua‘a awarded to the major ali‘i in the Great Mahele of 1948. The Commission received testimony from two Native Hawaiians with personal knowledge of the lands, boundaries, or place names of the mauka boundary between Waipunalei and Laupāhoehoe. One testified as to the presence of a water hole, and the other mentioned living in the area while shooting bullock on the lands of Humu‘ula. A 1916 map shows a FR Monument marking the boundary and depicts a water hole adjacent to the boundary. State Parks archaeologists found the old FR monument and a low, broad depression that could have been the water hole. Though the depression was dry, sediments indicated that the water still ponds there. Directly inland was a natural rock formation with very distinct surface patterns next to the base of what was once a very large koa tree. No other features of note or evidence of past use were seen in the area.

4) David Douglas Monument – The stone monument to honor Scottish botanist David Douglas remains present in an open, grassed area; a trail leading to the monument is maintained and marked with signage. The eight-foot tall triangular and tapered stone pillar sits on a triangular base and is topped with a single rock. Bronze plaques dedicate the monument, list those responsible for its construction in 1934, and (installed in 2014) commemorates the 108<sup>th</sup> anniversary of his death and 100<sup>th</sup> anniversary of the publication of his journals. If evidence of bullock pits or other uses of this area still exist, they are hidden by the dense grass and underbrush.

5) ‘Auwai or Ditch feature (transect roughly along the 3,500 ft elevation). Segments of a probable ditch or ‘auwai had been previously identified by NARS staff along the route used to access existing endangered species enclosures in the lower elevation, wet rain forest. The feature (which could be followed for a total of 167 ft (51 m)) appeared to be a long open trench cut into the rocky, soil embankment of a ridge and at angles and elevations conducive to water flow. Widths varied from 27.5 to 59 in (70 to 150 cm) and depths from 12 to 66 in (30 to 170 cm). Portions of the trench have collapsed, while others were no longer well defined due to erosional slippage or filling. The State Parks archaeologists confirmed that it was a manmade feature, and that a ditch seemed to be the feature's most likely function. However, the feature was puzzling, as it is located above the productive

agricultural zone for Native Hawaiian and subsequently introduced crops given the cooler temperatures at this elevation and the high percentages of cloud cover per hour and day throughout the year. While some association with the use of Laupāhoehoe Homestead lands for ranching or sugar cultivation is possible, those lands are at least two miles downslope of the ‘auwai.

Other than the features described above, no archaeological sites or historic properties were found in areas covered during these field inspections. These observations support general predictive models that the probability of archaeological sites in these upland forested areas is very low. Known uses of forested areas, mostly documented in the historic record, were primarily transient, intermittent, or periodic and left few durable remains behind. Thick vegetation growth and ground disturbance by feral animals, particularly pig rooting and wallowing, have likely obscured or obliterated any cultural deposits or stone alignments that might have remained in the area. The findings also are consistent with the results of other studies along the upper portions or margins of the FR; historic properties remaining in these areas mostly reflect periods of wild cattle hunting, ranching, or early forestry and watershed initiatives.

## **Determination of Effects**

### No-Action Alternative

Implementation of the no-action alternative would keep existing cultural and archaeological resource conditions static. Ground disturbance by feral animals, particularly pig rooting and wallowing, could continue to degrade or obliterate undocumented remnant cultural deposits or stone alignments. Habitat and watershed values could degrade as a result of continued ungulate disturbance, and many resources important for gathering and other cultural associations would be diminished or lost altogether, including native plants and birds.

### Preferred Alternative

Construction of fencing, improvement of trails to primitive condition, development of the Shack Camp camping site, and installation of management shelters and helicopter landing zones necessarily involves the removal of vegetation and limited ground disturbance. The recommendations for the treatment of cultural resources as detailed in the Kumu Pono study would be incorporated during all phases of implementing the Draft Management Plan:

“In regards to work which may be undertaken in the proposed Laupāhoehoe HETF, it is important that cultural resources – both tangible and intangible – be respected. For example, should fencing programs or work shelters be developed, care to ensure that cultural remains are not impacted, should be taken. It should be the goal of any undertaking to minimize the footprint, and ensure that the landscape is left in a natural state. Fencing programs, to protect

treasured natural-cultural resources from degradation by introduced animals have a long history in the region. Fencing and control of feral animals dates from the nineteenth century, and was expanded with the development of the forest reserve programs. Early fencing programs were at times destructive of the resources, today, programs designed to minimize the impacts should be employed. All participants in oral history interviews we have conducted over the last ten-plus years for lands of the Hilo forest region and Mauna Kea mountain lands have expressed the thought that care of the land, cultural resources, and forest is important.

We recommend that the HETF program managers and field crew members meet with a Department of Land and Natural Resources – State Historic Preservation Division (DLNR-SHPD) staff person, prior to undertaking any work on fence lines or other ground altering activities. All field crew members employed on any projects in the preserve should be informed of Historic Preservation Guidelines, and made aware that if any stone feature (such as walls, terraces, mounds, platforms, shelters, caves, trails, or boundary *ahu*) are found, work in the area is to be stopped and modified so as to minimize impacts on such features. The management staff should also monitor all clearing as it is undertaken, to ensure proper treatment of sites, should any be discovered. Should cultural sites be encountered, it is recommended that members of the Hawaiian community at Laupāhoehoe – such as Nā Waiwai o Laupāhoehoe – be contacted, and consultation regarding site treatment should be undertaken along with representatives of the DLNR-SHPD.

The Hawai‘i State Historic Preservation Statute (Chapter 6E), which affords protection to historic sites, including traditional cultural properties of ongoing cultural significance; the criteria, standards, and guidelines currently utilized by DLNR-SHPD for the evaluation and documentation of cultural sites should be complied with. The Hawai‘i Island Representative of DLNR-SHPD should be notified of any findings, when made.

If inadvertently discovered, burial remains should be protected in place. Work in the immediate vicinity of the remains should be terminated, and the Hawai‘i Island Representative of DLNR-SHPD should be notified of any findings. Final disposition of remains will be determined in consultation with DLNR-SHPD, and Native Hawaiian descendants of the families associated with Laupāhoehoe and adjoining lands. If any burial remains should be discovered, they should be treated on a case-by-case basis in concurrence with Chapter 6E-43 (as amended by Act 306).

Finally, it is suggested here, that if funding opportunities arise, and a work-force be needed for various projects (e.g., fencing, game control, and resource monitoring, etc.) that individuals with historical ties to the Laupāhoehoe lands be involved in the programs. Research and stewardship programs will have greater long-term success when members of the local community are informed and active participants. Educational opportunities for local school

programs will also help to inform communities of the values of the research being done, while researchers will also be exposed to traditional and historical values the community places on the natural and cultural landscape” (Maly and Maly 2006).

One goal of the Draft Management Plan is to protect the existing cultural and archaeological features found within Laupāhoehoe Forest. As such, before implementing management actions that could impact historic features (e.g., development of Shack Camp camping site, restoration of Maulua trail, installation of fencing adjacent to ‘auwai), DOFAW will consult with SHPD to develop an archaeological inventory survey plan, followed by an archaeological inventory survey, to document and delineate the known historic features listed above to identify planned measures to avoid negative impact to historic features, and where appropriate, to identify planned interpretation or preservation plans. The archaeological inventory survey will also evaluate the properties' significance for inclusion on the State and National Register of Historic Places. The inventory and consultation with SHPD will be completed before any ground disturbance near these known historic features will occur.

Should evidence of any unanticipated archaeological or cultural properties be encountered during implementation of the Draft Management Plan (e.g., fence construction, permitted research, etc.), the activity would immediately cease and the appropriate parties would be consulted immediately. Wherever possible, cultural resources would be avoided. Minimization options, in addition to site avoidance by relocating activities, would include data recovery, using either collection techniques or *in-situ* site stabilization protection.

Because of the limited number of documented features within Laupāhoehoe Forest, the low likelihood of undiscovered archaeological sites due to the elevation and dense rainforest setting, and the planned additional field work and mitigation measures to be incorporated to avoid damage or harm to known or unanticipated resources, the negative impact on cultural and archaeological resources is expected to be minor. Over the long-term, minor positive impacts would be anticipated as a result of the increased documentation of the historic features associated with the ranching era and the protection of native forest from ungulate disturbance.

No specific cultural practices have been identified that may be impacted by implementation of the Draft Management Plan, either during development of the Plan or during pre-consultation. However, to ensure continued public access into and within Laupāhoehoe Forest, conservation fencing will incorporate gates or step-overs at known access points or along historic trails, and additional step-overs will be added after construction as necessary. For cultural practices such as gathering, the applicable FR and NAR rules and procedures apply (HAR § 13-104 and HAR § 13-209) based on the location of the proposed practice. DOFAW's permit process is not intended to restrict constitutionally protected cultural practices, but is in place to ensure protection of unique natural resources and avoid over-collection of a particular resource, minimize the potential for user conflict (e.g., to ensure that approved

research is not sited in areas commonly used by cultural practitioners), and to provide safety or resource information (e.g., provide notification during periods of high fire threat or provide recommended protocols to reduce the spread of invasive species, etc.). The Draft Management Plan does not recommend changes to the current permitting procedure; however, DOFAW and USFS will evaluate its policies and permitting procedure to ensure protection of Hawaiian rights as identified under judicial decisions.

As noted previously, the mountain landscape, its native species, and the intangible components therein, are a part of a sacred Hawaiian landscape, which itself is a highly valued cultural property. Its protection and the continued exercise of traditional and customary practices in a traditional and customary manner, are mandated by native custom, and State and Federal laws (Maly and Maly 2006). The Draft Management Plan is specifically directed at the long-term protection of Laupāhoehoe Forest and its natural and cultural resources found within Laupāhoehoe Forest and proposes no substantive changes to existing traditional and customary practices. As such, implementation of the Draft Management Plan is anticipated to have a positive impact on the landscape and on traditional and customary practices (by protecting the native forest in which those practices may occur).

Consultation with SHPD pursuant to HRS § 6E-8 and NHPA § 106 would occur as necessary to confirm that proposed actions would have no adverse effect on the historic resources within Laupāhoehoe Forest, and mitigation requirements, if any, resulting from this consultation would be incorporated and implemented as appropriate.

## **Conclusion**

Both alternatives are in compliance with laws, regulations, and policies associated with archaeological and cultural resources. Mitigation measures to be incorporated into all phases of implementing the Draft Management Plan will avoid negative impacts to existing and previously unidentified cultural and archaeological resources. The no-action alternative is anticipated to have a long-term negative impact on cultural and archaeological resources due to continued degradation of the landscape by feral ungulates and invasive weeds. With the mitigation measures in place, implementation of the Draft Management Plan is anticipated to have a short-term minor negative impact and a long-term minor positive impact on cultural and archaeological resources.

## **Scenic resources**

### **Existing Conditions**

Landscape character represents distinct attributes of landform, vegetation, surface water features, and cultural features that exist in the landscape. In the largest context of place, the Hawaiian Islands are

considered unique. The extreme isolation of the islands produced, through evolution and specialization, a remarkable collection of species found nowhere else on the planet. These natural treasures are integral elements of the biological and cultural heritage of the Hawaiian Islands and their people.

From the scenic perspective the Laupāhoehoe Forest lies on the lower northeasterly facing flank of Mauna Kea, mauka of the Hāmākua coastline in the District of North Hilo. From the highway and the communities of the Hāmākua region, the boundaries of Laupāhoehoe Forest are indistinguishable from the adjacent mauka forested land (Hakalau NWR, Parker Ranch, Hilo FR), which provides a scenic mountainous backdrop of lava flows, dense native forest and shrubland, and pasture and grassland. Lava rock extrusions and overland flows create interesting texture and color in the landscape; and views of the summit of Mauna Kea are generally obstructed by vegetation, topography, or both. The scenic values of the mauka forests of the Hāmākua region are recognized generally within the Hawai‘i County General Plan and Hāmākua Community Development Plan.

Within Laupāhoehoe Forest, there is a very limited viewing audience: a few ranchers and hunters, research scientists, land managers, hikers, educators and their audiences, and extensive scenic vistas are typically obstructed by vegetation, topography, or both.

## **Determination of Effects and Conclusion**

### No-Action Alternative

Implementation of the no-action alternative would keep existing scenic conditions static.

### Preferred Alternative

There would be no anticipated impacts on scenic resources associated with the additional actions proposed under full implementation of the Draft Management Plan. Conservation fencing would not be visible beyond the immediate vicinity of fence; any planned trail improvements will be primitive, with limited clearing and marking of the trail way, and thus would not be visible beyond the immediate vicinity of the trail. No areas considered natural beauty sites within the Hawai‘i County General Plan would be adversely affected.

## **Summary of Effects**

The following table summarizes the anticipated impacts. The effects related to implementing each alternative are described in terms of the change from current conditions (i.e., the environmental baseline). Alternative 1, the no-action alternative, would continue present management actions. However, the consequences of implementing Alternative 1 may have positive, negligible, or negative effects. For example, under current management, failure to control ungulate populations would result in

a long-term, moderate, negative impact on native flora.

Table 3.2 Summary of Effects

	<b>Alternative 1 (No Action)</b>	<b>Alternative 2 (Preferred) Implementation of Draft Management Plan</b>
Soil	Long-term, minor, negative	Short-term, minor, negative Long-term, minor, positive
Air quality	Negligible	Negligible
Noise	Negligible	Negligible
Water	Long-term, minor, negative	Short-term, minor, negative Long-term, minor, positive
Fauna	Long-term, minor, negative	Short-term, minor, negative Long-term, minor, positive
Flora: rare plants	Long-term, moderate, negative	Short-term negligible Long-term, moderate, positive
Flora: native vegetation	Long-term, moderate, negative	Short-term, minor negative Long-term, moderate, positive
Hunting	Negligible	Long-term, minor to moderate, negative (reduced hunting acreage) Long-term, minor, positive (improved access)
Public Use: Recreation, Gathering, Education, Illegal Use	Negligible	Long-term, minor, positive
Research	Negligible	Negligible
Socioeconomic Resources	Long-term, minor, negative	Long-term, minor, positive
Cultural and Archaeological Resources	Long-term, minor, negative	Short-term, minor, negative Long-term, minor, positive
Scenic Resources	Negligible	Negligible

## Section 4. Cumulative Impacts

A cumulative impact is 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 non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR 1508.7). Table 4.1 lists the past, present, and reasonably foreseeable future actions in and near the project area. Many activities listed within this table have been long-standing existing activities within the area.

Table 4.1: Past, Present, and Foreseeable Future Actions Near Laupāhoehoe Forest

<b>Agency or Ownership</b>	<b>Past and Ongoing Activities</b>	<b>Future Activities</b>
USFS	The Laupāhoehoe Science and Education Center, consisting of a bunk house, toilet and showers, and meeting/class room was completed in 2015.	A Forest Pavilion (Field Education Center) was covered by a previous EA and has yet to be built; it will consist of a covered pavilion, toilet/comfort station, and parking area on a 3-acre parcel just outside the Laupāhoehoe Forest boundary.
State DLNR	Grazing within and around the Laupāhoehoe Forest and for the past 30 years.	Continued grazing on lands adjacent to Laupāhoehoe Forest, anticipated to be similar in scale as past activities.
USFWS	The Hakalau Forest NWR is adjacent to the Laupāhoehoe Forest/HETF. USFWS frequently does restoration work using volunteers. Road access to their areas uses alternative routes. Typical volunteer usage is approximately 10-12 people/weekend year-round.	Anticipated to be similar in scale as past and ongoing activities. Potential expansion makai (Koa Forest and Maulua Gulch units) and to the northwest (Kūka‘iau Ranch), dependent on funding.
USDA-FS, other agency, State, private	Research and monitoring (including maintenance of stream gauges in Kaiwilahilahi, the Ha‘akoa, and Ka‘awali‘i Streams at approximately 2,000 ft elevation, of weather station adjacent to Blair Road at 3,500-4,000 ft elevations).	Similar to past activities; may involve both continuation of long-term research and initiation of new short and long-term research. Specific research depending on funding and academic/agency interest and information needs.
Mauna Kea Watershed Alliance	Conservation actions to protect and enhance watershed ecosystems, biodiversity and resources, covering 500,000 acres across the upper elevation	Anticipated to be similar in scale to past and ongoing activities.



	Mauna Kea landscape, including invasive weed removal, fencing, reforestation.	
Department of Hawaiian Home Lands (DHHL)	Primarily grazing on 56,200 acres on the northeast slopes of Mauna Kea. The ‘Āina Mauna Legacy Program received final approval in 2011: goal is to develop an economically self-sustaining improvement and preservation program for the natural and cultural resources; proposes multiple actions including native forest and wildlife habitat restoration, invasive species eradication, sustainable commercial koa forestry, eco-tourism, and infrastructure improvements.	Activities outlined in the ‘Āina Mauna Legacy Program plan are anticipated to increase in scale over time as the plan is implemented.
Parker Ranch	Grazing and salvage koa logging at Waipunalei.	Anticipated to be similar in scale to past and ongoing activities.
Kūka‘iau Ranch	Conservation easement on 3,830 acres – to discontinue cattle ranching and restore to koa forest (2012 funding through DOFAW Forest Legacy Program).	Koa forest restoration anticipated to continue and over time, increase overall acreage of koa forest.

## Alternative 1

Under the no-action alternative, the slow and insidious degradation of the native forest and watershed of Laupāhoehoe primarily due to ungulate disturbance and the spread of invasive species would continue to occur. The cumulative effect would eventually reduce the area of healthy native forest on the island of Hawai‘i to perhaps unsustainably low levels for recovery of certain rare plants, animals and habitat.

## Alternative 2

In general, cumulative effects as a result of implementing the Laupāhoehoe Forest Draft Management Plan are either minor and do not require spatial mitigation, or they are beneficial. Cumulative effects from local, short-term disturbances caused by fence construction, trail improvement or maintenance, or additional outreach events (noise, emissions, traffic) are expected to be extremely minor, temporary and insignificant. Reforestation of the upper-elevation area of Laupāhoehoe Forest and fencing approximately 2,694 acres of intact native forest would increase forested areas and add to the acreage on Hawai‘i Island that is protected from ungulate disturbance. When considered with other planned actions near Laupāhoehoe Forest, the conservation actions would be anticipated to be cumulatively

beneficial and contribute to the recovery of (or prevent the extinction of) endangered plants, endangered forest birds, the ‘io, the koloa maoli, and the ‘ōpe‘ape‘a.

Hunters have expressed concern in the past about the cumulative effects on hunting because they observe the increase in acreage of areas proposed for fencing as part of NWR management, watershed initiatives, private actions, and Forest Reserve and NAR management plans, and feel there is an ongoing loss of hunting area. DOFAW provides over 950,000 acres of hunting areas statewide with over 600,000 acres of public hunting area on the island of Hawai‘i (FR, Game Management Area, and NAR). Public hunters are a valuable conservation partner, but public hunting alone cannot prevent ongoing damage to the native rare plants and animals found in Hawaii's forests. Approximately 14 percent of DOFAW lands (10% on Mauna Kea, 4% elsewhere) is currently considered under “high-level protection” with fencing and feral ungulate control programs in place. Under the most ambitious current plans for fencing and ungulate removal over the next decade, another eight percent of DOFAW lands on the island would be affected, including the identified conservation units in the Laupāhoehoe Forest Draft Management Plan. In an effort to balance all of DOFAW's mandates, approximately 22% of Laupāhoehoe Forest (0.4% of DOFAW lands) is proposed to be fenced to protect native plants and animals and to conserve valuable watershed, implemented over 15 years, with the majority of the forest unfenced and available for game mammal hunting. In this context, the cumulative effect of the Laupāhoehoe Forest Draft Management Plan on public hunting is not considered significant.

## **Section 5. Consistency with Hawai‘i State Plan and Coastal Zone Management Act**

### **Hawai‘i State Plan**

#### **Themes, Goals, and Objectives**

Initially adopted in 1978 and updated over time, the Hawai‘i State Plan establishes a set of themes, goals, objectives and policies that are meant to guide the State's long-range development and provide a basis for determining priorities and allocating limited resources. The overall theme of the Plan is that Hawai‘i's people, as both individuals and groups, generally accept and live by a number of principles that are an integral part of society: individual and family self-sufficiency, social and economic mobility, and community or social well-being. The State goals are identified as:

- “(1) a strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawai‘i's present and future generations;
- (2) a desired physical environment, characterized by beauty, cleanliness, quiet, stable natural

systems, and uniqueness, that enhances the mental and physical well-being of the people;

(3) physical, social, and economic well-being for individuals and families in Hawai‘i, that nourishes a sense of community responsibility, of caring, and of participation in community life” (HRS §226-4).

HRS §226-102 outlines the overall direction and provides that “[t]he State shall strive to improve the quality of life for Hawai‘i’s present and future population through the pursuit of desirable courses of action in seven major areas of statewide concern which merit priority attention: economic development, population growth and *land resource management*, affordable housing, crime and criminal justice, quality education, *principles of sustainability*, and *climate change adaptation*” (emphasis added to areas relevant to the Laupāhoehoe Draft Management Plan). Specifically, priority guidelines for climate change adaptation state “encourage the preservation and restoration of natural landscape features, such as coral reefs, beaches and dunes, forests, streams, floodplains, and wetlands, that have the inherent capacity to avoid, minimize, or mitigate the impacts of climate change” (HRS §226-109(5)).

HRS Chapter 226 provides objectives and policies for population, the economy, the physical environment, facility systems, and socio-cultural advancement. Among these, the most relevant to the Laupāhoehoe Draft Management Plan are §§ 226-11 (land-based, shoreline, and marine resources), 226-12 (scenic, natural beauty, and historic resources) and 226-13 (land, air, and water quality), which identify the protection of Hawai‘i’s unique and fragile environmental resources, the enhancement of Hawai‘i’s scenic assets, natural beauty, and multi-cultural/historical resources, and pursuit of improved quality of Hawai‘i’s air, land and water resources, and greater awareness and appreciation of Hawai‘i’s environmental resources as objectives.

## Discussion

Implementation of the Laupāhoehoe Draft Management Plan is consistent with and implements the Hawai‘i State Plan by protecting the natural resources of Laupāhoehoe Forest from further degradation by feral ungulates, invasive weeds, and other threats, promoting research that will enhance protection efforts and contribute to better understanding on how to mitigate for climate change, and increasing outreach and education about native forests. The protection of Laupāhoehoe Forest as outlined in the Draft Management Plan is a 15-year plan that is considered achievable based on historic and current funding resources and opportunities. The protection of an elevational gradient of native forest not only protects the forest, but also directly protects watershed and water supply, rare native plants, and habitats for endangered plant and animal species. Protecting the natural resources also protects cultural resources, as for many Native Hawaiians, they are one and the same. Protecting native forest maintains opportunities for traditional and customary practices, such as the gathering of certain plants for cultural purposes. Finally, the improvements to public access and the planned outreach and education efforts

identified in the Draft Management Plan further the State Plan's objective to promote educational programs which enhance appreciation of Hawai'i's environmental resources.

## **Coastal Zone Management Program**

### **Objectives and policies**

HRC Chapter 205A requires all state and county agencies to enforce the coastal zone management objectives and policies, as outlined in HRS § 205A-2. Ten areas are addressed:

- (1) recreational resources – provide coastal recreational opportunities accessible to the public;
- (2) historic resources – protect, preserve, and, where desirable, restore those natural manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture;
- (3) scenic and open space resources – protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources;
- (4) coastal ecosystems – protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems;
- (5) economic uses – provide public or private facilities and improvements important to the State's economy in suitable locations;
- (6) coastal hazards – reduce hazard to life and property from tsunamis, storm waves, stream flooding, erosion, subsidence, and pollution;
- (7) managing development – improve the development review process, communication, and public participation in the management of coastal resources and hazards;
- (8) public participation – stimulate public awareness, education, and participation in coastal management;
- (9) beach protection – protect the beaches for public use and recreation, and
- (10) marine resources – promote the protection, use, and development of marine and coastal resources to assure their sustainability.

### **Discussion**

A discussion of the Laupāhoehoe Draft Management Plan's consistency with the coastal zone management objectives follows:

Recreational resources: Laupāhoehoe Forest is a wilderness area, with limited existing legal public access. The Laupāhoehoe Forest is not adjacent to the shoreline or beach, and the proposed activities in the Draft Management Plan are not anticipated to affect an ocean recreation area, swimming area, surf

site, fishing area, or boating area.

The Draft Management Plan proposes improvement of public access and recreational opportunities within Laupāhoehoe Forest that may positively impact recreational users. Specifically, the Draft Management Plan identifies existing trails (Spencer, Maulua and Peneki) for maintenance as primitive trails, and proposes the development of additional primitive trails 1) along the north fence line (upper boundary) from Mana Road to Blair Road, 2) connecting Spencer to Peneki, 3) from Mana Road to the Maulua trail, roughly parallel to the southern forest boundary and running through the proposed camping area at Shack Camp, and 4) from Blair Road to the south boundary, roughly following the FR and NAR boundary (between the 4,500 and 5,000 ft elevation). The Draft Management Plan also identifies the development of primitive camping in the area of Shack Camp, consisting of up to ten tent sites, a management shelter that would be available for public use by reservation, self-contained composting toilets, and a covered open-sided shelter for cooking.

In addition, the Plan proposes that the State work with adjacent landowners to work on alternative access to the forest, pursue potential land acquisitions through fee simple purchase (which could eliminate private land barriers), and consider acquisition of long-term leases of state or private land adjacent to the forest when current leases expire.

Laupāhoehoe Forest is an existing State hunting area; the impact on hunting is anticipated to be minor to moderate as a result of the planned fenced conservation units (approximately 2,659 total acres), which will necessarily reduce the acreage available for game mammal hunting by 22%. The units were selected to protect areas of high-quality intact native forest while avoiding areas of high hunter activity, and the fencing will incorporate gates or step-overs to allow hunter and other forest user movement through the forest. Most of the proposed fencing is located at some distance from existing access points into Laupāhoehoe, on the forested area bordering Hakalau NWR. While there may be a moderate negative impact on individuals who travel distances within Laupāhoehoe Forest, off-trail and away from established access points, to preferred hunting locations within the proposed conservation units, the surrounding 78% of Laupāhoehoe Forest will remain an accessible alternative for hunting, as will hunting areas elsewhere on the island of Hawai‘i. To the general hunting community, the negative impact is anticipated to be minor, because the majority of Laupāhoehoe Forest will remain available for hunting (78%), as game animals will remain able to move freely from mauka to makai portions of Laupāhoehoe Forest, and because numerous opportunities for hunting exist elsewhere on the island for licensed hunters, who make up less than 2% of the island's population.

Historic resources: Laupāhoehoe Forest is not within a designated historic or cultural district, is not listed or nominated to the Hawai‘i or National Register of Historic Places, and is not within or adjacent to a Hawaiian fishpond or historic settlement area. Portions of the forest have been surveyed for historic or archaeological resources, but the majority of the area is undeveloped land that has not been

surveyed.

The development of a primitive hiking trail from Mana Road to Maulua Trail and development of primitive recreational camping facilities (designated tent camping sites, installation of open-sided shelter with roof catchment and firepit, composting toilets) at Shack Camp could impact the known historic features of Maulua trail or Shack Camp. The intent of the Draft Management Plan is to protect these historic features, and planned mitigation measures to avoid damage or harm to these features, and enhance public appreciation of their historic value, include avoidance of documented features when siting the trail or tent camping sites, shelters and composting toilets, installation of interpretive signage regarding the historic features, and consultation with SHPD for additional mitigation measures and actions.

Should evidence of any unanticipated archaeological or cultural properties be encountered during construction, vegetation clearing or fence construction would immediately cease and the appropriate parties would be consulted immediately. Wherever possible, cultural resources would be avoided. Minimization options, in addition to site avoidance by relocating activities, would include data recovery, using either collection techniques or *in-situ* site stabilization protection.

Because of the limited number of documented features within Laupāhoehoe Forest, the low likelihood of undiscovered archaeological sites due to the elevation and dense rainforest setting, and the planned mitigation measures to avoid damage or harm to known or unanticipated resources, the negative impact on cultural and archaeological resources is expected to be minor. Over the long-term, minor positive impacts would be anticipated as a result of the increased documentation of the historic features associated with the ranching era and the protection of native forest from ungulate disturbance.

Consultation with SHPD pursuant to HRS § 6E-8 and NHPA § 106 will occur as necessary to confirm that proposed actions would have no adverse effect on the historic resources within Laupāhoehoe Forest, and mitigation requirements, if any, resulting from this consultation would be incorporated and implemented as appropriate.

Scenic and open space resources: Actions implemented under the Laupāhoehoe Forest Draft Management Plan will not alter any natural landforms or existing public views and does not involve the construction of a multi-story structure, a structure visible from the nearest coastal roadway, or a structure in waters seaward of the shoreline. It does involve undeveloped land (e.g., Laupāhoehoe Forest), but the Draft Management Plan is specifically directed at the long-term protection of the natural and cultural resources found within Laupāhoehoe Forest.

Coastal ecosystems: Actions implemented under the Laupāhoehoe Forest Draft Management Plan do not involve dredge and fill activities, the discharge or placement of material into a body of water or wetland, earthwork, grading, or grubbing, or the construction of waste treatment facilities.

Laupāhoehoe Forest is not within the Special Management Area or the Shoreline Setback Area or in close proximity to a reef or coral colonies, but it is within the State Conservation District and is within a State Forest Reserve and Natural Area Reserve. There are intermittent and perennial streams located within Laupāhoehoe Forest, and the forest provides habitat for endangered plants, forest birds, raptors, waterbirds, and bats. The Draft Management Plan is specifically directed at the long-term protection of the natural and cultural resources found within Laupāhoehoe Forest, and fencing of the planned conservation units is for the long-term protection of the streams and habitat for endangered species.

Economic uses: Actions implemented under the Laupāhoehoe Forest Draft Management Plan do not involve a harbor or port, is not a visitor industry facility or visitor industry related activity, and does not relate to commercial fishing or seafood production, energy production or transmission, or seabed mining. The Laupāhoehoe Forest does not include agricultural lands or lands designated for such use.

Coastal hazards: Laupāhoehoe Forest is not on or abutting a sandy beach, is not located within a potential tsunami inundation area, is not within a flood hazard area according to FEMA Flood Insurance Rate Maps, and is not within a subsidence hazard area.

Managing development: Implementation of the Laupāhoehoe Forest Draft Management Plan is anticipated to require final approval of the NARS Commission (for actions within the NAR) and the BLNR, informal section 7 consultation with USFWS, and section 106 consultation with SHPD. These permits or consultations may be applied for or conducted after the environmental review process is complete. The proposed actions identified in the Laupāhoehoe Forest Draft Management Plan conform with State and County land use designations for the site, because the actions are specifically directed towards the long-term protection and enhancement of the natural and cultural resources of this area. The public has been notified: the Draft Management Plan was drafted in consultation with the Laupāhoehoe Advisory Council, twelve public meetings were held discussing draft plan content, and the Draft Management Plan has been posted on the Internet since April 2015.

Public participation: As noted above, information about the Laupāhoehoe Forest has been disseminated to the public and the public has been provided an opportunity to comment on the plan, both during development and currently through the environmental review process. A public informational meeting was held on the Draft Management Plan in June 2015.

Beach protection: Actions identified in the Laupāhoehoe Forest Draft Management Plan will not occur on or adjacent to a beach or within the shoreline setback area and are not anticipated to affect natural shoreline processes or public access to and along the shoreline.

Marine resources: Actions implemented under the Laupāhoehoe Forest Draft Management Plan are not anticipated to involve or affect the use or development of marine or coastal resources and does not involve research of ocean processes or resources.

## Section 6. Anticipated Determination under HRS Chapter 343 and Supporting Findings and Recommendations

Based on the discussion above, DLNR anticipates a **Finding of No Significant Impact (FONSI)** declaration. A final determination will be made by DLNR after consideration of the comments on the Draft EA, and a separate Decision Notice and FONSI will be prepared by the USFS as a separate document in accordance with NEPA.

In determining whether the proposed action will have a significant impact on the environment, DLNR considered the phases of the proposed action, the expected consequences, and the cumulative as well as the short and long-term effects of the action. In addition, DLNR specifically evaluated the implementation of the Draft Management Plan under the following 13 significance criteria, as provided in HAR §11-200-12:

1. *Involves an irrevocable commitment to loss or destruction of any natural or cultural resource.*

Implementation of the Draft Management Plan does not involve an irrevocable commitment to loss or destruction of any natural or cultural resources. Instead, the vision for Laupāhoehoe Forest is as an important research, education and demonstration forest where globally relevant activities are conducted to benefit the people and ecosystems of Hawai‘i, all Pacific islands, and the tropical world. Maintaining the integrity of the existing forest and the health and abundance of the native species that inhabit it is critical to the vision. Implementation of the Plan would benefit biological and watershed resources. Impacts to pig hunting, which is considered by some to be a contemporary cultural practice, would occur, but would be less than significant because of the proposed location and limited size (approximately 22% of the total area) of the planned fenced conservation units.

2. *Curtails the range of beneficial uses of the environment.*

Implementation of the Draft Management Plan does not curtail the range of beneficial uses of the environment. The Draft Management Plan outlines proposed management actions to protect natural and cultural resources within Laupāhoehoe Forest while enhancing compatible human use. Opportunities for public enjoyment and outdoor recreation activities, such as hunting, educational visits, and hiking, will continue and potentially be enhanced through the proposed trail improvements.

3. *Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.*

The proposed action is consistent with the environmental policies and guidelines established in HRS Chapter 344 and contributes to the conservation of threatened and endangered species, pursuant to HRS



Chapter 195D. HRS §344-3 provides in part:

It shall be the policy of the State, through its programs, authorities, and resources to:

(1) Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawai'i. ...

HRS §344-4 provides in part:

In pursuance of the state policy to conserve the natural resources and enhance the quality of life, all agencies, in the development of programs, shall, insofar as practicable, consider the following guidelines: ...

(2) Land, water, mineral, visual, air, and other natural resources

(D) Encourage management practices which conserve and protect watersheds and water sources, forest, and open space areas; ...

Implementation of the Draft Management Plan does not conflict with the state's long-term environmental policies or goals and guidelines as expressed in HRS Chapter 344; instead, it is entirely consistent with HRS Chapter 344.

The draft Hāmākua Community Development Plan identifies the importance of protecting the mauka forests from threats such as feral animals, invasive flora and fauna, and limited public access, and implementation of the Draft Management Plan is entirely consistent with the vision and objectives of the Community Development Plan.

4. *Substantially affects the economic welfare, social welfare, or cultural practices of the community or State.*

Implementation of the Draft Management Plan does not negatively affect the economic welfare, social welfare or cultural practices of the community or State. While the economic and social welfare of the community and state will be positively impacted by the implementation of the Draft Management Plan through long-term improvement in the health of native forests and watersheds, support of jobs and purchases associated with conservation management, and the encouragement of research related to tropical forestry, the impact is anticipated to be minor in the context of the island and State economy. Effects to pig hunting are not anticipated to be significant, and other subsistence resources associated with native forests in or near Laupāhoehoe Forest would be enhanced through conservation units

selected to protect intact native forest. Healthy native forests offer recreational, cultural and watershed values that contribute to social welfare.

*5. Substantially affects public health.*

Implementation of the Draft Management Plan would not substantially affect public health in any adverse way.

*6. Involves substantial secondary impacts, such as population changes or effects on public facilities.*

Implementation of the Draft Management Plan is not anticipated to involve substantial secondary impacts (such as population changes or effects on public facilities).

*7. Involves a substantial degradation of environmental quality.*

Implementation of the Draft Management Plan does not involve a substantial degradation of environmental quality; instead, the Draft Management Plan outlines proposed management actions to protect natural and cultural resources within Laupāhoehoe Forest while enhancing compatible human use. Laupāhoehoe Forest will remain forested watershed, and under full implementation of the Draft Management Plan, approximately 22% of the area, primarily composed of intact native forest, will be protected from further degradation attributable to feral ungulates. In addition, reforestation of previously grazed areas should improve wildlife and plant habitat in the upper elevations. The proposed action is expected to contribute to long-term protection of environmental quality associated with healthy native forests and watersheds.

*8. Is individually limited but cumulatively has considerable effect upon environment or involves a commitment for larger actions.*

Implementation of the Draft Management Plan outlines a vision, objections, and specific management actions for the next 15 years. As proposed, it does not have considerable cumulative adverse effects nor does it involve a commitment for larger actions. In general, cumulative impacts are beneficial.

*9. Substantially affects a rare, threatened or endangered species, or its habitat.*

Implementation of the Draft Management Plan will protect rare, threatened and endangered plant and animal species and their habitat. Best management practices associated with construction of conservation fencing, trail improvement, permitted research, educational activities, and development of primitive camping, management shelters, and helicopter landing zones will minimize negative short-term impacts to listed species and habitat (e.g., botanical and wildlife surveys along fence or trail corridors to identify rare plants, host plants for rare invertebrates, or roosting or nesting sites for native birds or the 'ōpe'ape'a for protection). Rare species protocols (e.g., flagging plants, identifying buffer

zones, etc.) would be implemented to avoid negative impacts to any rare plant species. Under full implementation of the Draft Management Plan, approximately 22% of the area, primarily composed of intact native forest, will be protected from degradation attributable to feral ungulates. This protected area of native habitat would be anticipated to benefit listed forest birds (by protecting recovery habitat and minimizing the quantity of mosquito breeding areas) and rare plants (by protecting high-quality areas of intact native forest that either serves as current habitat or is appropriate for rare species outplanting).

*10. Detrimentially affects air or water quality or ambient noise levels.*

Implementation of the Draft Management Plan is not anticipated to detrimentally affect air or water quality or ambient noise levels. Long-term benefits to water quality and quantity are expected as a result of protecting forest health.

*11. Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.*

Implementation of the Draft Management Plan does not affect nor is likely to suffer damage by being located in an environmentally sensitive area such as a floodplain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters. The Laupāhoehoe Forest is not located in or near any of the above-mentioned environmentally sensitive areas.

*12. Substantially affects scenic vistas and view planes identified in county or State plans or studies.*

Implementation of the Draft Management Plan does not affect scenic vistas or viewplanes identified in county or State plans or studies and is anticipated to maintain or improve visual quality through maintenance of native forest.

*13. Requires substantial energy consumption.*

The proposed action does not require substantial energy consumption. Petroleum fuels would be used by equipment utilized for fence construction but this energy consumption is not anticipated to be substantial, especially in comparison to island-wide energy consumption.

## **Section 7. References**

- Ainsworth, A. and J.B. Kauffman. 2010. Interactions with Fire and Nonnative Species Across an Elevation/Plant Community Gradient in Hawaii Volcanoes National Park. *Biotropica* 42(6):647-655.
- Akashi, Y. and D. Mueller-Dombois. 1995. A Landscape Perspective of the Hawaii Rain Forest Dieback. *Journal of Vegetation Science* 6:449-464.

- Anderson, R.C., et al. 2001. Dieback of *Acacia koa* in Hawaii: ecological and pathological characteristics of affected stands. *Forest Ecology and Management* 5576:1-14.
- Aplet, G.H., S.J. Anderson, and C.P. Stone. 1991. Association between feral pig disturbance and the composition of some alien plant assemblages in Hawai'i Volcanoes National Park. *Vegetation* 95:55-62.
- Baker, J.K. 1979. The feral pig in Hawai'i Volcanoes National Park. *Proceedings: First Conference on Scientific Research in the National Parks*, pp. 365-367.
- Bonaccorso, F., Gorresen, P.M., Todd, C. and C. Cornett. 2008. Seasonal Movements and the Occurrence of Hoary Bats in Hawai'i. Oral. Hawai'i Conservation Conference. Honolulu, HI.
- Bruland, G.L., Browning, C.A. and Evensen, C.I. 2010. Effects of feral pigs (*Sus scrofa*) on watershed health in Hawai'i: A literature review and preliminary results on runoff and erosion. In J. Roumassett, K. Burnett, and A. Balisacan (Eds.), *Sustainability science for watershed landscapes* (pp. 251-277). Singapore: Institute of Southeast Asian Studies.
- Cabin, R.J. et al. 2000. Effects of long-term ungulate exclusion and recent alien species control on the preservation and restoration of a Hawaiian tropical dry forest. *Conservation Biology* 14(2):439-453.
- Carpenter, A., McEldowney, H., and Yent, M. 2006. Historic Properties Identification and Field Report Upper Laupāhoehoe and Humu'ula sections Hilo Forest Reserve Reforestation Project. Report prepared for Division of Forestry and Wildlife, Department of Land and Natural Resources.
- Carver, E. and J. Caudill. 2007. Banking on nature 2006: The economic benefits to local communities of National Wildlife Refuge visitation. Division of Economics, U.S. Fish and Wildlife Service.
- Chynoweth, M.W. et al. 2013. Biology and Impacts of Pacific Island Invasive Species. 9. *Capra hircus*, the Feral Goat (Mammalia: Bovidae). *Pacific Science* 67(2):141-156.
- Cole, R.J. et al. 2012. Vegetation Recovery 16 Years after Feral Pig Removal from a Wet Hawaiian Forest. *Biotropica* 44(4): 463-471.
- Cooray, R.G. and D. Mueller-Dombois. 1981. *Island Ecosystems: Biological Organization in Selected Hawaiian Communities*. Hutchinson Ross Publishing Co., Stroudsburg, PA. pp. 309-317.
- County of Hawai'i. 2015. Hāmākua Community Development Plan (preliminary report). Available at: <http://www.hawaiicountycdp.info/hamakua-cdp>
- County of Hawai'i. 2005. General Plan. Available at <http://www.cohplanningdept.com/community-planning/general-plan/>
- County of Hawai'i. 2010. Community Profile Draft: Hāmākua Community Development Plan. Available at <http://www.hawaiicountycdp.info/hamakua-cdp/other-information/draft-hamakua-cdp->

[documents/Hamakua%20Profile2012view.pdf](#)

Cuddihy, L.W., J.A. Davis, and S.J. Anderson. 1982. A Botanical Survey of the Proposed Laupāhoehoe Natural Area Reserve, Hawai‘i. Endangered Plant Species Program. Division of Forestry and Wildlife, Department of Land and Natural Resources, Hilo, Hawai‘i.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation: effects of humans, their activities and introductions. University of Hawaii Press, Honolulu, Hawaii.

D'Antonio, C.M., et al. 2000. Variation in the impact of exotic grasses on native plant composition in relation to fire across an elevational gradient in Hawaii. *Austral Ecology* 25(5): 507-522.

Dunkell, D.O., et al. 2011. Runoff, Sediment Transport, and Effects of Feral Pig (*Sus scrofa*) Exclusion in a Forested Hawaiian Watershed. *Pacific Science* 65(2): 175-194.

Giambelluca, T.W., Nullet, M.A., and Schroeder, T.A. 1986. Hawai‘i Rainfall Atlas, Report R76, Hawai‘i Division of Water and Land Development, Department of Land and Natural Resources, Honolulu. vi + 267 p.

Giffin, Jon. 1978. Ecology of the feral pig on the island of Hawai‘i. *Elepaio* 37(12): 140-142.

Gorreson, Marcos, R. Camp, J. Klavitter, and T. Pratt. 2008. Abundance, Distribution and Population Trend of the Hawaiian Hawk: 1998-2007. Hawaii Cooperative Studies Unit, University of Hawaii at Hilo. Technical Report HCSU-009. <http://hilo.hawaii.edu/hcsu/documents/HCSU-009GorresonetaliotrendsFinal.pdf>

Governor Linda Lingle. 2006. Report of Findings for the Establishment of the Hawai‘i Experimental Tropical Forest: Suggested Sites and Infrastructure Needs. [http://dlnr.hawaii.gov/dofaw/files/2014/02/Establishment\\_of\\_The\\_Hawaii\\_Experimental\\_Tropical\\_Forest.pdf](http://dlnr.hawaii.gov/dofaw/files/2014/02/Establishment_of_The_Hawaii_Experimental_Tropical_Forest.pdf)

Hawai‘i Department of Business, Economic Development, and Tourism. 2015. 2014 State of Hawai‘i Data Book. <http://dbedt.hawaii.gov/economic/databook/db2014/>

Hawai‘i Department of Hawaiian Home Lands. 2011. ‘Āina Mauna Legacy Program. Information available at [http://dhhl.hawaii.gov/wp-content/uploads/2011/05/Aina\\_Mauna\\_Legacy\\_Program\\_FINAL.pdf](http://dhhl.hawaii.gov/wp-content/uploads/2011/05/Aina_Mauna_Legacy_Program_FINAL.pdf)

Hawai‘i Department of Health (DOH). 2014. 2014 State of Hawai‘i Water Quality Monitoring and Assessment Report: Integrated Report to the U.S. Environmental Protection Agency and the U.S. Congress Pursuant to §303(d) and §305(b), Clean Water Act (P.L. 97-117). Honolulu, Hawai‘i.

Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife. 1983. (1)

Abundance and Distribution of Koloa on Island of Hawaii. (2) Movements, Survival, Reproductive Success and Habitat of Koloa on the Island of Hawaii. Project # W-18-R-8. Job # R-III-H. July 1, 1981 to July 31, 1983.

Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife. 1989. Laupāhoehoe Draft Management Plan. Available at <http://dlnr.hawaii.gov/ecosystems/files/2013/07/Laupahoehoe-Management-Plan.pdf>

Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife. 1996. Best Management Practices for Maintaining Water Quality in Hawai'i. Honolulu, Hawai'i.

Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife. 2006. Hilo Forest Reserve Reforestation Project Final Environmental Assessment. Available at [http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Hawaii/2000s/2006-10-08-HA-FEA-HILO-Forest-RESERVE-REFORESTATION.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/2000s/2006-10-08-HA-FEA-HILO-Forest-RESERVE-REFORESTATION.pdf)

Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife. 2010. Hawai'i Statewide Assessment of Forest Conditions and Resource Strategy (SWARS). Available at [http://dlnr.hawaii.gov/forestry/files/2013/09/Hawaii\\_Statewide\\_Forest\\_Assessment\\_and\\_Strategies\\_2010.pdf](http://dlnr.hawaii.gov/forestry/files/2013/09/Hawaii_Statewide_Forest_Assessment_and_Strategies_2010.pdf)

Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife. 2015. Kukaiau Koa Forest Conservation Easement. <http://dlnr.hawaii.gov/forestry/lap/forest-legacy/projects/>

Hawai'i Department of Land and Natural Resources. 2011. The Rain Follows the Forest – Hahai no ka ua I ka ululā'au. A Plan to Replenish Hawai'i's Source of Water. <http://hawaii.gov/dlnr/chair/pio/nr/2011/The-Rain-Follows-the-Forest.pdf>

Hawai'i Department of Land and Natural Resources. 2015. Hawai'i's State Wildlife Action Plan. Prepared by H.T. Harvey and Associates, Honolulu, Hawai'i.

Hawai'i Department of Land and Natural Resources and US Forest Service. 2015. Laupāhoehoe Forest Draft Management Plan.

Hawai'i Office of Planning, Coastal Zone Management Program. 2010. Hawai'i Watershed Guidance. Prepared by Tetra Tech EM, Inc., Honolulu, Hawai'i. [http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/hi\\_watershed\\_guidance\\_final.pdf](http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/hi_watershed_guidance_final.pdf)

Hawai'i Revised Statutes. Current statutes accessible through [www.capitol.hawaii.gov/hrscurrent/](http://www.capitol.hawaii.gov/hrscurrent/)

Hawai'i Tropical Forest Recovery Task Force. 1994. Hawai'i Tropical Forest Recovery Action Plan. Available at <http://www.fs.fed.us/psw/ef/hawaii/documents/HITropicalForestRecoveryPlan.pdf>

Iwashita, D.K., et al. 2013. Coarse woody debris carbon storage across a mean annual temperature gradient in tropical montane wet forest. *Forest Ecology and Management* 291:336-343.

Mack, M.C. and C.M. D'Antonio. 1998. Impacts of biological invasions on disturbance regimes. *Tree* 13(5):195-198.

Maly, K. and O. Maly. 2006. Hilo Palikū – Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe Forest Section, Ahupua‘a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai‘i. Kumu Pono Associates, LLC.

Menard, T. 2001. Activity patterns of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) in relation to reproductive time periods. MSc Thesis. University of Hawai‘i at Manoa.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaii’s Comprehensive Wildlife Conservation Strategy. Department of Land and Natural Resources. Honolulu, Hawai‘i.

Mueller-Dombois, D. 1980. The ‘ōhi‘a dieback phenomenon in the Hawaiian rain forest. The recovery process in damaged ecosystems. J. Cairns, Jr. Ann Arbor, Ann Arbor Science Publishers Inc.

Nogueira-Filho, S.L., et al. 2009. Ecological impacts of feral pigs in the Hawaiian Islands. *Biodiversity and Conservation* 18(14):3677-3683.

Palmer, D. 2003. Hawaii's ferns and fern allies. University of Hawaii Press: Honolulu.

Parham, James, G. Higashi, E. Lapp, D. Kuamoo, R. Nishimoto, S. Hau, J.M. Fitzsimmons, D. Polhemus, W. Devick. 2008. Atlas of Hawaiian Watersheds and Their Aquatic Resources. <http://www.hawaiiwatershedatlas.com>

Parker Ranch. 2015. Parker Ranch – Habitat and Special Places. <http://parkerranch.com/stewardship-education/habitat-and-special-places/>

Pukui, Mary Kawena and Samuel H. Elbert. 1986. Hawaiian Dictionary. University of Hawaii Press: Honolulu.

Pukui, Mary Kawena, S. Elbert, and E. Mookini. 1974. Place Names of Hawaii. University of Hawaii Press: Honolulu.

Sasaki, D.M., L. Pang, H.P. Minette, C.K. Wakida, W.J. Fujimoto, S.J. Manea, R. Kunioka, C.R. Middleton. 1993. Active surveillance and risk factors for Leptospirosis in Hawai‘i. *The American Journal of Tropical Medicine and Hygenics*. January 1993, 48(1):35-43.

Scott, M.J., S. Mountainspring, F.L. Ramsey, and C.B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation. *Studies in Avian Biology* No. 9, Cooper

Ornithological Society. Allen Press, Lawrence, Kansas.

Scowcroft, P.G. and J.G. Giffin. 1983. Feral herbivores suppress mamane and other browse species on Mauna Kea, Hawaii. *Journal of Range Management*: 638-645.

Sherrod, David R., Sinton, John M., Watkins, Sarah E., and Brunt, Kelly M. 2007. Geologic map of the State of Hawai'i: US Geological Survey Open-File Report 2007-1089. Available at <http://pubs.usgs.gov/of/2007/1089/>.

Smith, C.W. and T.J. Tunison. 1992. Fire and alien plants in Hawaii: research and management implications for native ecosystems. Alien plant invasions in native ecosystems of Hawaii: management and research. Stone, C.P., C.W. Smith, and J.T. Tunison (eds.). Honolulu, Cooperative National Park Resources Studies Unit: 394-408.

Southwick Associates. 2011. The Economics Associated with Outdoor Recreation, Natural Resources Conservation, and Historic Preservation in the United States prepared for the National Fish and Wildlife Foundation. [http://www.trcp.org/assets/pdf/The\\_Economic\\_Value\\_of\\_Outdoor\\_Recreation.pdf](http://www.trcp.org/assets/pdf/The_Economic_Value_of_Outdoor_Recreation.pdf)

Stewart, M. Carolyn. 2010. Mauna Kea Watershed Management Plan. Prepared for the Mauna Kea Watershed Alliance.

Stone, C.P. 1985. Feral ungulates in Hawai'i: Toward controlling the adverse effects of introduced vertebrates. In Stone, C.P. and J.M. Scott (eds.). *Hawaii's Terrestrial Ecosystems: Preservation and Management*.

Thaxton, J.M., et al. 2010. Native Species Regeneration Following Ungulate Exclusion and Nonnative Grass Removal in a Remnant Hawaiian Dry Forest. *Pacific Science* 64(4):533-544.

US Census Bureau. 2015. Community Facts for Laupāhoehoe CDP, using American FactFinder. [http://factfinder.census.gov/faces/nav/jsf/pages/community\\_facts.xhtml](http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml) (November 16, 2015).

U.S. Department of Agriculture Forest Service (USFS). 2007. Establishment Record for the Hawai'i Experimental Tropical Forest within Hawai'i County, Hawai'i. Available at <http://www.fs.fed.us/psw/ef/hawaii/documents/HETFEstablishmentRecord.pdf>.

USFS. 2011. Final Environmental Assessment HETF Laupāhoehoe Construction Project. Available at <http://www.hetf.us/page/resources/>.

U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2014. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

United States Department of the Interior, U.S. Fish and Wildlife Service (USFWS). 1984. The



Hawaiian Hawk Recovery Plan. Region 1, Portland, OR.

USFWS. 1996. Big Island Plant Cluster Recovery Plan. USFWS, Portland, OR. 202+ pp. Available at [http://ecos.fws.gov/docs/recovery\\_plan/1996/960926a.pdf](http://ecos.fws.gov/docs/recovery_plan/1996/960926a.pdf)

USFWS. 1998a. Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster. U.S. Fish and Wildlife Service, Portland, OR. Accessed at: [http://ecos.fws.gov/docs/recovery\\_plan/980511a.pdf](http://ecos.fws.gov/docs/recovery_plan/980511a.pdf)

USFWS. 1998b. Recovery Plan for the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). U.S. Fish and Wildlife Service, Portland, OR. Accessed at: [http://ecos.fws.gov/docs/recovery\\_plan/980511b.pdf](http://ecos.fws.gov/docs/recovery_plan/980511b.pdf)

USFWS. 2003. 50 CFR Part 17, RIN 1018-AH02, Endangered and Threatened Wildlife and Plants; Final Designation and Nondesignation of Critical Habitat for 46 Plant Species From the Island of Hawai'i, HI. Federal Register Vol. 68, No. 127, 2003. Rules and Regulations.

USFWS. 2006. Revised Recovery Plan for Hawaiian Forest Birds. Region 1, Portland, OR. 622 pp.

USFWS. 2008. 50 CFR Part 17, RIN 1018-AU96, Endangered and Threatened Wildlife and Plants: Withdrawal of Proposed Reclassification of the Hawaiian Hawk or Io (*Buteo solitarius*) From Endangered to Threatened; Proposed Rule to Remove the Hawaiian Hawk From the Federal List of Endangered and Threatened Wildlife. Federal Register Vol. 73, No. 152, 2008.

USFWS. 2012. Land Protection Plan and Environmental Assessment for the Proposed Additions to Hakalau Forest National Wildlife Refuge. Available at [http://www.fws.gov/uploadedFiles/Region\\_1/NWRS/Zone\\_1/Big\\_Island\\_Complex/Hakalau\\_Forest/PDFs/Hakalau%20Forest%20NWR%20Final%20LPP-EA.pdf](http://www.fws.gov/uploadedFiles/Region_1/NWRS/Zone_1/Big_Island_Complex/Hakalau_Forest/PDFs/Hakalau%20Forest%20NWR%20Final%20LPP-EA.pdf)

USFWS. 2015. USFWS Threatened and Endangered Species System (TESS). Washington: GPO. Accessed at: [http://ecos.fws.gov/tess\\_public/StartTESS.do](http://ecos.fws.gov/tess_public/StartTESS.do).

United States Department of the Interior, U.S. Geological Survey (USGS). 2005. Biocomplexity of introduced avian diseases in Hawaii: Threats to biodiversity of native forest ecosystems. Prepared by B.L. Woodworth, C.T. Atkinson, M.D. Samuel, D.A. LaPointe, P.C. Banko, and J.A. Ahumada. USGS Fact Sheet 2005:3139. Available at <http://biology.usgs.gov/pierc/Biocomplexity/Biocomplexity.pdf>.

USGS. 2006. Feral pigs, introduced mosquitoes, and the decline of Hawaii's native birds. Prepared by D.A. LaPointe. USGS Fact Sheet 2006-3013. Available at [http://biology.usgs.gov/pierc/Fact\\_Sheets/Pigs\\_and\\_mosquitoes.pdf](http://biology.usgs.gov/pierc/Fact_Sheets/Pigs_and_mosquitoes.pdf).

Warner, Richard E. 1956-1969. Ecological investigation on the Hawaiian pig (1959); Ecology of the Wild Pig (1963), and Feral Game Mammal Survey (1969). State of Hawaii, Division of Fish and Game, Project # W-r-R-10, Project # W-5-R13; Project # W-5-R14; and Project # W-5-R-20.

## **Appendix A. List of Agencies and Persons Consulted**

The following agencies, organizations, and individuals were sent requests for comments on the Laupāhoehoe Forest Draft Management Plan in October 2015.

### Federal

US Army Pohakuloa Training Area  
USDA Natural Resources Conservation Service (NRCS)  
NRCS Hilo Service Center  
US Department of Transportation, Federal Highways Administration  
USFWS – Hakalau NWR  
USFWS – Pacific Islands NWR Complex  
USFWS – Pacific Islands Office  
USGS-Biological Resources Division  
US National Park Service – Hawaii Volcanoes National Park  
US Representative Mark Takai  
US Representative Tulsi Gabbard  
US Senator Mazie Hirono  
US Senator Brian Schatz

### State of Hawaii

Office of Governor David Ige  
Office of Lieutenant Governor Shan Tsutsui  
Department of Agriculture  
Department of Business, Economic Development and Tourism – Land Use Commission  
Department of Business, Economic Development and Tourism – Office of Planning  
Department of Education, Hilo District  
Department of Hawaiian Home Lands  
Department of Hawaiian Home Lands – Hawaii District Supervisor  
Department of Health  
Department of Health – Environmental Planning Office  
Department of Health – Clean Water Branch  
DLNR – Division of Aquatic Resources  
DLNR – Division of Conservation and Resource Enforcement  
DLNR – Land Division  
DLNR – Office of Conservation and Coastal Lands  
DLNR – Division of State Parks  
DLNR – Historic Preservation Division  
Department of Transportation  
Hawai‘i Island Burial Council

Natural Area Reserves System Commission  
Office of Environmental Quality Control  
Office of Hawaiian Affairs  
Hawai‘i State Senator Gilbert Kahele, District 1  
Hawai‘i State Senator Russell Ruderman, District 2  
Hawai‘i State Senator Josh Green, District 3  
Hawai‘i State Senator Lorraine Inouye, District 4  
Hawai‘i State Representative Mark Nakashima, District 1  
Hawai‘i State Representative Cliff Tsujii, District 2  
Hawai‘i State Representative Richard Onishi, District 3  
Hawai‘i State Representative Joy San Buenaventura, District 4  
Hawai‘i State Representative Richard Creagan, District 5  
Hawai‘i State Representative Nicole Lowen, District 6  
Hawai‘i State Representative Cindy Evans, District 7  
Laupāhoehoe Community Public Charter School  
UH-Hilo  
Office of Maunakea Management

#### County of Hawaii

Department of Parks and Recreation  
Department of Research and Development  
Planning Department  
Police Department  
Office of Mayor Billy Kenoi  
Office of Council Member Valerie Poindexter, Hawai‘i County Council District 1  
Office of Council Member Aaron Chung, Hawai‘i County Council District 2

#### Other Organizations

Big Island Invasive Species Committee  
Bishop Museum  
Conservation Council of Hawai‘i  
CGAPS (Coordinating Group on Alien Pest Species)  
Edith Kanaka‘ole Foundation  
Hamakua Mushrooms  
Hawai‘i Audubon Society  
Hawai‘i Conservation Alliance  
Hawai‘i County Native Hawaiian Chamber of Commerce  
Hawai‘i Hunting Advisory Council  
Hawai‘i Hunting Association  
Hawai‘i Island Economic Development Board  
Hawaiian Civic Club of Hilo  
Hawaiian Electric Light Company (HELCO)

Kahea  
Kamehameha Schools  
Kukui‘ohiwai  
Lana‘i Culture and Heritage Center  
Laupāhoehoe Train Museum  
Mauka and Makai Access Committee  
Maulua Investments  
Na Pua No‘eau  
Parker Ranch  
Pig Hunters of Hawai‘i  
Plant Extinction Prevention Program  
Sierra Club, Moku Loa Group  
Mauna Kea Watershed Alliance  
The Nature Conservancy of Hawai‘i  
UH-Hilo Ka Haka ‘Ula O Ke‘elikolani  
Volcano Rare Plant Facility

Individuals

Greg Asner  
Paul Banko  
Noah Beatty  
Laura Brezinsky  
Robert Bolick  
James and Joyce Braun  
Joel Bridgman  
Lawrence E Butler and Frank Perry  
Tom Carpenter  
Debbie Chang  
Alfred and Laverne Chow  
David Clausnitzer  
James Allen Costa  
Michael Crosson  
Rob Culbertson  
Darrin Ray DeVries  
Jeffrey Dias  
Paul Souza Dias  
Brigette Doneaux  
Kimball Dougherty  
Estanislao R Eugenio  
Toribio and Violet Francisco TR  
J.B. Friday  
Robert L. Giuliani Trust

Trevor Gloor  
Trevnia Wang and David Hasenstab  
Mitchell and Jennifer Haynie  
David Henry  
Evelyn Hokama  
Rick and Kristine Holasek  
Derwin Ignacio  
Michael and Claudia Ignacio  
Kelly and Chandra Jose  
Peter Jose  
Richard Jose  
Samuel Kaaua  
Eliott Ke  
Everett Ke  
Christine Kornet  
Julie Leialoha  
Libraqua Trust  
David Lovell  
Dorothy and Mark Maggi/Snyder  
Mona Malani  
John and Marla McCall  
Peter Mills  
Susan Miyasaka  
Alfred Nobriga Trust  
David Nouskajian  
Theo and Diana Ostermann  
Reginald Page and Paige Breen  
William and Louise Pape  
Robert Patey  
Lane Pestana  
Alan Pestana  
Tracy Pulido  
George, Helene, & Joyce Robertson  
Sandy Saemann  
Jill Scofield  
Enias Spencer  
Glenn Spencer  
Charles Spencer  
Everett Spencer  
Janet Stromberg  
Robert Summers  
Nicole Tergeoglan  
S. Vanderwilt

Draft Environmental Assessment: Laupāhoehoe Forest Draft Management Plan  
Joint HEPA/NEPA document  
March 2016

Peter Vitousek  
Deborah Ward  
Richard Warren  
Margaret Wille  
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Holly Young  
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Laupāhoehoe Advisory Council

Judi Steinman  
Darus Ignacio  
Pi'i La'eha  
David Montgomerie  
Alapaki Nahale-a  
Robert Nishimoto  
Jonathan Price  
Scott Sanderson  
Bill Stormont  
Christopher Yuen

## **Appendix B. Public comments received during scoping period**

Written comments were received from the following and are reproduced on the following pages:

Hawai‘i Department of Health, Clean Water Branch  
Hawai‘i Department of Health, Environmental Planning Office  
Hawai‘i Department of Land and Natural Resources, Division of Aquatic Resources  
Hawai‘i Department of Transportation  
Hawai‘i Office of Planning  
US Fish and Wildlife Service  
Hawai‘i County Police Department  
Hawai‘i County Cultural Resources Commission



STATE OF HAWAII  
DEPARTMENT OF HEALTH  
P. O. BOX 3378  
HONOLULU, HI 96801-3378

In reply, please refer to:  
EMD/CWB

11020PJF.15

November 18, 2015

Ms. Tanya Rubenstein  
Natural Area Reserves Project Coordinator  
Department of Land and Natural Resources  
1151 Punchbowl Street, Room 325  
Honolulu, Hawaii 96813

Dear Ms. Rubenstein:

**SUBJECT: Pre-Consultation on Environmental Assessment (EA) for the  
Laupahoehoe Forest Management Plan (Hawaii)  
Island of Hawaii, Hawaii**

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated October 12, 2015, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: <http://health.hawaii.gov/epo/files/2013/05/Clean-Water-Branch-Std-Comments.pdf>.

1. Any project and its potential impacts to State waters must meet the following criteria:
  - a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.
  - b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.
  - c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).
2. You may be required to obtain National Pollutant Discharge Elimination System (NPDES) permit coverage for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55).



For NPDES general permit coverage, a Notice of Intent (NOI) form must be submitted at least 30 calendar days before the commencement of the discharge. An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the applicable form ("CWB Individual NPDES Form" or "CWB NOI Form") through the e-Permitting Portal and the hard copy certification statement with the respective filing fee (\$1,000 for an individual NPDES permit or \$500 for a Notice of General Permit Coverage). Please open the e-Permitting Portal website located at: <https://eha-cloud.doh.hawaii.gov/epermit/>. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the appropriate form. Follow the instructions to complete and submit the form.

3. If your project involves work in, over, or under waters of the United States, it is highly recommended that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 835-4303) regarding their permitting requirements.

Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and HAR, Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of \$25,000 per day per violation.
5. It is the State's position that all projects must reduce, reuse, and recycle to protect, restore, and sustain water quality and beneficial uses of State waters. Project planning should:
  - a. Treat storm water as a resource to be protected by integrating it into project planning and permitting. Storm water has long been recognized as a source of irrigation that will not deplete potable water resources. What is often overlooked is that storm water recharges ground water supplies and feeds streams and estuaries; to ensure that these water cycles are not disrupted, storm water cannot be relegated as a waste product of impervious surfaces. Any project planning must recognize storm water as an asset that sustains and protects

natural ecosystems and traditional beneficial uses of State waters, like community beautification, beach going, swimming, and fishing. The approaches necessary to do so, including low impact development methods or ecological bio-engineering of drainage ways must be identified in the planning stages to allow designers opportunity to include those approaches up front, prior to seeking zoning, construction, or building permits.

- b. Clearly articulate the State's position on water quality and the beneficial uses of State waters. The plan should include statements regarding the implementation of methods to conserve natural resources (e.g., minimizing potable water for irrigation, gray water re-use options, energy conservation through smart design) and improve water quality.
- c. Consider storm water Best Management Practice (BMP) approaches that minimize the use of potable water for irrigation through storm water storage and reuse, percolate storm water to recharge groundwater to revitalize natural hydrology, and treat storm water which is to be discharged.
- d. Consider the use of green building practices, such as pervious pavement and landscaping with native vegetation, to improve water quality by reducing excessive runoff and the need for excessive fertilization, respectively.
- e. Identify opportunities for retrofitting or bio-engineering existing storm water infrastructure to restore ecological function while maintaining, or even enhancing, hydraulic capacity. Particular consideration should be given to areas prone to flooding, or where the infrastructure is aged and will need to be rehabilitated.

If you have any questions, please visit our website at: <http://health.hawaii.gov/cwb/>, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,



ALEC WONG, P.E., CHIEF  
Clean Water Branch

JF:ay

c: EPO [via e-mail [noella.narimatsu@doh.hawaii.gov](mailto:noella.narimatsu@doh.hawaii.gov) only]

DAVID Y. IGE  
GOVERNOR OF HAWAII



VIRGINIA PRESSLER, M.D.  
DIRECTOR OF HEALTH

STATE OF HAWAII  
DEPARTMENT OF HEALTH  
P. O. BOX 3378  
HONOLULU, HI 96801-3378

In reply, please refer to:  
File:

EPO 15-260

October 20, 2015

Ms. Tanya Rubenstein  
Natural Area Reserves Project Coordinator  
Department of Land and Natural Resources  
1151 Punchbowl Street, Room 325  
Honolulu, Hawaii 96813  
Via email: Tanya.Rubenstein@hawaii.gov

Dear Ms. Rubenstein:

**SUBJECT: Pre-Consultation on Environmental Assessment (PC EA) for the Laupahoehoe Forest Management Plan, Hawaii**

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your PC EA to our office on October 19, 2015. Thank you for allowing us to review and comment on the proposed project. The PC EA was routed to the District Health Office on Hawaii. They will provide specific comments to you if necessary. EPO recommends that you review the standard comments and available strategies to support sustainable and healthy design provided at: <http://health.hawaii.gov/epo/landuse>. Projects are required to adhere to all applicable standard comments.

EPO also encourages you to examine and utilize the Hawaii Environmental Health Portal. The portal provides links to our e-Permitting Portal, Environmental Health Warehouse, Groundwater Contamination Viewer, Hawaii Emergency Response Exchange, Hawaii State and Local Emission Inventory System, Water Pollution Control Viewer, Water Quality Data, Warnings, Advisories and Postings. The Portal is continually updated. Please visit it regularly at: <https://eha-cloud.doh.hawaii.gov>

We request that you utilize all of this information on your proposed project to increase sustainable, innovative, inspirational, transparent and healthy design.

Mahalo nui loa,

A handwritten signature in blue ink, appearing to read "Laura Leialoha Phillips McIntyre".

Laura Leialoha Phillips McIntyre, AICP  
Program Manager, Environmental Planning Office

Attachment 1: OEQC Viewer - <http://eha-web.doh.hawaii.gov/oeqc-viewer/>

Attachment 2: U.S. EPA EJSCREEN 3 page report - <http://www2.epa.gov/ejscreen>

c: DHO Hawaii {via email only}



hawaii.gov Stay Connected

OEQC Viewer

Hybrid

Laupahoehoe 3 sites found

Results Filter

Show sites with no location

- Laupahoehoe Forest Research Educ Center (DEA-AFNSI)  
Environmental Assessment (Agency)
- Hawaii Experimental Laupahoehoe Construction (FEA-FONSI)  
Environmental Assessment (Agency)
- Hawaii Experimental Tropical Forest Laupahoehoe Construction (DEA-AFNSI)  
Environmental Assessment (Agency)

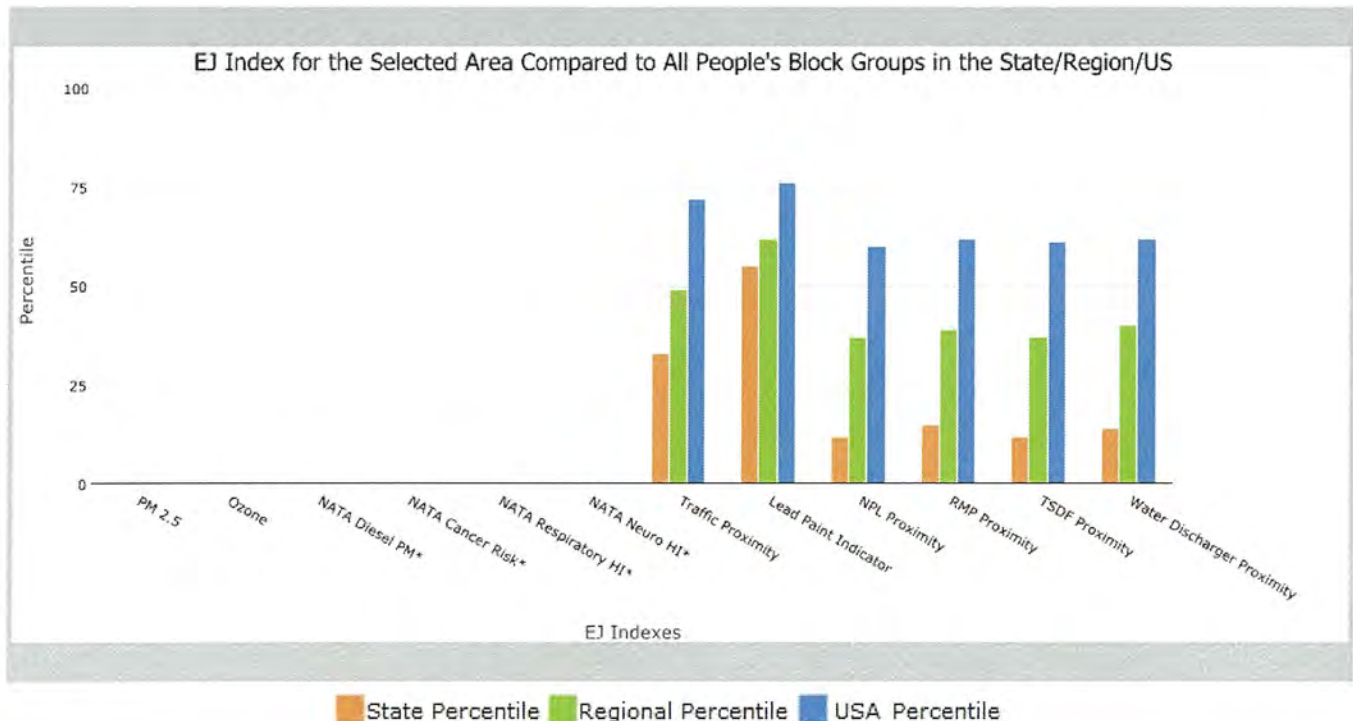
Map data ©2015 Google Imagery ©2015, Data MBARI, DE, Hawaii & map engine

for 4 mile Ring Centered at 19.985459,-155.243979, HAWAII, EPA Region 9

Approximate Population: 1790

Laupahoehoe Micropolitan Area

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
<b>EJ Indexes</b>			
EJ Index for PM2.5	N/A	N/A	N/A
EJ Index for Ozone	N/A	N/A	N/A
EJ Index for NATA Diesel PM*	N/A	N/A	N/A
EJ Index for NATA Air Toxics Cancer Risk*	N/A	N/A	N/A
EJ Index for NATA Respiratory Hazard Index*	N/A	N/A	N/A
EJ Index for NATA Neurological Hazard Index*	N/A	N/A	N/A
EJ Index for Traffic Proximity and Volume	33	49	72
EJ Index for Lead Paint Indicator	55	62	76
EJ Index for Proximity to NPL sites	12	37	60
EJ Index for Proximity to RMP sites	15	39	62
EJ Index for Proximity to TSDFs	12	37	61
EJ Index for Proximity to Major Direct Dischargers	14	40	62



This report shows environmental, demographic, and EJ indicator values. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.



# EJSCREEN Report



for 4 mile Ring Centered at 19.985459,-155.243979, HAWAII, EPA Region 9

Approximate Population: 1790

Laupahoehoe Micropolitan Area





## EJSCREEN Report

for 4 mile Ring Centered at 19.985459,-155.243979, HAWAII, EPA Region 9

Approximate Population: 1790

Laupahoehoe Micropolitan Area



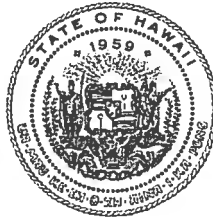
Selected Variables	Raw Data	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
<b>Environmental Indicators</b>							
Particulate Matter (PM 2.5 in $\mu\text{g}/\text{m}^3$ )	N/A	N/A	N/A	9.95	N/A	9.78	N/A
Ozone (ppb)	N/A	N/A	N/A	49.7	N/A	46.1	N/A
NATA Diesel PM ( $\mu\text{g}/\text{m}^3$ ) <sup>*</sup>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NATA Cancer Risk (lifetime risk per million) <sup>*</sup>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NATA Respiratory Hazard Index <sup>*</sup>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NATA Neurological Hazard Index <sup>*</sup>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Traffic Proximity and Volume (daily traffic count/distance to road)	57	280	43	190	41	110	61
Lead Paint Indicator (% Pre-1960 Housing)	0.33	0.17	76	0.25	65	0.3	61
NPL Proximity (site count/km distance)	0.0029	0.092	7	0.11	0	0.096	0
RMP Proximity (facility count/km distance)	0.035	0.18	8	0.41	4	0.31	7
TSDF Proximity (facility count/km distance)	0.003	0.092	7	0.12	0	0.054	3
Water Discharger Proximity (facility count/km distance)	0.03	0.33	7	0.19	6	0.25	4
<b>Demographic Indicators</b>							
Demographic Index	46%	51%	32	46%	52	35%	71
Minority Population	78%	77%	39	57%	69	36%	84
Low Income Population	15%	25%	32	35%	21	34%	21
Linguistically Isolated Population	1%	6%	26	9%	21	5%	47
Population With Less Than High School Education	7%	10%	47	18%	32	14%	35
Population Under 5 years of age	7%	6%	63	7%	56	7%	60
Population over 64 years of age	12%	14%	43	12%	62	13%	52

\* The National-scale Air Toxics Assessment (NATA) environmental indicators and EJ indexes, which include cancer risk, respiratory hazard, neurodevelopment hazard, and diesel particulate matter will be added into EJSCREEN during the first full public update after the soon-to-be-released 2011 dataset is made available. The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: <http://www.epa.gov/ttn/atw/natamain/index.html>.

For additional information, see: [www.epa.gov/environmentaljustice](http://www.epa.gov/environmentaljustice)

EJSCREEN is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJSCREEN outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

DAVID Y. IGE  
GOVERNOR OF HAWAII



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
DIVISION OF AQUATIC RESOURCES  
1151 PUNCHBOWL STREET, ROOM 330  
HONOLULU, HAWAII 96813

SUZANNE D. CASE  
CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA  
FIRST DEPUTY

JEFFREY T. PEARSON  
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES  
BOATING AND OCEAN RECREATION  
BUREAU OF CONVEYANCES  
COMMISSION ON WATER RESOURCE MANAGEMENT  
CONSERVATION AND COASTAL LANDS  
CONSERVATION AND RESOURCES ENFORCEMENT  
ENGINEERING  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
KAHOOLAWE ISLAND RESERVE COMMISSION  
LAND  
STATE PARKS

Date: November 16, 2015  
DAR # 5197

MEMORANDUM

TO: Bruce S. Anderson, DAR Administrator *SLA*  
DATE: *Nov. 17, 2015*  
FROM: Troy Sakihara, Aquatic Biologist *TS BSA*  
SUBJECT: Environmental Assessment for the Laupahoehoe Forest Draft Management Plan

Comment	Date Request	Receipt	Referral	Due Date
	October 12, 2015	October 15, 2015	October 29, 2015	November 30, 2015

Requested by: Tanya Rubenstein, Natural Area Reserves Project Coordinator  
Hawaii Division of Forestry and Wildlife, Department of Land and Natural Resources

Summary of Proposed Project

Title: Laupahoehoe Forest Draft Management Plan, Environmental Assessment (Hawaii)

Project by: DOFAW, DLNR and USDA Forest Service Pacific Southwest Research Station's  
Institute of Pacific Islands Forestry.

Location: State of Hawaii, County of Hawaii

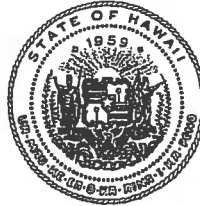
Brief Description: This is a 15-year prospective draft management plan for the Laupahoehoe Forest to preserve and protect its natural resources, native biota and ecological integrity, as well as to enhance public use, education, recreation, outreach and research in this area. It was co-developed by DOFAW, USFS and the Laupahoehoe Advisory Council.

Comments: DAR has no major objections or concerns with the Draft Management Plan as the goals and objectives of this plan align with DAR's mission. The applicant is reminded that Best Management Practices are upheld during all phases of the proposed plan implementation to assure minimizing any and all negative impacts to the aquatic resources and stream habitat. Negative impacts of concern to DAR include, but are not limited to: erosion resulting from alterations to the stream bank; improvements to infrastructure, fencing, and trails; as well as impacts as a result of conducting surveys and/or any other activities that are conducted in close proximity to streams or any other aquatic habitat.



Thank you for providing DAR the opportunity to review and comment on the Draft Management Plan. Should there be any changes to the project plan, DAR requests the opportunity to review and comment on those changes.

DAVID Y. IGE  
GOVERNOR OF HAWAII

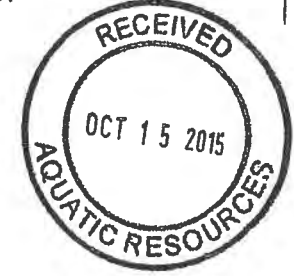


STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES

DIVISION OF FORESTRY AND WILDLIFE  
1151 PUNCHBOWL STREET, ROOM 325  
HONOLULU, HAWAII 96813

SUZANNE D. CASE  
CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
COMMISSION ON WATER RESOURCE MANAGEMENT  
KEKOA KALUHIWA  
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AQUATIC RESOURCES  
BOATING AND OCEAN RECREATION  
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CONSERVATION AND COASTAL LANDS  
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ENGINEERING  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
KAHOOLAWE ISLAND RESERVE COMMISSION  
LAND  
STATE PARKS

DART # 5197



October 12, 2015

TO: INTERESTED AGENCIES, ORGANIZATIONS and INDIVIDUALS

Re: Pre-Consultation on Environmental Assessment (EA) for the Laupāhoehoe Forest Management Plan (Hawai'i)

The Hawai'i Division of Forestry and Wildlife (DOFAW) of the Department of Land and Natural Resources (DLNR) and the USDA Forest Service (USFS) Pacific Southwest (PSW) Research Station's Institute of Pacific Islands Forestry (IPIF) are preparing an EA in compliance with Chapter 343, HRS for a Draft Management Plan for Laupāhoehoe Forest (map attached). The purpose of this letter is to share information about the project, request your assistance in identifying historic sites or cultural practices that might be impacted by the project, and invite you to share any issues that you wish to be addressed in the EA or any other concerns you may have.

JK ✓  
TS

The 12,343 acre (ac) (5,134 hectare (ha)) Laupāhoehoe Forest area consists of two state-managed parcels of land: 4,449 ac of state land designated as Forest Reserve (FR), and 7,894 ac of land designated as a Natural Area Reserve (NAR) (see attached map). Both of these programs are under DLNR-DOFAW and were established to protect native Hawaiian forest for current and future generations. In addition, the Laupāhoehoe Forest is designated as part of the Hawai'i Experimental Tropical Forest (HETF).

In 1992, the Hawai'i Tropical Forest Recovery Act authorized the establishment of the HETF to serve as a center for long-term research and a focal point for developing and transferring knowledge and expertise for the management of tropical forests. USFS-IPIF, based in Hilo, works cooperatively with the DLNR-DOFAW to coordinate research, management, and educational activities and to jointly develop and implement research and education, and management plans for the experimental forest.

The Draft Management Plan will be a guiding document for DLNR-DOFAW and the USFS-IPIF, outlining planned management actions over the next fifteen years and providing background information for why those actions were chosen. The overall goal is to protect, maintain, and enhance Laupāhoehoe Forest's unique natural, cultural, and geological resources while also enhancing compatible human uses. The proposed management actions include fence construction and pig removal to protect biological and water resources, invasive weed control, planting of rare native plants, wildfire prevention and response, public access and the development of interpretive trails for the public, continued research relevant to management and restoration of tropical forest

ecosystems, and encouragement of educational and outreach programs on tropical forests, conservation biology and natural resource management. The Draft Management Plan can be viewed at

[http://dlnr.hawaii.gov/ecosystems/files/2013/07/DRAFT\\_Laupahoehoe\\_mngt\\_plan\\_04162015\\_small.pdf](http://dlnr.hawaii.gov/ecosystems/files/2013/07/DRAFT_Laupahoehoe_mngt_plan_04162015_small.pdf).

The Draft Management Plan was jointly developed by DOFAW, the USFS, and the Laupāhoehoe Advisory Council (LAC) through a collaborative planning process. Formed in December 2010, the LAC is a community-based advisory council that provides guidance and consultation to DOFAW and USFS on issues of management, research, and education in Laupāhoehoe Forest.

The EA will address topics including but not limited to: native plants and animals; invasive species; cultural resources; socioeconomic impacts; and public access. We invite your comments on any of these topics. We would especially appreciate your input on the following issues in the project area:

1. History, land use and cultural sites e.g., historic or archaeological sites, burials;
2. Traditional gathering practices in the project area – both past and present;
3. Cultural associations through traditions, legends, traditional use, or otherwise; and
4. Referrals of kūpuna who might be willing to share their cultural knowledge of the area.

This information will help us determine if there will be any impacts to cultural resources by proposed management actions, ensure that all potential cultural impacts are appropriately considered, and to prevent to the greatest extent possible any negative impact.

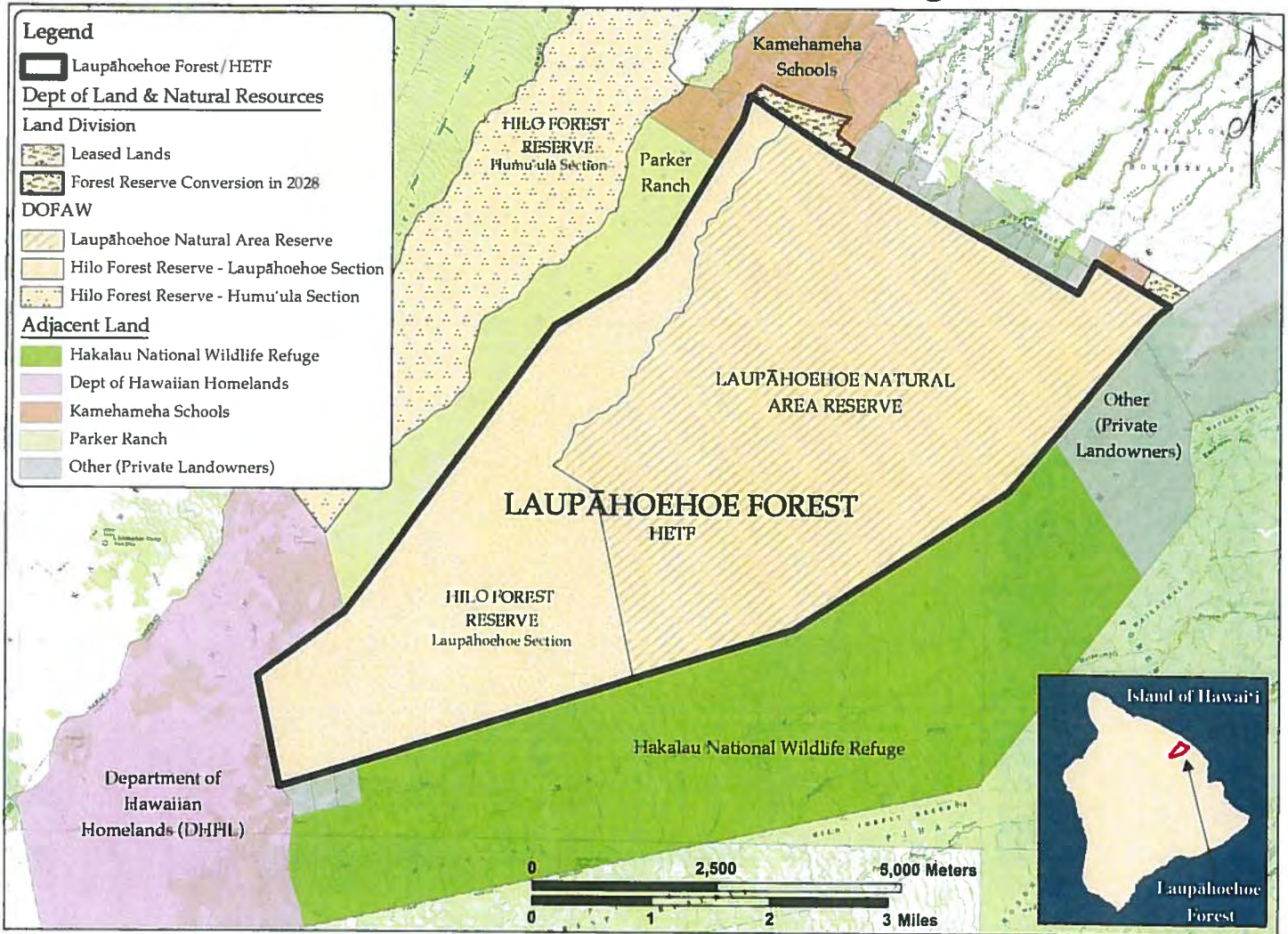
**Please send comments on the project by November 30, 2015** and indicate whether you wish to receive a copy of the Draft EA. If you have any questions, contact me at 808-587-0027 or email: [Tanya.Rubenstein@hawaii.gov](mailto:Tanya.Rubenstein@hawaii.gov) or contact the HETF Manager, Mel Dean at 808-854-2651 or [mkdean@hawaii.edu](mailto:mkdean@hawaii.edu). Thank you in advance for your cooperation and for sharing your knowledge!

Sincerely,



Tanya Rubenstein, Natural Area Reserves Project Coordinator

# Laupāhoehoe Forest Landowner Designation



DAVID Y. IGE  
GOVERNOR



STATE OF HAWAII  
DEPARTMENT OF TRANSPORTATION  
869 PUNCHBOWL STREET  
HONOLULU, HAWAII 96813-5097

FORD N. FUCHIGAMI  
DIRECTOR

Deputy Directors  
JADE T. BUTAY  
ROSS M. HIGASHI  
EDWIN H. SNIFFEN  
DARRELL T. YOUNG

IN REPLY REFER TO:  
STP 8.1884

October 30, 2015

TO: THE HONORABLE SUZANNE CASE, CHAIRPERSON  
DEPARTMENT OF LAND AND NATURAL RESOURCES (DLNR)

ATTN: TANYA RUBENSTEIN  
NATURAL AREA RESERVES PROJECT COORDINATOR  
DIVISION OF FORESTRY AND WILDLIFE

FROM: *For* FORD N. FUCHIGAMI *J.T. Butay*  
DIRECTOR OF TRANSPORTATION

SUBJECT: LAUPAHOEHOE FOREST MANAGEMENT PLAN  
PRE-CONSULTATION ON ENVIRONMENTAL ASSESSMENT  
LAUPAHOEHOE, NORTH HILO, HAWAII  
TMK: (3) 3-7-001:002 AND 012

The subject plan is not expected to significantly impact the State Transportation facility. We do request that an electronic copy of the Draft Environmental Assessment be sent to us for our review and comments.

If there are any questions, please contact Mr. Norren Kato of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

DEPT. OF LAND  
& NATURAL RESOURCES  
STATE OF HAWAII

2015 NOV -6 AM 10:03

RECEIVED





## OFFICE OF PLANNING STATE OF HAWAII

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813  
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

DAVID Y. IGE  
GOVERNOR


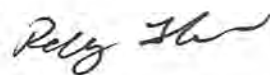
LEO R. ASUNCION  
ACTING DIRECTOR  
OFFICE OF PLANNING

Telephone: (808) 587-2846  
Fax: (808) 587-2824  
Web: <http://planning.hawaii.gov/>

Ref. No. P-14946

November 16, 2015

To: Suzanne Case, Chairperson  
Department of Land and Natural Resources

From:  Leo R. Asuncion, Acting Director 

Attention: Tanya Rubenstein  
Natural Area Reserves Project Coordinator

Subject: Pre-Consultation on an Environmental Assessment for the Laupāhoehoe Forest Management Plan

*RECEIVED  
DIVISION OF FORESTRY AND WILDLIFE  
STATE OF HAWAII  
NOV 17 AM 10:24  
105-11115-21*

Thank you for the opportunity to provide comments on the pre-consultation request for the Draft Management Plan / Environmental Assessment proposed by the State of Hawaii, Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW) and the U.S. Department of Agriculture (USDA) Forest Service (USFS). The pre-consultation review material was transmitted to our office by letter dated October 12, 2015.

Per the instructions on the cover letter, once available, the Office of Planning (OP) would like an electronic copy of the Draft Environmental Assessment (Draft EA) on compact disc.

It is our understanding that the Laupāhoehoe Forest Management Plan seeks to comprehensively protect and preserve Laupāhoehoe Forest while enhancing public use and benefits through education, recreation, outreach, demonstration, and research activities. The proposed Draft EA will expand on the Draft Management Plan's overview of the history of the forest, describe the current condition of this Natural Area Reserve (NAR), and provide an overview of current management activities and agency missions.

The Laupāhoehoe Management Plan is the driving vision for the next fifteen years for this forest reserve. It provides guidance for stakeholders and recommendations on how to protect and preserve the area. The Management Plan documents current forest conditions and threats; serves as a management tool for work plans, staffing requirements, and budgets; and serves as a funding guidance so that DOFAW and the USFS can pursue additional resources.

The proposed Draft EA will provide further in-depth information on the role forests play in providing clean freshwater for downstream human and wildlife populations and in supporting healthy coastal marine resources, and recommend management actions.

The OP has reviewed the transmitted material and has the following comments to offer:

1. The Draft EA is needed to meet the requirements for Hawaii Revised Statutes (HRS) Chapter 343. Pursuant to the Hawaii Administrative Rules (HAR) § 11-200-10(4) – technical, economic, social, and environmental characteristics – this project must demonstrate that it is consistent with a number of state environmental, social, and economic goals and policies for land-use development.

OP provides technical assistance to state and county agencies in administering the statewide planning system in HRS Chapter 226, the Hawaii State Plan. The Hawaii State Plan provides goals, objectives, policies, and priority guidelines for growth, development, and the allocation of resources throughout the State. The Hawaii State Plan includes diverse objectives and policies of state interest including but not limited to the economy, agriculture, the visitor industry, federal expenditure, the physical environment, facility systems, socio-cultural advancement, climate change adaptation, and sustainability.

The Draft EA should include an analysis that addresses whether the proposed project conforms or is in conflict with the goals, objectives, policies, and priority guidelines listed in the Hawaii State Plan.

2. The coastal zone management area is defined as “all lands of the State and the area extending seaward from the shoreline to the limit of the State’s police power and management authority, including the U.S. territorial sea” see HRS § 205A-1 (definition of "coastal zone management area").

HRS Chapter 205A requires all state and county agencies to enforce the coastal zone management (CZM) objectives and policies. The Draft EA should include an assessment as to how the proposed project conforms to the CZM objectives and its supporting policies set forth in HRS § 205A-2. The assessment on compliance with HRS Chapter 205A is an important component for satisfying the requirements of HRS Chapter 343. These objectives and policies include recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, managing development, public participation, beach protection, and marine resources.

3. The Draft EA should indicate the extent of involvement of the USDA-USFS in the management of this forest reserve/NAR. Our office will need this information to determine if the involvement of federal agencies, receipt of federal funding, or required permits will have an impact on the plans and programs that fall under the

jurisdiction of OP.

4. Pursuant to HAR § 11-200-10(6) – identification and summary of impacts and alternatives considered; in order to ensure that the Hamakua coastline remain protected, the negative effects of stormwater runoff originating from human land-based activities should be evaluated. The Draft EA should summarize the potential impact to nearshore marine resources and actions proposed to ensure the coastal ecosystem is protected and potential hazards mitigated.

The Draft Management Plan, in Table 2, page 24 lists the known streams and watershed basins of the Laupāhoehoe Forest. With these hydrological resources in mind, the Draft EA should evaluate current erosion controls in place for flood prone areas in the Laupāhoehoe Forest Reserve. This, as well as the marine water quality classification, should be considered when developing mitigation measures to protect the downslope coastal ecosystem.

The Draft Management Plan lists detailed information on the Laupāhoehoe Forest Reserve. It provides a historical background of the Laupāhoehoe Forest; provides a description of the current land use activities, existing infrastructure; provides a site description; and lists the cultural resources of the forest reserve. Furthermore, it details the existing threats to the natural and cultural resources; provides an overview of the existing management of the forest reserve; provides information on the proposed management program; and lists administrative background for the Hawaii Experimental Tropical Forest Cooperative Agreement planning group.

The Draft EA should also examine the cumulative impact on coastal resources from polluted runoff and sediment loss from planned development such as the USFS facility (listed on page 19 of the Draft Management Plan) currently under construction, as well as any future buildings, infrastructure improvements, fencing, public access trails, or roadways.

The Draft EA should examine the natural process of the land such as water resources, topographic contours, vegetated versus hardened surfaces, soil absorption rates, the connecting non-permeable roadways, public access trails within the reserve, and any existing drainage infrastructure that may directly connect the forest reserve/NAR to the coastline. Furthermore, it should account for land-based activities that will disturb the soil such as future infrastructure, facilities, and fencing within the nature reserve.

OP has a number of resources available to assist in the development of projects which



ensure sediment and stormwater control on land, thus protecting the nearshore environment. OP recommends consulting these guidance documents and stormwater evaluative tools when developing strategies to address polluted runoff. They offer useful techniques to keep soil and sediment in place and prevent contaminating nearshore waters, while considering the practices best suited for each project. The three evaluative tools that should be used during the design process include:

- Hawaii Watershed Guidance provides direction on site-appropriate methods to safeguard Hawaii's watersheds and implement watershed plans  
[http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/HI Watershed Guidance Final.pdf](http://files.hawaii.gov/dbedt/op/czm/initiative/nonpoint/HI_Watershed_Guidance_Final.pdf)
- Stormwater Impact Assessments can be used to identify and evaluate information on hydrology, stressors, sensitivity of aquatic and riparian resources, and management measures to control runoff, as well as consider secondary and cumulative impacts to the area  
[http://files.hawaii.gov/dbedt/op/czm/initiative/stomwater\\_impact/final\\_storm water\\_impact\\_assessments\\_guidance.pdf](http://files.hawaii.gov/dbedt/op/czm/initiative/stomwater_impact/final_storm_water_impact_assessments_guidance.pdf)
- Low Impact Development (LID), A Practitioners Guide covers a range of structural best management practices (BMP's) for stormwater control management, roadway development, and urban layout that minimizes negative environmental impacts  
[http://files.hawaii.gov/dbedt/op/czm/initiative/lid/lid\\_guide\\_2006.pdf](http://files.hawaii.gov/dbedt/op/czm/initiative/lid/lid_guide_2006.pdf)

5. OP anticipates that the material presented in the Draft Management Plan will be incorporated into the Draft EA.

If you have any questions regarding this comment letter, please contact Josh Hekeia of our office at (808) 587-2845.



# United States Department of the Interior



FISH AND WILDLIFE SERVICE  
Pacific Islands Fish and Wildlife Office  
300 Ala Moana Boulevard, Room 3-122  
Honolulu, Hawaii 96850

DEC 04 2015

In Reply Refer To:  
01EPIF00-2016-TA-0020

Ms. Tanya Rubenstein  
Department of Lands and Natural Resources  
1151 Punchbowl Street, Room 224  
Honolulu, Hawaii 96813

Subject: Pre-consultation on the Environmental Assessment for the Laupahoehoe Forest Management Plan, Laupahoehoe, Hawaii

Dear Ms. Rubenstein:

Thank you for your letter dated October 12, 2015, requesting our comments on preparation of a Draft Environmental Assessment (DEA) on the Draft Laupahoehoe Management Plan (Plan). The Plan outlines management actions over the next 15 years with an overall goal to protect, maintain, and enhance Laupahoehoe Forest's unique natural, cultural, and geological resources, while also enhancing compatible human uses. The proposed management actions include fence construction and pig removal to protect biological and water resources, invasive weed control, planting of rare native plants, wildfire prevention, public access and improved trails, research, and public education.

As described below, we recommend that the DEA include discussions of the Plan's beneficial and adverse effects to species and critical habitat listed or designated under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). Overall, we feel that the most effective way to conserve listed species and their habitats in the wet forest habitats present at Laupahoehoe is to fence large landscape scale areas in order to protect forested habitats from the effects of ungulates. The detrimental effects of ungulates are well documented (Loope and Scowcroft 1985, Stone 1985, Stone et al. 1992, Loh and Tunison 1999). Ungulates in Hawaii damage native forest habitat and negatively affect rare species populations by foraging on native species, removing native understory vegetation, suppressing regeneration of native canopy species, and dispersing seeds of invasive alien plant species in their fur, hooves, and droppings.

### *Listed Plants*

Surveys for rare plants in the Laupahoehoe Forest have occurred multiple times over the previous decades. We have reviewed our databases, including data compiled by the Hawaii Biodiversity and Mapping Program, to compare the locations of listed plants and their habitats



with management actions proposed in the Plan. Based on this data, it appears that most of management actions that would benefit listed plants will not occur where highest densities of listed plants were historically found. Our database shows that the highest density of listed plants have been found in the lower elevations of Laupahoehoe Forest; however, the proposed conservation units are primarily in the middle elevations. We understand that many extant plant locations in the lower elevations of the Laupahoehoe Forest are protected by smaller enclosures, however these small enclosures protect individuals and do not protect the native landscape as a whole or allow for adequate regeneration of the species to achieve recovery-size populations. The small enclosures will become small islands surrounded by degraded habitat, and will not lead to the recovery of listed plant populations or native habitats.

We recommend that the DEA document: 1) how many extant plant populations are found both in and out of the proposed conservation units, 2) how the proposed Plan will affect those populations, 3) how the Plan fits with recovery objectives for the listed plants, and 4) whether the Plan will provide for habitat that will serve for the recovery needs of the species (ie. be protected and managed).

#### *Critical habitat*

Critical habitat for six species is designated within the Laupahoehoe Forest. Beneficial effects to critical habitat from the Plan will come from the proposed conservation units, invasive species control and eradication, and forest restoration. Adverse effects to critical habitat from the Plan will come from ongoing habitat degradation from ungulates in unfenced areas of the Laupahoehoe Forest, and may increase in unfenced areas as the ungulates no longer have access to the fenced areas. Overall, the Plan proposes to fence relatively small areas of critical habitat, as shown in Table 1. We recommend that the DEA analyze the beneficial and adverse effects of the Plan on designated critical habitat.

**Table 1. Approximate area of designated critical habitat (CH) within the Plan's proposed fenced units. LF: Laupahoehoe Forest**

Species	Acres of CH within proposed fenced units	Acres (% of total) of CH in LF within proposed fenced units	Total number of CH units designated on Hawaii Island
<i>Clermontia peleana</i>	1,030	6,505 (16)	3
<i>Clermontia pyrrularia</i>	0	0	2
<i>Cyanea platyphylla</i>	0	0	2
<i>Cyrtandra giffardii</i>	220	3,731 (6)	3
<i>Cyrtandra tintinnabula</i>	1,030	5,738 (18)	2
<i>Phyllostegia warshaueri</i>	23	3,840 (0.6)	2

#### *Forest Birds*

Laupahoehoe Forest provides habitat for endangered forest birds including the federally and state listed akiapoloau (*Hemignathus munroi*), akepa (*Loxops coccineus coccineus*), and Hawaiian creeper (*Oreomystis mana*). The highest quality habitat for native birds is found in upper elevations where temperatures are too cool for avian malaria and its mosquito vector. In addition, some species, such as the iiwi (*Vestiaria coccinea*), move seasonally between forests in the Hakalau National Wildlife Refuge (Refuge) and Laupahoehoe Forest. Climate change models predict a 2.6 degree warming in habitats that native forest birds occupy and this warming is

likely to have a serious effect on the future distribution of forest birds due to an increase in the distribution of avian disease (Fortini et al. 2015). The higher elevations of Laupahoehoe Forests are predicted to still provide habitat for native forest birds in the future (Fortini et al. 2015) and therefore protection of these higher elevation forests is critical for Hawaiian forest bird conservation. In addition, the higher elevation forests in Laupahoehoe are designated as Recovery Areas for listed forest birds (USFWS 2006). The Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006) states that protection, reforestation, fencing, and ungulate control are needed within the Recovery Areas of the Laupahoehoe parcel. Reducing or eliminating the detrimental effects of ungulates on native forests is a key component of forest bird recovery (USFWS 2006).

The higher elevations of Laupahoehoe Forest are not proposed for fenced protection and ungulate control in the Plan. We recommend the DEA address the effects the management proposed in the plan for the upper elevations of Laupahoehoe Forest will have on forest bird populations and recovery.

#### *Invasive Species*

The Plan was developed before the Rapid Ohia Death had been established on Hawaii Island. We recommend that the Plan include biosecurity measures and adaptive management efforts to address this new threat.

#### *Laupahoehoe Natural Area Reserve*

The Laupahoehoe Forest covered by the Plan includes the Laupahoehoe Natural Area Reserve (NAR). The NAR System was established to preserve Hawaii's unique ecosystems in as unmodified a condition as possible. The Service feels that this mission is incompatible with ungulate populations remaining in unfenced habitat. The Plan only proposed to fence a small portion of the Laupahoehoe NAR. We recommend the DEA address the effects to habitats within the NAR from ongoing ungulate degradation.


#### *Summary*

We recognize that this Plan is a guiding document for the next 15 years, and therefore is a first step in the long-term planning for the Laupahoehoe Forest. We also recognize the challenges inherent in developing a comprehensive management plan for a multiple-use forest, and commend the Department of Lands and Natural Resources, U.S. Forest Service, and the Laupahoehoe Advisory Committee for their efforts in developing this Plan. We anticipate the Plan will provide an overall benefit to native species and their habitats.

However, we recommend that the proposed fenced conservation units be expanded to include more of the NAR, critical habitat units, known rare plant locations, and forest bird habitat. Expanding the conservation units to include upper elevation forest bird habitat and lower elevation NAR and rare plant habitat will create a conservation unit that protects the full elevational gradient of habitats in Laupahoehoe, and also will increase connectivity with the Refuge.

Thank you for the opportunity to provide comments on preparation of the DEA and the Plan. If you have questions regarding this letter, please contact Rachel Rounds, Fish and Wildlife Biologist, (phone: 808-792-9400, email: [Rachel\\_Rounds@fws.gov](mailto:Rachel_Rounds@fws.gov)).

Sincerely,

  
acting for  
Michelle Bogardus  
Island Team Manager  
Maui Nui and Hawaii Islands

Literature cited

- Fortini, L. B., A.E. Vorsino, F.A. Amidon, E.H. Paxton, and J.D. Jacobi. 2015. Large scale range collapse of Hawaiian forest birds under climate change and the need 21st century conservation options. PLoS ONE 10(10): e0140389. doi:10.1371/journal.pone.0140389
- Loh, R. K. and J. T. Tunison. 1999. Vegetation recovery following pig removal in Olaa-Koa Rain Forest Unit, Hawaii Volcanoes National Park. Technical Report #123. Pacific Cooperative Studies Unit. University of Hawai'i at Mānoa, Honolulu, HI.
- Loope, L. L. and P. G. Scowcroft. 1985. Vegetation response within exclosures in Hawaii: a review. Pages 377-402 in C. P. Stone and J. M. Scott (eds.), Hawaii's terrestrial ecosystems: preservation and management. University of Hawaii Press, Honolulu, HI.
- Stone, C. P. 1985. Alien animals in Hawaii's native ecosystems: Toward controlling the adverse effects of introduced vertebrates. Pages 251-297 in C.P. Stone and J.M. Scott (editors). Hawaii's terrestrial ecosystems: preservation and management. Cooperative National Park Resources Studies Unit, University of Hawaii Press, Honolulu, HI.
- Stone, C. P., L. W. Cuddihy, and J. T. Tunison. 1992. Responses of Hawaiian ecosystems to removal of feral pigs and goats. Pages 666-704 in C. P. Stone, C. W. Smith, and J. T. Tunison (editors). Alien plant invasions in native ecosystems of Hawaii: management and research. Cooperative National Park Resources Studies Unit, University of Hawaii Press, Honolulu, HI.
- (USFWS) U.S. Fish and Wildlife Service. 2006. Revised Recovery Plan for Hawaiian Forest Birds. Portland, OR.

William P. Kenoi  
Mayor



Harry S. Kubojiri  
Police Chief

Paul K. Ferreira  
Deputy Police Chief

## County of Hawai`i

### POLICE DEPARTMENT

349 Kapi`olani Street • Hilo, Hawai`i 96720-3998  
(808) 935-3311 • Fax (808) 961-2389

October 28, 2015

Ms. Tanya Rubenstein  
Natural Area Reserves Coordinator  
State of Hawaii, Department of Land and Natural Resources  
Division of Forestry and Wildlife  
1151 Punchbowl Street, Room 325  
Honolulu, HI 96813

Dear Ms. Rubenstein:

**Subject: Pre-Consultation on Environmental Assessment (EA) for the  
Laupāhoehoe Forest Management Plan (HI)**

Staff, upon reviewing the provided documents, does not have any comments or public safety concerns. We are not requesting a copy of the Draft EA when completed.

Thank you for allowing us the opportunity to comment.

If you have any questions, please contact Captain Andrew Burian, Commander of the Hāmākua District, at (808) 775-7533.

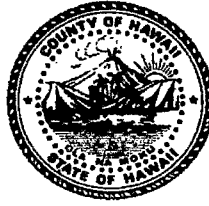
Sincerely,



HENRY J. TAVARES JR.  
ASSISTANT POLICE CHIEF  
AREA I OPERATIONS BUREAU

AB:lli  
150683

William P. Kenoi  
Mayor



Deborah Chang, Chair  
Ke'ala Lee Loy, Vice Chair  
Ronald Dela Cruz  
Lily Dudoit  
Nicole Lui  
Barbara Meheula  
Boone Morrison  
Christine Wada

## County of Hawai'i

### PLANNING DEPARTMENT CULTURAL RESOURCES COMMISSION

Aupuni Center • 101 Pauahi Street, Suite 3 • Hilo, Hawai'i 96720  
Phone (808) 961-8288 • Fax (808) 961-8742

January 22, 2016

Ms. Tanya Rubenstein  
Natural Area Reserves Project Coordinator  
Department of Land and Natural Resources, Division of Forestry and Wildlife  
1151 Punchbowl Street, Room 325  
Honolulu, HI 96813

Dear Ms. Rubenstein:

**SUBJECT: Pre-Consultation on Environmental Assessment (EA) for the Draft Laupāhoehoe Forest Management Plan**

**TMKs: (3) 3-7-001:002 and 012, Laupāhoehoe, North Hilo, Hawai'i**

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The Hawai'i County Cultural Resources Commission (CRC) reviewed the subject Draft Management Plan for Laupāhoehoe Forest at their January 13, 2016 meeting, and thanks you for the opportunity to comment. The CRC was appreciative of the attendance of Mr. Nicholas Agorastos and Ms. Tabettha Block, who represented the Draft Management Plan and was able to answer questions from the commissioners.

The CRC understands that the Draft Management Plan is to be a guiding document for the management of the 12,342 acre Laupāhoehoe Forest over the next fifteen years. Proposed management actions include fence construction, pig removal, weed control, outplanting of native plants, wildfire prevention and response, public access and the development of trails, continued research, and encouragement of education and outreach programs. While Mr. Agorastos and Ms. Block answered many of the questions that the commissioners had regarding the Draft Management Plan and the preparation of the draft EA, we are listing the comments below as record of the consultation.

Comments were as follows:

- P. 15: It is mentioned that gathering for Native Hawaiian religious and customary gathering rights requires an HETF permit. Please elaborate on the procedure for applying for a permit, considerations made when granting an HETF permit (i.e. non-commercial,

limits on quantity and species, number of individuals applying), the permitting authority (including length of time it takes to review and issue a permit), permit enforcement, and how the permit is in alignment with the protection of Hawaiian rights as identified under judicial decisions.

- P. 17: No mention is made of the Waipunalei Trail. Maly & Maly call it the Waipunalei-Laupāhoehoe trail. Please include it in the list and maps of trails within the Laupāhoehoe Forest and be on alert for traditional features made of stone that would be remnants of the historic trail. According to the Maly study, there is an 1856 reference to road work done on this trail, which may make it subject to the Highways Act of 1892, as currently administered by DLNR - Nā Ala Hele.
- P. 17: The draft EA should identify the location of historic trails on the property to avoid blocking passage on them when building fence lines.
- P. 20: The Shack Camp is already being used as a staging area for activities in the upper forest and is planned as a “primitive camping area” for the public in the future. Has any historic resources or archaeological inventory or preservation plan been done to identify what remains of this historic site and area to ensure that its historic record is preserved? This should be done before further human impacts occur and advice from State Historic Preservation Division (SHPD) and the CRC sought regarding management of the historic and cultural resources.
- P. 36: Shack Camp should be included in the listing of archaeological and historic sites.
- P. 64: Under “Cultural Resources” it should be clear to permittees, researchers, staff, and the public that any inadvertently discovered cultural resources, including prehistoric artifacts, stone platforms, cairns, caves etc. (not just burials) should be reported immediately. This should be included as a condition in all permits.
- Pp. 79-82: There are no planned actions for archaeological survey and/or historic preservation of Shack Camp or the Maulua and Waipunalei trails. This should be part of the plan. We note that the need is generally acknowledged on p. 55 as a proposed action under “Research” with no specific time frame. Such surveys should be done early before ground disturbance inadvertently damages the sites.
- The County of Hawai‘i recently acquired public access from Uweki Road (Maulua) along the northern property boundary of TMK: (3) 3-4-002:004 mauka to the Laupāhoehoe Forest Reserve as part of a subdivision action on the stated parcel. This access should be included in the public access locales described in the management document. A copy of the access agreement can be provided upon request.
- The County of Hawai‘i General Plan is the policy document for the long range comprehensive development of the island of Hawai‘i. In part, the purpose of the General Plan is to provide a framework for regulatory decisions, capital improvement priorities, acquisition strategies, and other pertinent government programs within the County organization and coordinated with State and Federal programs. The draft EA should evaluate the project with respect to the General Plan. Other than the goals/policies already identified in the draft management plan on Table 1 (p. 13), please also consider



Ms. Tanya Rubenstein  
DLNR, Division of Forestry and Wildlife  
Page 3  
January 22, 2016

County of Hawai'i General Plan goals and policies relating to historic sites, specifically policies 6.3(e) and 6.3(k).

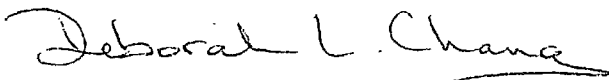
- There appear to be several historic sites on the property including the Dr. David Douglas monument, remnants of the Kūka'iau Ranch, and at least a few historic trails. An evaluation of the properties' significance for inclusion on the State (HAR 13-198) or National Register of Historic Places (36 CFR Part 60) should also be made.
- The proposed management plan (beginning on p. 45) should include any plans for the treatment and management of the known historic properties. As there is a good probability that there are extant historic and cultural properties on the subject lands that have yet to be identified, the management plan should also include a process by which these resources can be identified, communicated to forestry management, and incorporated into the plan such that the resources can be managed properly.

In response to your request for contact information for individuals or organizations that may be willing to share their cultural knowledge of the area, the following have been identified:

- Hui Mālama i ke Ala 'Ūlili; <http://www.alaulili.com/> or [kealaulili@gmail.com](mailto:kealaulili@gmail.com)
- Leon No'eau Peralto; [leon.peralto@gmail.com](mailto:leon.peralto@gmail.com)
- Jeffrey Dias; phone (808) 776-1273
- Waltham Johansen; P.O. Box 72, Pa'auilo, HI 96776

Mahalo for allowing us the opportunity to provide pre-consultation comments for the preparation of a draft EA for the Laupāhoehoe Forest Management Plan, we look forward to review of the draft. Should you have any questions regarding the consultation, please contact CRC staff member Lucas Mead at (808) 961-8140 or at [Lucas.Mead@hawaiicounty.gov](mailto:Lucas.Mead@hawaiicounty.gov).

Me ka pono,



DEBORAH CHANG, Chairperson  
Hawai'i County Cultural Resources Commission

LM:klt

\\cohs33\planning\public\wpwin60\Cultural Resources Commission\Projects\Laupahoehoe Forest Management Plan\LFMP Pre draft  
EA - CRC to DOFAW.doc

cc via email: Hawai'i County Cultural Resources Commission  
Nicholas Agorastos [nicholas.v.agorastos@hawaii.gov](mailto:nicholas.v.agorastos@hawaii.gov)  
Tabetha Block [tabethaablock@fs.fed.us](mailto:tabethaablock@fs.fed.us)

## **Appendix C:**

# **Historic Properties Field Inspection Report Laupāhoehoe Forest Draft Management Plan**

# Historic Properties Field Inspection Report

## Laupāhoehoe Forest Draft Management Plan

Laupāhoehoe Natural Area Reserve and the Laupāhoehoe Section of Hilo Forest Reserve  
Laupāhoehoe, North Hilo, Hawai'i Island (TMK: (3) 3-7-001: 002 and 012)

Prepared by Holly McEldowney, PhD

Martha Yent, M.A

Tracy Tam Sing, M.A.

Division of State Parks

Prepared for

Division of Forestry and Wildlife

Department of Land and Natural Resources

State of Hawaii

February 2016

At the request of the Division of Forestry and Wildlife (DOFAW), three archaeologists from the Division of State Parks conducted field inspections of selected areas within the Laupāhoehoe Natural Area Reserve and the Laupāhoehoe section of Hilo Forest Reserve that could be affected by project components proposed in Laupāhoehoe Forest Management Plan (Figs. 1 and 3). The inspections were conducted to assess the probability of historic properties within these potentially affected areas and to provide a basis for recommending any further steps needed to identify and appropriately manage historic properties within the project area. These recommendations would also provide DOFAW guidance on steps needed to comply with the State of Hawaii and federal historic preservation laws. All inspections took place between May 26 and 28, 2015 with the three authors of this report being the principle investigators. All report figures, including illustrations and photographs, are in the appendix.

Four areas were selected for inspection because observations by DOFAW staff or historic records indicated a higher probability of historic properties in these areas (Figs. 1-3). The first inspection covered a transect running roughly along the 3,500 to 3,580 ft. elevation contours where a proposed conservation unit would be fenced in the wet rain forest zone (Figs. 14 and 15). The second inspection ran almost the entire width of Laupāhoehoe Ahupua'a at a higher elevation (5,000 to 5,080 ft. elevation). The route roughly corresponds with the early 1900s "Maulua Trail" use drive cattle or from a ranch in the south to Humu'ula where more established routes eventually lead to markets. Included in this inspection was the area called "Shack Camp" at the southern end of Maulua Trail and adjacent to the boundary between the

lands of Maulua and Laupāhoehoe (Figs. 26-28). The area served as a cattle corral and ranch station. Proposed management uses of this area include establishing a trail roughly corresponding to the historic trail to provide access for conservation and reforestation efforts as well as recreation. A camp site is proposed at Shack Camp to accommodate DOFAW staff and volunteers working on these projects.

The third inspection focused on the intersection of surveyed boundaries for the lands of Laupāhoehoe, Waipunalei, and Humu'ula. Boundary Commission testimonies recorded in 1875 to help establish boundaries for the privately held land of Waipunalei refer to a traditionally named place at this intersection which included a pool and place where early 1800s bullock hunters lived while working (Figs. 7, 8, 10, 12, 13). The site sits at an elevation between 5,540 and 5,560 ft. and is included in one of the proposed forest restoration areas. The fourth inspection included the area where a monument was erected in 1934 to commemorate David Douglas, a famed Scottish botanist, who died in a bullock pit (i.e., pit trap) at or near the monument site in 1832 (Figs. 8, 10, 40, and 41). This area is within the highest elevation forest restoration area at approximately 6,000 ft.

Ground visibility varied among the four areas inspected. Visibility was best along most of the Maulua Trail route and at the traditional place adjacent to the boundary intersections where tall-stature and dense stands of tropical ash, planted in 1936 for timber, restricts growth of understory species and feral pig rooting helps eliminate ground cover (Figs. 17 and 18). Pig rooting also decreases the probability of low surface features, midden scatters, or discarded objects, from the pre-contact or historic periods, remaining intact and visible. Visibility was worst, both immediately and at any distance, in the Shack Camp area and in that at or near the David Douglas monument (Figs. 27, 28, 33, 39, and 40). In both areas a thick cover of kikuyu grass, which had not been grazed for a while, obscures the ground almost entirely. To be seen, objects or features needed to exceed the height of the dense grass clumps or be stumbled upon. Visibility was moderately good along the lower, wet forest transect (Figs. 14 and 15). Immediate ground surfaces were mostly visible, mostly due to pig damage disrupting ground cover, but wider views were less clear at a distance because of the density of understory and sub-canopy plants.

A major portion of the largest Forest Restoration Site, that abutting Humu'ula and Waipunalei to the north of Laupāhoehoe, was surveyed by State Parks archeologist for a proposed reforestation project in 2005.<sup>1</sup> The project was eventually canceled. Three transect were surveyed by foot within the Laupāhoehoe portion of this previous project area and no historic properties were identified along any of them (Fig. 4). Ground visibility during the survey was restricted by dense thickets of 'ākala (Hawaiian Raspberry) and

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<sup>1</sup> McEldowney, Holly, Alan Carpenter, and Martha Yent. 2006. *Historic Properties Identification and Field Report, Upper Laupāhoehoe and Humu'ula Sections, Hilo Forest Reserve Reforestation Project*. Manuscript prepared by the Division of State Parks for the Division of Forestry and Wildlife, Department of Land and Natural Resources.

dense patches of grass. Much of the area had been or was actively being disturbed by pig rooting (Figs. 5-6).

After the field inspection was completed, the Hawai'i Island Cultural Resources Commission was consulted on the Laupāhoehoe Forest Draft Management Plan. Members questioned whether the historic Waipunalei Trail was in the project area and if any remnants of the trail or features associated with its use could be affected by proposed management actions (Ltr. Chang to Rubenstein, Jan. 22, 2016). The three historic maps examined place the trail outside the currently proposed project areas as do more recent depictions shown on Tax Map Key maps and the USGS Quadrangles (Figs. 3, 2, 4, 7, 9, and 12). In Boundary Commission testimonies recorded in 1875 for Waipunalei Ahupua'a, a testifier named Paka describes an old trail running into the woods called Kalaikukui. It was said to run along the mauka corner of the land of Hako which was bounded by Laupāhoehoe on the south and Waipunalei on the north. This route is roughly similar to the trail later labeled the Waipunalei Trail and shown running inland to either side of the Laupāhoehoe and Waipunalei boundary (Fig. 12). A recommended mitigation measure for the management plan includes preparing a guidance document that will help management staff and volunteers recognize these types of features should any be found in unexpected areas and what to do should they be found.

### **Identified Potential Historic Properties**

The following five potential historic properties (Figs. 1-3) were identified during the inspection and recorded to some extent (documentation will be incorporated in the proposed inventory survey plan, in preparation):

- 'Auwai or Ditch Feature: Segments of a probable ditch or 'auwai had been previously identified by DOFAW staff on the route used to access existing endangered species enclosures in the lower elevation, wet rain forest. Potentially it also crosses the down-slope perimeter fence of the proposed conservation unit in this area. Archaeologists on the team agreed that it was a manmade feature and that a ditch seemed to be the feature's most likely function given that appeared to be a long open trench cut into the rocky, soil embankment of a ridge and at angles and elevations conducive to water flow (Fig 16). Portions have collapsed while others were no longer well defined due to erosional slippage or filling. The feature could be followed for a total of 51 m (167 ft.) with widths varying from 150 to 70 cm (59 to 27.5 in.) and depths from 170 to 30 cm (66 to 12 inches). The purpose of a ditch at this elevation is puzzling. It is above the productive agricultural zone for native Hawaiian and subsequently introduced crops given cooler temperatures at this elevation and the high percentages of cloud cover per hour and day throughout the year. Some association with use of the Laupāhoehoe Homestead lands for

ranching or sugar cultivation is possible but those lands are at least 2 miles downslope of the 'auwai (Fig. 12). It is also possible that it was somehow associated with traditional Hawaiian uses of the lower forest which involved bird catching or activities needed to gather or process forest resources.

- Maulua Trail Section: A few recognizable sections of the Maulua Trail had been identified previously by DOFAW staff along the trail's route shown on USGS Topographic maps (Fig. 4). The trail first appears on a 1916 map running roughly north from Shack Camp located on the Maulua-Laupāhoehoe boundary (Figs. 10-13). It is labeled going to Keanakolu, ranch station in Humu'ula. Cattle were presumably driven from the fenced complex at Shack Camp along the trail to lands with more accessible routes to steamer landings and other markets or became a short-cut for ranch hands moving to and from the coast or other ranch lands. The trail was recognizable when the edges were defined by stone alignments or curbing, cuts in embankments or slopes where the trail crossed ridges or uneven terrain, or leveled segments of stone and soil in flatter areas (Figs. 20-25). Three trail sections were described during the field inspection. Trail width varied from 3.5 to 1.4 m (4 to 11 ft.) with most sections being 2.5 m (8 ft.) wide. The longest segment recorded was 47 m (154 ft.) long and included a distinct ramp feature cut into a sloping ridge face and a retaining wall feature near its base (Fig. 19). Attempts to follow the trail beyond the immediate segment mapped were unsuccessful.
- Shack Camp Ranching Complex: What was labeled and called "Shack Camp" as early as 1916 was a 125 acre fenced area leased from the Territory of Hawaii by Kukaiau Ranch which was running cattle in neighboring Maulua (Figs. 10-13). The area was desirable because it had at least two water sources, a pond and spring. The only features of this camp found during the inspections were the small house (or shack), feeding and watering troughs, scattered fruit trees, a small orchard of fruit trees on a rise above the house, a pole for the telephone line installed by Kukaiau Ranch by 1922 to connect Maulua and ranching holdings at Umikoa, and the large pond shown on maps (Figs. 26-34). The house has collapsed and is badly deteriorated as are the troughs. The spring shown on a 1916 map was not located. As evident during the inspection and on aerial photographs from the 1960s and 1970s, portions of the camp pasture area have been bulldozed to create earthen reservoirs and roads.
- Traditional Place at Ahupua'a Boundaries: The Commission of Boundaries, generally called the Boundary Commission, was established in 1862 to certify the boundaries for ahupua'a awarded to the major Ali'i in the Mahele of 1948. To help verify the traditional boundaries of these lands, the commission heard testimony from those having personal knowledge of these lands, the boundaries, or place names along the boundaries. Two native Hawaiians, Paka and Hoahimoa,

testified that a place named Kulanihakoi (also transcribed as Kulanikakoi and Kulanikekoi) was the mauka boundary of Waipunalei and Laupāhoehoe. Paka testifies that there is a water hole at this location and Hoahimoa mentions having lived at Kulanihakoi while shooting bullock on the lands of Humu'ula (Boundary Commission Book B: 367 and 368). The survey map prepared to verify these boundaries in 1875 depicts the location of Kulanihakoi and the waterhole (Figs. 7 and 8). A 1916 map of the area shows a Forest Reserve Monument marking the boundary of the reserve at this location, labels the place Kulanihakoi, and depicts a water hole adjacent to the boundary (Fig. 10). The waterhole is still shown on a 1921-1922 map without the place being named (Fig. 12 and 13). The *Hawaiian Dictionary* translates Kū-lani-hā.ko'i as a "Mythical pond or lake in the sky, its overflow comes to the earth as rain."<sup>2</sup> The name can also be used to imply one having been drenched by water. *A Dictionary of the Hawaiian Language* has the following: "[Ku, the god, Ku, represented in rain and storm, lani, heaven, and hakoi, heavy.] What is above or on high; a supposed place in the heavens from which the waters of rain came; the windows of heaven:...."<sup>3</sup> No specific reference was found suggesting that this particular place is associated with this belief, but it is a possibility.

The substantial ironwork Territorial Forest Reserve monument (i.e., post) indicated on the maps was easily found during field inspection as was a low, broad depression that could have been the water hole (Figs. 35 and 36). Sediments in the leveled base of the depression may indicate that water still ponds there although it was dry at the time of the inspection. Directly inland was a natural rock formation next to the base of what was once a very large koa tree (Fig. 37). The surface patterns of a number of rocks in the outcrop were very distinct (Fig. 38). It would not be surprising if they were associated with particular beliefs or customs although no specific information was found to substantiate this possibility. No other features of note or evidence of past use were seen in the area.

- David Douglas Monument: Stone monument constructed in 1934 to honor the Scottish botanist, David Douglas, is relatively well known and visited by those venturing along the upper Mauna Kea road from Waimea to the Saddle Road. A trail leading to the monument is maintained and marked with signage. The eight-foot tall, triangular and tapered stone pillar sits on a triangular base and is topped with a single rock and sits in an open, grassed area (Fig. 41). Bronze plaques dedicate the monument to Douglas, list those initially responsible for its construction in 1934, and, installed in 2014, commemorates the 108<sup>th</sup> anniversary of his death and 100<sup>th</sup> anniversary of the publication of his journals (Fig. 40 and 41). If any evidence of bullock pits or other uses of this

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<sup>2</sup> Pukui, Mary Kawena and Samuel Elbert. 1977. *Hawaiian Dictionary*. Honolulu, University of Hawaii Press, 165.

<sup>3</sup> Andrews, Lorrin. 1922. *A Dictionary of the Hawaiian Language*. Revised by Henry H. Parker. Honolulu, Board of Commissioners of Public Archives, Territory of Hawaii.

area still exists in this portion of this forest restoration area, they are well hidden by dense grass and underbrush (Fig. 39 and 40).

Other than the features described above, no archaeological sites or historic properties were found in areas covered during these field inspections, including those areas where ground surfaces were sufficiently visible. These observations support general predictive models that the probability of archaeological sites in these upland forested areas is very low. Known uses of forested areas, mostly documented in the historic record, were primarily transient, intermittent, or periodic and left few durable remains behind. Thick vegetation growth and years of ground disturbance by feral animals, particularly pig rooting and wallowing, have likely obscured or obliterated any cultural deposits or stone alignments that might have remained from these uses. The findings also underscore the results of other studies along the upper portions or margins of the forest reserve. Historic properties remaining in these areas mostly reflect periods of wild cattle hunting, ranching, or early forestry and watershed initiatives.

### **Recommended Documentation and Treatment Actions**

The following steps are recommended to more thoroughly evaluate the historic properties identified and propose ways to mitigate adverse effects potentially resulting from actions taken under the Laupāhoehoe Forest Management Plan. Figure 2 depicts location of historic properties and proposed projects in the draft management plan. Potential inventory and mitigation commitments are outlined in the table on the following page.

- 'Auwai or Ditch Feature: Additional field work should be conducted to complete documentation and evaluation of this unusual feature. Particular effort should focus on exploring areas up and down slope of the feature to see if additional ditch segments exist which might clarify the features extent and purpose. This survey should provide sufficient information to determine the site's boundaries so that the ditch can be avoided when fences delineating the proposed Conservation Unit are installed and unit maintenance work is performed. The recommended mitigation treatment for this feature is avoidance. As part of the survey, a records search should be conducted targeting documents pertaining to historic land uses of Laupāhoehoe which might help explain the need for a ditch at this elevation. Archaeological reports for surveys conducted within the lower forest and upper agricultural zones along the Hilo-Hāmākua Coast should also be reviewed to see if similar features were reported elsewhere and more specific purposes suggested.
- Maulua Trail Section: As with the 'auwai, additional field survey should focus on defining the boundaries of the trail's physical remnants and confirming that others segments do not exist.



Given the thorough and credible search DOFAW staff has already made for trail remnants, the chance of finding many other existing segments is relatively low. The recommended mitigation treatment for this feature is preservation which would require preparation of a plan setting out measures to preserve and potentially interpret the site. If a trail for staff and volunteers is established along the general route of Maulua Trail as proposed, there would be interpretive opportunities to discuss the trail and the region's ranching history.

- Shack Camp Ranching Complex: A more thorough survey of the Shack Camp area and its potential historic components is not feasible nor worth the effort needed to systematically survey such a large area covered in dense, tall kikuyu grass that is also badly rutted by pig rooting. Wooden objects or features that could be present are probably badly deteriorated and any low stone surface features are likely obscured or disturbed by pigs. The initial mitigation measure recommended is preparing a plan that combines preservation treatments for identified components of the complex and an ongoing commitment to record any features found in the future in those areas currently obscured by vegetation. The approaches proposed in the plan would be those feasible in this wet environment and compatible with the broader mission of restoring native forests and conserving native ecosystems.

One element of the plan could be maintaining or restoring the historic character of a limited portion of the original Shack Camp complex. The preservation area would encompass the location of the wooden house (or shack), the fruit tree orchard on the rise southeast of the house, and the stand of imported timber trees immediately south of the shack (Fig. 26). This area could become the focal point of the campsites proposed in the protection and management plan to accommodate support staff and volunteers while still maintaining some semblance of an open pasture and ranch camp that it was historically. The original wooden house, now in ruins, could be demolished and any usable fixtures (e.g., door knobs, etc.) or boards salvaged for reuse. A wooden cabin could be constructed at the location of the original structure that is designed to be generally consistent in appearance with small ranch structures of the early 1900s. The cabin could provide shelter for support staff or volunteers when needed, storage for equipment and supplies, and be available by reservation for public use. The fruit trees could be minimally maintained as long as they remain healthy and the large timber species kept unless they pose a hazard. Interpretive material focusing on the complex and adjacent lands could help staff and volunteers better understand the region's history. Other components of the historic complex, such as the pond and spring shown on the historic maps, could also be considered for inclusion in the preservation plan if additional assessments suggest this warranted and feasible. A more systematic survey should be conducted of this limited area.

Table 1: Recommended Inventory and Potential Mitigation Actions for Identified Historic Properties

Project Areas	Proposed Project Uses	Identified Historic Properties Recommended Inventory and Potential Mitigation Actions
<p>Laupāhoehoe NAR: Habitat Conservation Units: 297 acres 1277 acres 1071 acres (por.)</p>	<p>Fence Installation Ongoing Management Actions Helicopter Landing Zone Trail Improvement</p>	<p><u>'Auwai-Ditch Feature:</u> Complete Inventory Determine Extent of Ditch Propose Buffer to Ensure Protection Propose Preservation by Avoidance as Stipulated in Prepared Plan</p>
<p>Hilo Forest Reserve Laupāhoehoe Section: Three Forest Restoration Sites Conservation Unit (por. 1071 acres) Trail Access (Two Sections)</p>	<p>Forest Restoration Actions: Clearing, Planting, Ongoing Management) Shelter, Primitive Campsites and Ancillary Facilities Fence Installation Helicopter Land Zone Establish Trails Trail Improvement</p>	<p><u>Shack Camp Ranching Complex</u> Complete Inventory of Identified Components of Complex Define Boundaries of Preservation and Restoration Area Prepare Preservation Plan, including Restoration of Selected Shack Camp Components Establish Standard Procedures if Remnants of Shack Camp or Other Historic Properties found beyond Preservation/Restoration Area <u>Maulua Trail Segments</u> Complete Inventory of Known Trail Segments and Potential Additional Segments Prepare Preservation Plan for Trail Segments, including Interpretation <u>Traditional Place-Kulanihakoi</u> Conduct Inventory Survey of General Location Determine Protective Buffer for Appropriate Area Prepare Preservation Plan if Feasible and Appropriate <u>David Douglas Monument</u> Determine Protective Buffer for Area Prepare Preservation Plan, Including Existing Maintenance of Monument Area and Access Trail <u>General Project Area</u> Establish Standard Practices and Procedures if Historic Properties Discovered during Project in Low Probability Areas</p>

A second element of the plan should establish steps to be followed if historic features are discovered within the Shack Camp complex during vegetation clearing or ground disturbance occurring as part of native forests restoration or conservation efforts. The steps would include providing workers with an overview of the kinds of features or objects potentially encountered and instructions on how to report any finds and their locations. Instructions should include the standard practices leaving any find in place and avoiding the immediate area until the disposition or treatment of feature or object can be determined. Commitment made in the plan should also address the process by which any treatment decisions will be made depending on the kind or scale of the discovery.

- Traditional Place at Ahupua'a Boundaries (Kulanihako'i): The cursory inspection of this traditional place and temporary habitation site was not sufficient to clearly assess which remaining physical features of the area might be characteristic of the named place or if any man-made evidence of past habitation is truly absent as it appeared during the inspection. A systematic survey of the area should be conducted to identify and record any distinct physical features that are reminiscent of those mentioned in the historic records and any evidence of past habitation. In particular, the survey should propose a protective buffer for the potentially significant area so that it can be avoided during forest restoration efforts. If restoring this area becomes an option, a preservation plan should be prepared setting out how a habitat resembling that present in the early 1800s would be established and the precautions needed to avoid adversely affecting known or unidentified historic properties.
- David Douglas Monument: The grounds immediately surrounding the monument and the access trail are currently maintained by DOFAW staff. It is recommended that these established practices continue. Maintaining a cleared area around the monument in this moist environment helps preserve the rock and mortar monument and plaques. As with the Shack Camp Complex, it is not realistic to conduct systematic ground surveys in the vicinity of the monument given the dense kikuyu grass and thick underbrush covering the uneven terrain. Another inspection should be conducted to define an appropriate protective buffer in the immediate vicinity of the monument and access route. The buffer would define the area to be avoided when forest restoration actions are undertaken in the upland-most section of the Laupāhoehoe Forest Reserve. As with traditional place Kulanihako'i, a preservation plan should be prepared if forest restoration actions within the protective buffer become an option or are desirable.

## Recommended Compliance Approaches

Actions proposed under the Laupāhoehoe Forest Management Plan are subject to historic preservation review under Hawaii state and federal laws and regulations. Sections 6E-7 and 8, Hawaii Revised Statutes (HRS), and the implementing administrative rule, Chapter 13-275, Hawaii Administrative Rules (HAR), requires any agency to give the State Historic Preservation Division (SHPD), acting on behalf of the Department of Land and Natural Resources, the opportunity to review any project that may affect historic properties. The project shall not commence until SHPD has issued its written concurrence. HRS §6E-7 and 8 applies because the Laupāhoehoe Forest is state land and DOFAW is a state agency. The project is also subject to Section 106 of the National Historic Preservation Act (Title 54 U.S.C.) and its implementing regulations (36 CFR Part 800) because it is partially funded through the federal Hawaii Experimental Tropical Forest project of the U.S. Department of Agriculture Forest Service (USDA-FS). While USDA-FS is technically responsible for complying with the Section 106 project review process, it is preferable to coordinate as closely as possible the approaches taken to state and federal compliance.

Based on the results of this field inspection, credible observations by DOAW staff, and a review of other archaeological work in the general area, it is recommended that DOFAW seek a determination from SHPD that significant historic properties are known or are likely to be present in limited portions of the overall project area and are unlikely in the remaining portions (HAR §13-275-5(b)). If SHPD concurs, DOFAW can propose preparing an inventory survey plan which would set out the methods and approaches to be used in each higher probability area (HAR §13-275-5(c)). These would include conducting systematic surveys to identify any additional sites in these areas, to complete documentation of known properties, evaluate their significance, define site boundaries, and propose mitigation measures. Most historic properties can be avoided when projects components are implemented. Preservation or mitigation plans would be prepared to mitigate any adverse effects as needed. The mitigation plan prepared subsequent to the inventory should include a commitment to follow general practices and procedures if historic properties are discovered during the project in low probability areas.

To comply with federal historic preservation review process, the USDA-FS should consider preparing a Memorandum of Agreement (MOA) in accordance with the law's implementing regulations. The framework of a MOA is better suited to setting out approaches that can be implemented concurrently with those suggested or required by the state-level process. The MOA would establish in the preamble (i.e., "whereas" clauses) the general nature of the project; that there are known historic properties within specific and limited portions of the project area; that historic properties are unlikely in most of the other areas; and that the types of actions needed to implement the project require minimal ground disturbance and their siting is relatively flexible. The MOA stipulations would then commit to those actions proposed in the state-level inventory plan and any anticipated preservation or mitigation measures. These would

include completing work on the known or potential historic properties (e.g., extended survey in immediate vicinity of identified sites, significance evaluations, site boundaries, etc.) and identifying the general plans needed to achieve the potential treatment options. An important stipulation is committing to preparing a general practices and procedures document to guide actions taken if historic properties are discovered unexpectedly during the project, particularly in areas where they are not expected.

Guidance should be sought from USDA-FS staff assigned to assist local Forest Service employees with Section 106 compliance matters. The signatories to the MOA will include the official representing the USDA-FS or U. S. Department of Agriculture and the Hawaii State Historic Preservation Officer. The Department of Land and Natural Resources should be a signatory as an “invited party” because it will be jointly responsible for the project and for fulfilling many of the MOA terms. It also needs to be actively involved should the MOA be amended, terminated, or disputed. Projects included under the MOA should be those that have a reasonable chance of occurring over with the next five to ten years. The MOA can be amended if project priorities or approaches change during this period.

## Appendix: Report Figures, Including Illustrations and Photographs

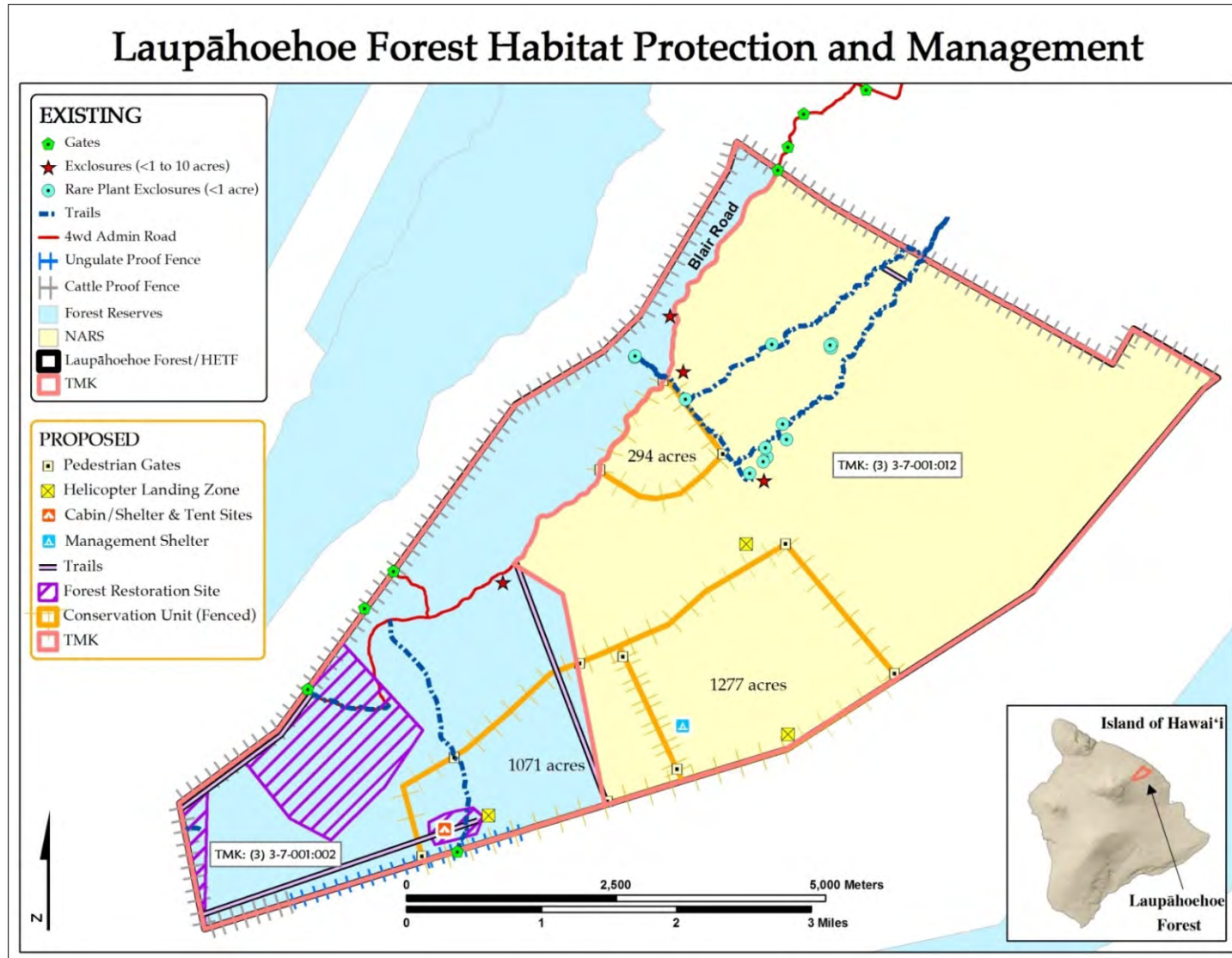


Figure 1: Tax Map Key Designations for the Laupāhoehoe Section of Hilo Forest Reserve (TMK: (3) 3-7-001: 002) and Laupāhoehoe Natural Area Reserve (TMK: (3) 3-7-001: 012).



# Laupāhoehoe Forest Historic Properties

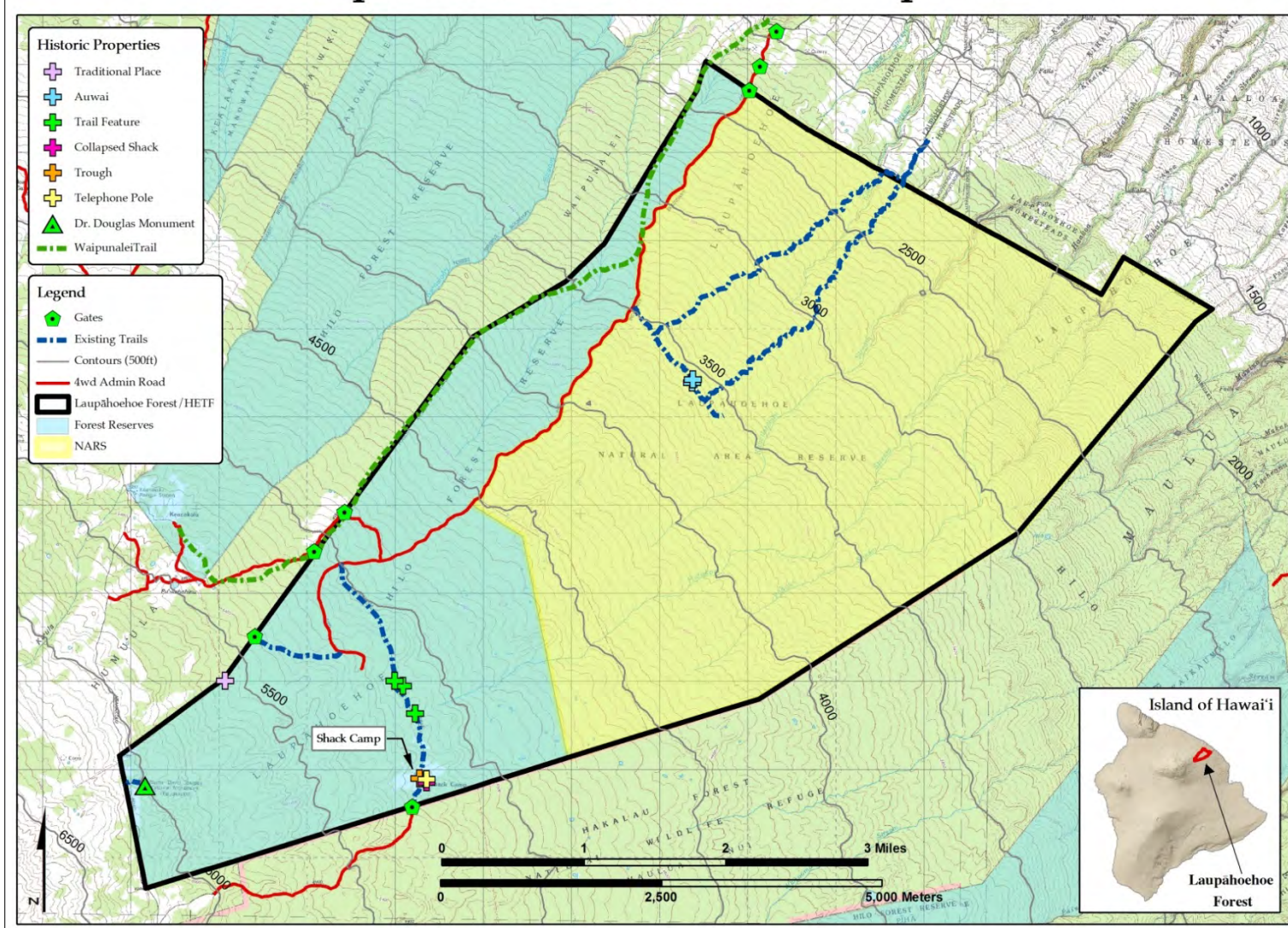


Figure 2: Location of Potential Historic Properties Identified in Laupāhoehoe Section of Hilo Forest Reserve and Laupāhoehoe Natural Area Reserve. Also included are the routes currently used when staff performs management work in the reserves. The blue-dashed trail follows the route of the Maulua Trail as shown on the USGS Topographic Quad (Keanakolu 1982)



# Laupāhoehoe Forest Historic Properties and Planned Management

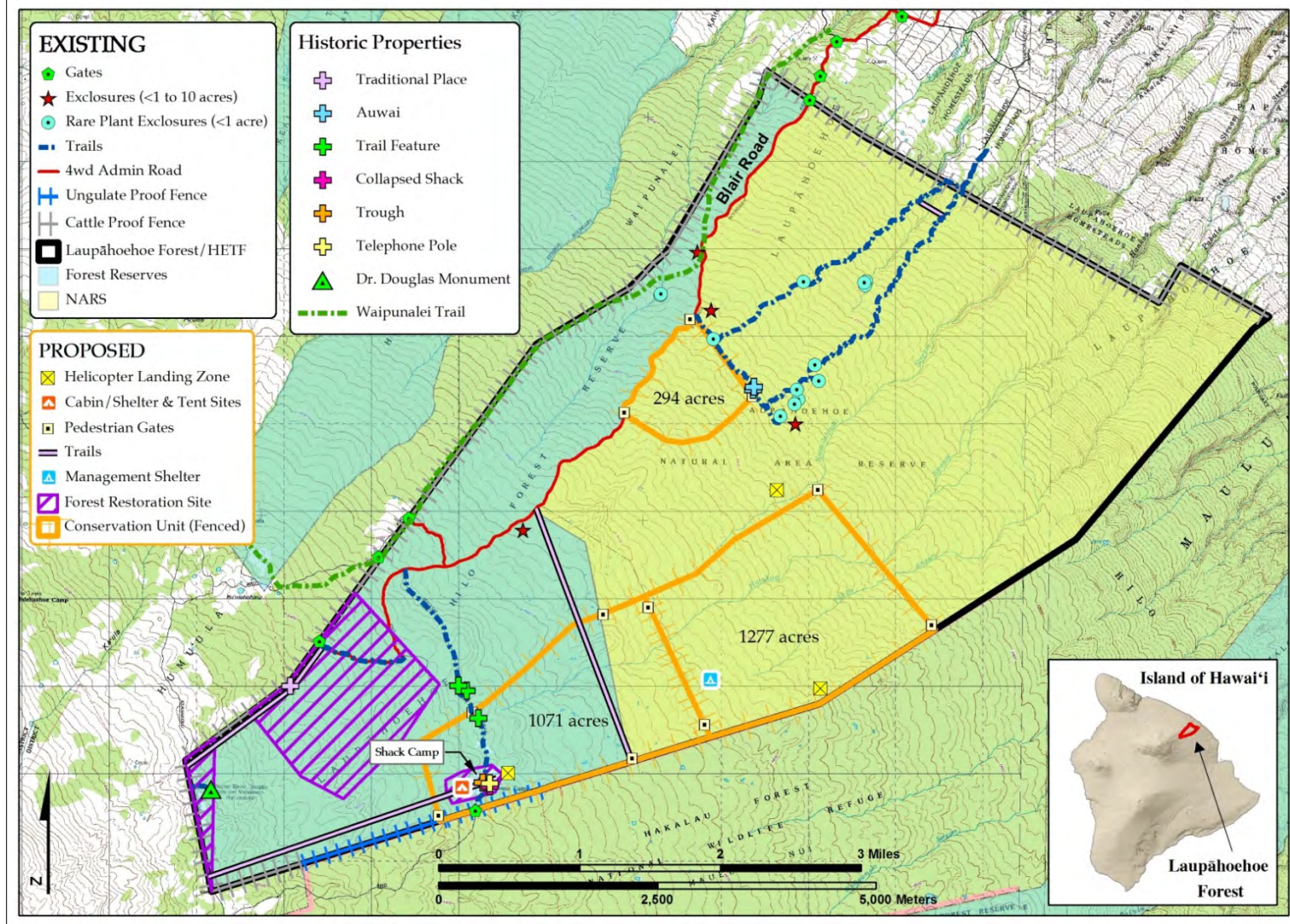


Figure 3: Location of Potential Historic Properties Identified and Proposed Management Actions



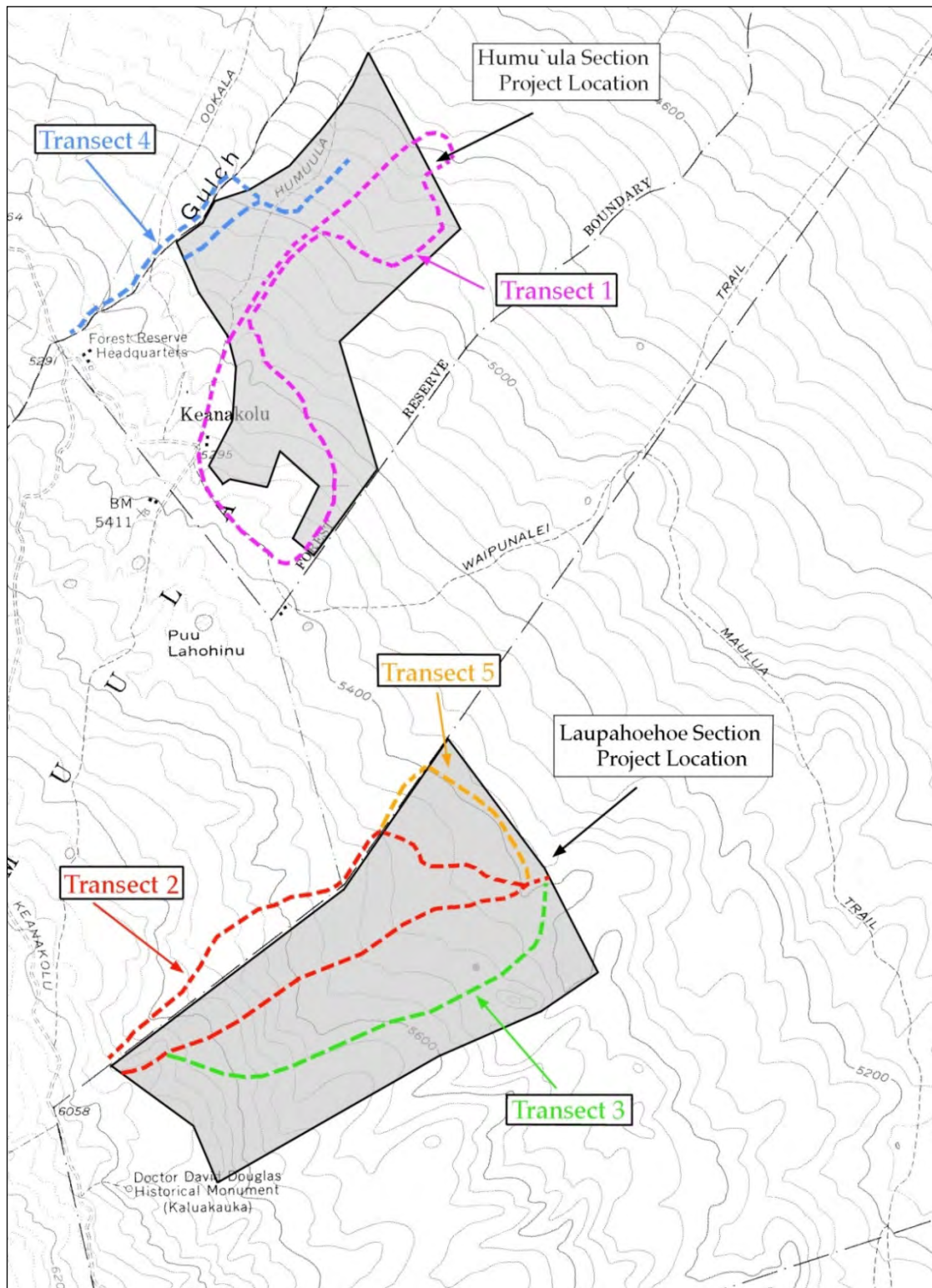


Figure 4: Approximate Routes of Transects Surveyed by State Parks Archaeologist in 2005 for the Forest Restoration Project, Laupāhoehoe. The Laupāhoehoe Section transects (# 2, 3, and 5) sample approximately three quarters of the largest forest restoration site proposed in the current project. No historic properties were found.





Figure 5: Vegetation and Terrain at or Near Proposed Forest Restoration Sites, Laupāhoehoe Section (Views Facing Northeast). Taken during the 2005 survey, the photographs illustrate the ridge and swale formations in the project area, the dense ground cover (upper photograph), and general characteristics of the forest (lower photograph).





Figure 6: Vegetation and Terrain along Northern Boundary of the Forest Restoration Site, Laupāhoehoe Section (Views Facing Southwest). These 2005 photographs illustrate the thick patches of ‘ākala covering portions of the project area. The fence in the lower photograph marks the boundary of Laupāhoehoe and Waipunalei with the open pasture being on Waipunalei.

Waterhole at "Kulanihakoi"

Trail Called Kalaikukui

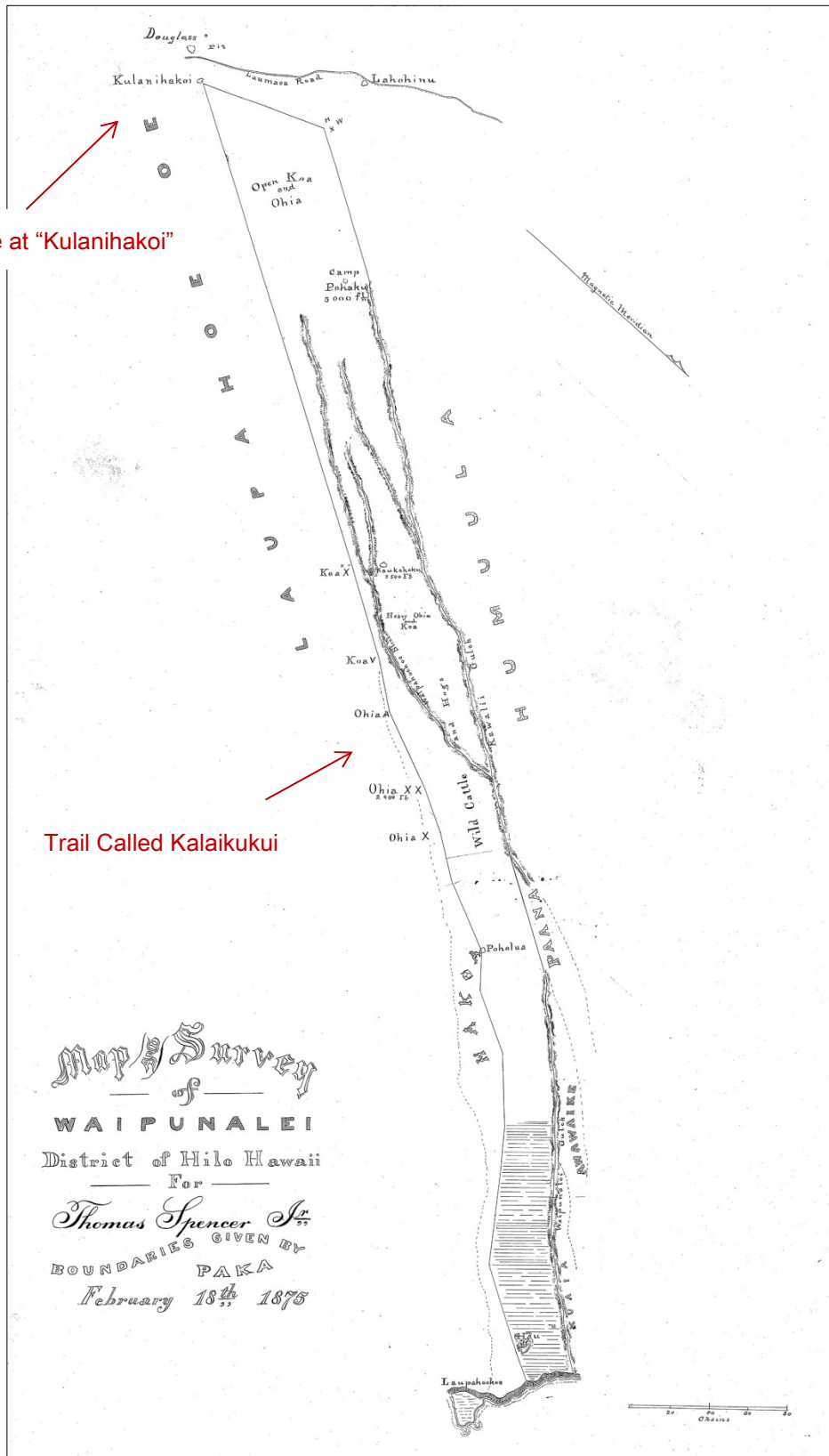


Figure 7: Survey Map Prepared to Certify the Boundary of Waipunalei Prepared in 1875 (Reg. Map 667)

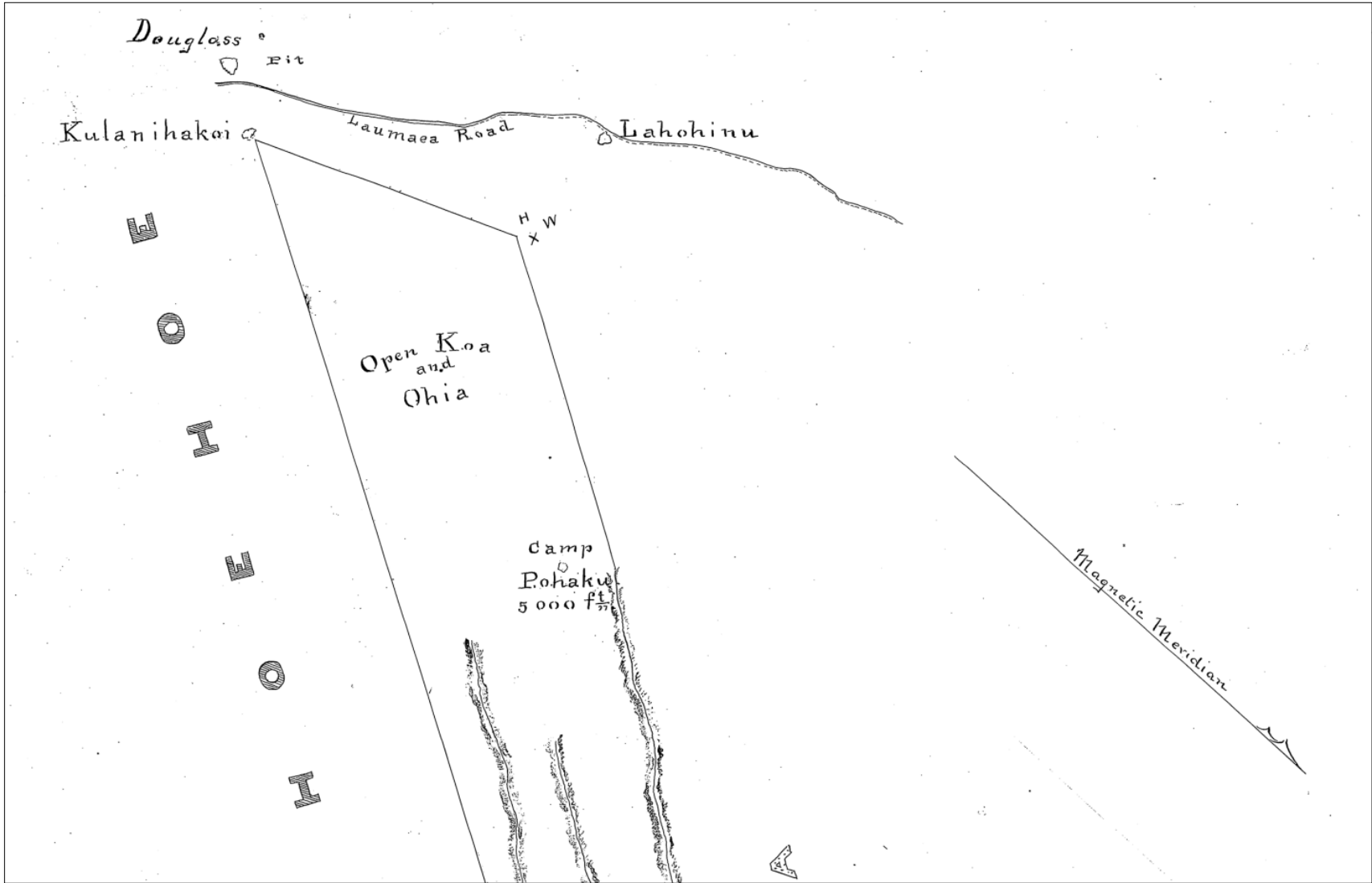


Figure 8: Extracted Section of Waipunalei Ahupa'a Boundary Map Focusing on the Waterhole at "Kulanihakoi" (Reg. Map 667). Unlike other early maps, this one places the upper road across the Mauna Kea slopes makai of the David Douglas pit.



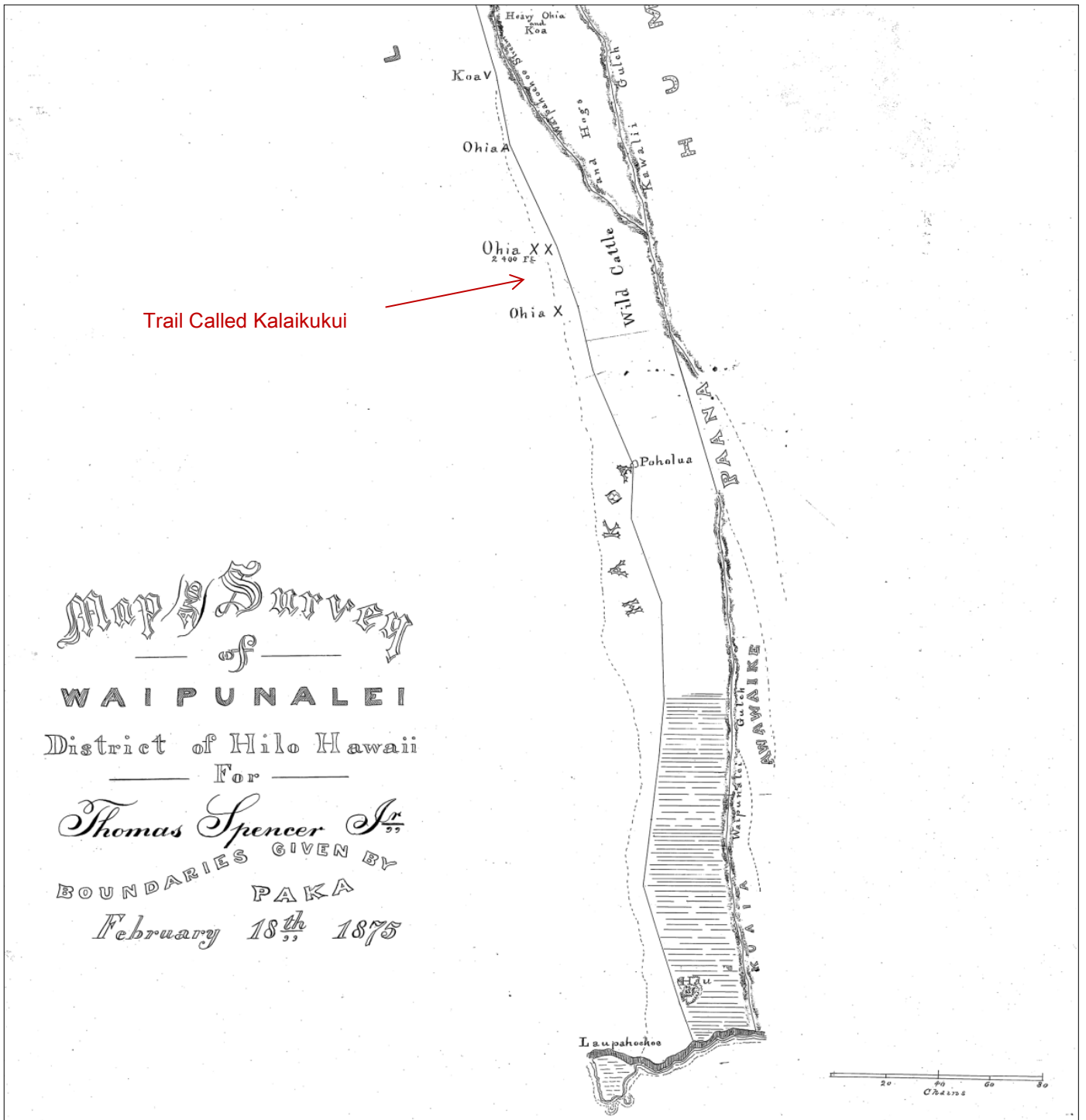


Figure 9: Extracted Section of Waipunalei Ahupa‘a Boundary Map Focusing on the Trail Called Kalaikui (Reg. Map 667). The old trail leading into the lower forest was said to follow the boundary between Laupāhoehoe and the land of Hakoā. This trail may have been the forerunner to what was later called the Waipunalei Trail.

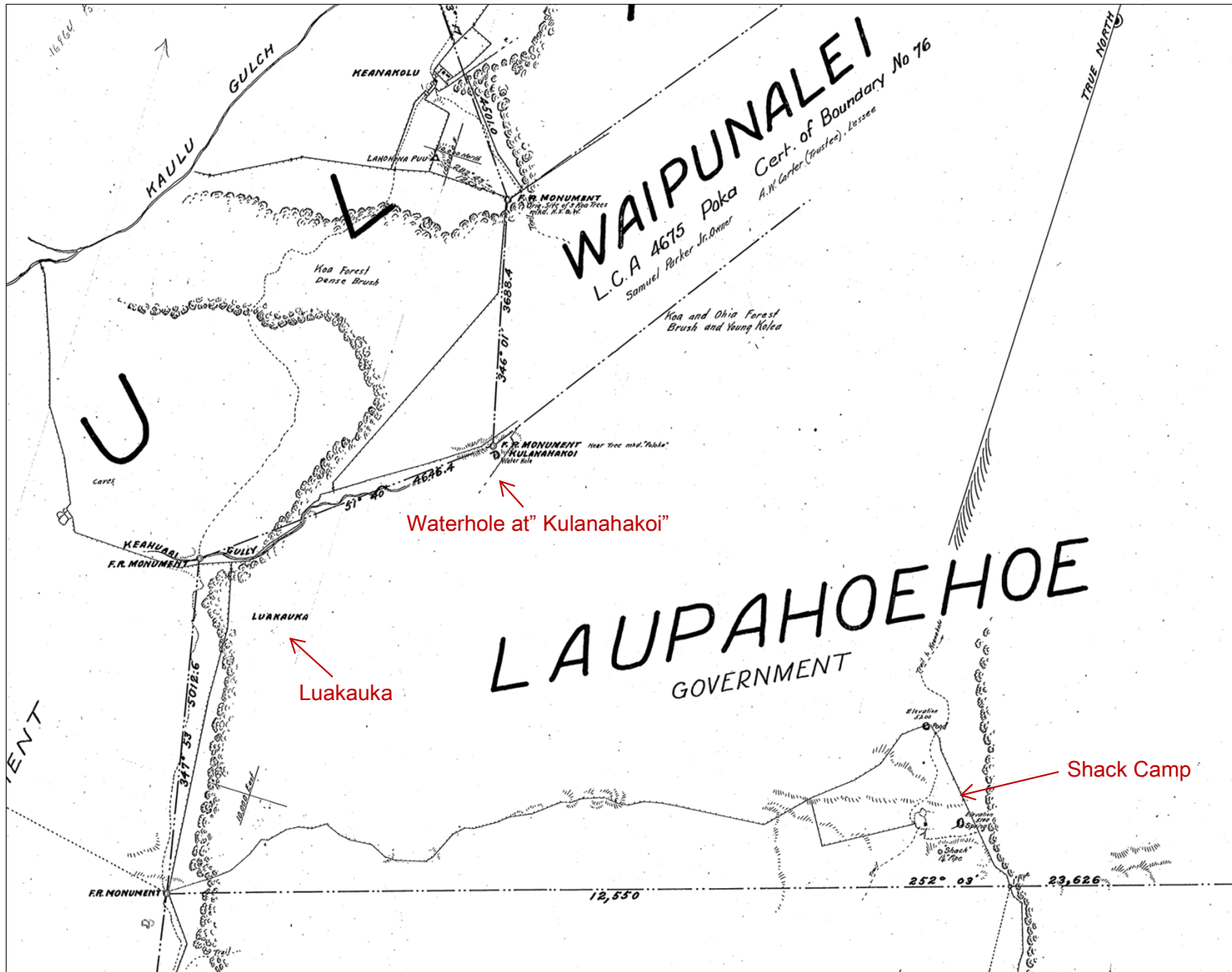


Figure 10: Shack Camp, Waterhole at “Kulanahakoi”, and Luakauka (David Douglas Pit) on 1916 Map of Upper Hilo Forest Reserve Boundaries (Reg. Map 2594).

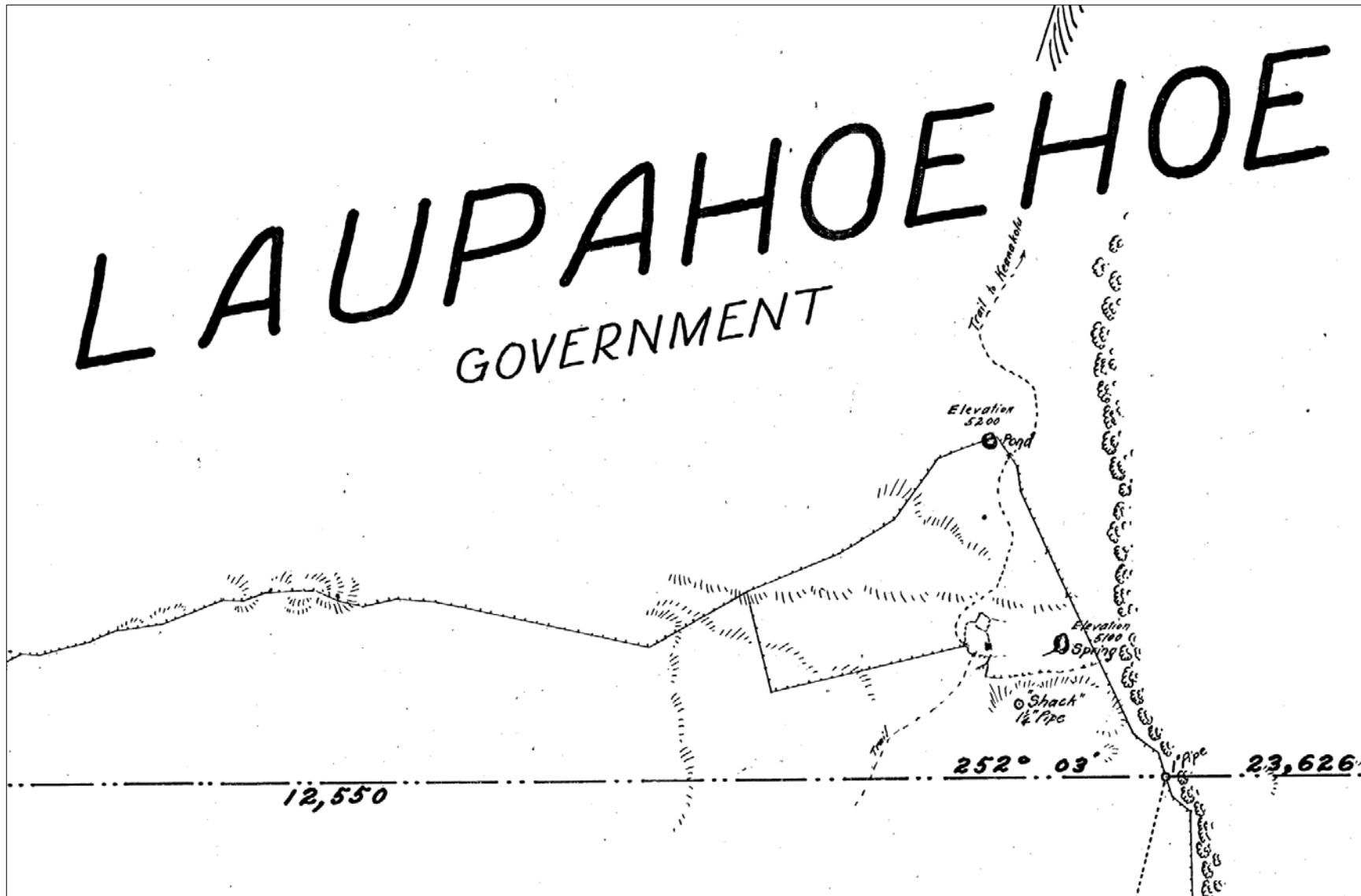


Figure 11: Shack Camp Features as Shown on 1916 Map of the Upper Hilo Forest Reserve (Reg. 2594). The black square appears to represent the shack and the "Trail to Keanakolu" may be the forerunner to what is now called Maulua Trail. The "Pond" was located during the field inspections but not the spring east of the shack.



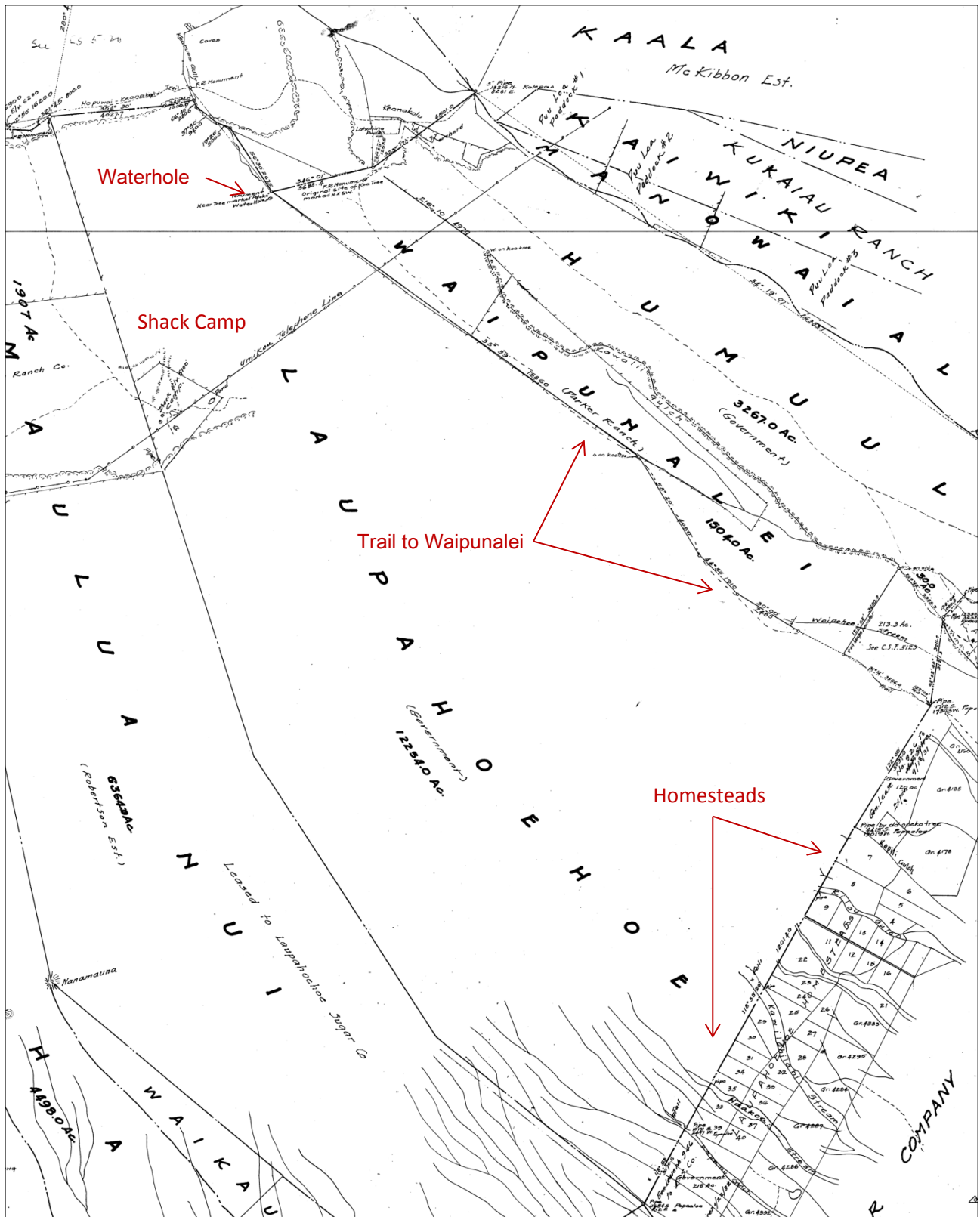


Figure 12: Laupāhoehoe Ahupua'a Extracted from 1921-1922 Hilo Forest Reserve Map (Reg. Map 2682). Depicted are Shack Camp, the Umikoa Telephone Line, waterhole at the mauka Waipunalei-Laupāhoehoe Boundary, what probably became the Waipunalei Trail, and Laupāhoehoe Homesteads.

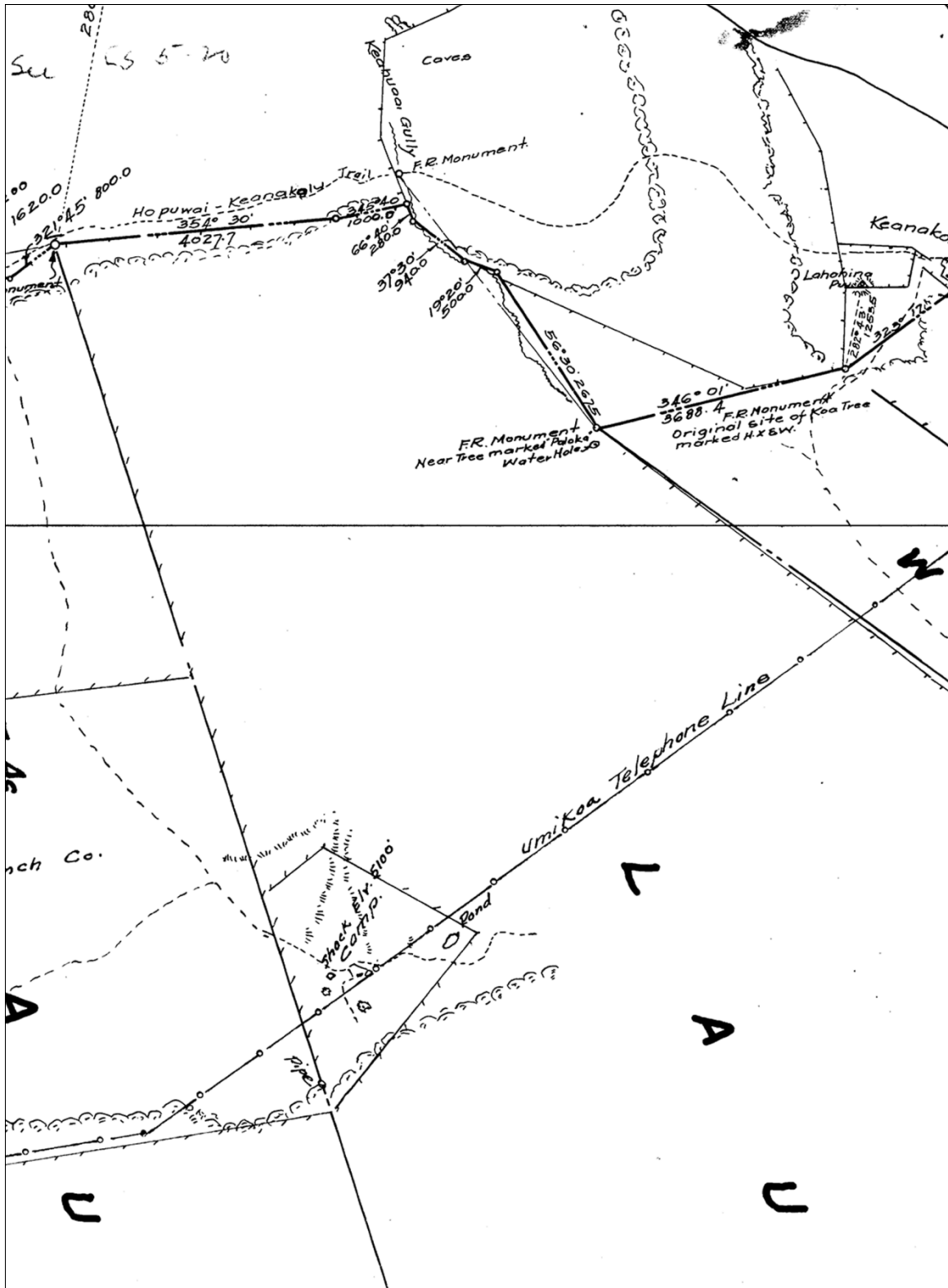


Figure 13: Shack Camp, Waterhole, and Umikoa Telephone Line on 1921-1922 Map of Upper Hilo Forest Reserve Boundaries (Reg. Map 2594).





Figure 14: Forest Understory and Ground Cover in Proposed Habitat Conservation Unit, Laupāhoehoe NAR. Blue flagging marks current maintenance trails in the NAR.



Figure 15: Post and Hog Wire Fencing Used to Protect Current Rare Plant Enclosures. The conservation unit fencing proposed in this project would be similar.





Figure 16: 'Auwai or Ditch Feature Near the Proposed Conservation Unit (View Facing East). The ditch is 0.80 m wide in this section.





Figure 17: Open Understory and Ground Cover in Planted Tropical Ash Stands. Identified remnants of the Maulua Trail are located within these stands as is the general route of the trail as shown on the USGS topographic map (Keanakolu Quad, 1982).



Figure 18: Understory and Ground Cover Vegetation in the Planted Tropical Ash Stands.

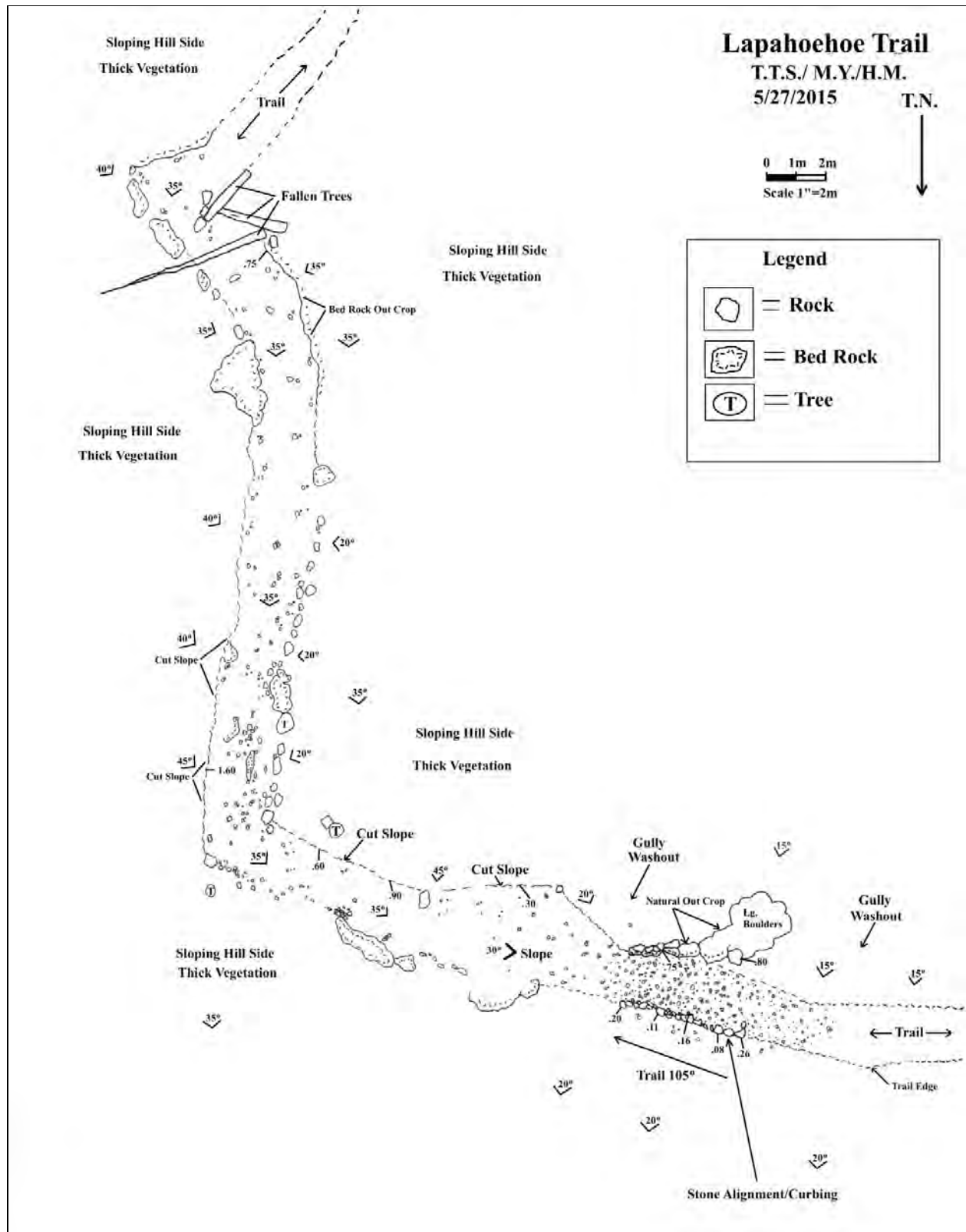


Figure 19: Mapped Remnant of Maulua Trail. This segment is 22 m (72 ft.) long (Map prepared by Tracy Tam Sing). Edges of the trail are defined intermittently by stone alignments and embankment cuts.





Figure 20: Trail Segment with Defined Curbstone Alignment. Beyond this segment is the start of a switchback that turns right after the incline visible in the photograph. An embankment cut defines the trail edge on the right hand side..



Figure 21: Upper Portion of Switchback. The trail grade was created by cutting the soil and rock embankment visible on the left and leveling what became the trail bed.





Figure 22: Notch Cut in Low Ridge for Maulua Trail Alignment. This was the second segment identified and recorded during the inspection.



Figure 23: Interior of Trail Notch Cut for Maulua Trail. The notch is roughly 2.1 m wide and the edge cut 1.16 m high.





Figure 24: Trail Cut in Low Rise to Create Trail Bed. This is the third identified and recorded segment.



Figure 25: Grinding Stone Located 20 m (65 ft.) West of the Third Recorded Maulua Trail Segment. The dense basalt slab was machine cut to create the grinding surface initially. It is 18 cm (7 in) long and 5 cm (2 in) thick.





Figure 26: Open Grass Areas and Identified Features of the Shack Camp Complex (Google Earth Image Dated 8-17-2013). Visible are the locations of the collapsed shack, the fruit tree orchard, and the pond.





Figure 27: Location of Pond Shown at Northern Extent of the Shack Camp Paddock on Historic Maps (View Facing Northwest). Water collects in the swale during rainy periods or heavy rains.



Figure 28: Grassy Field That Was Once the Open Pasture of the Shack Camp Paddock (View Facing South). Visible on the right is the bulldozed embankment of the former road cut.





Figure 29: Collapsed Roofing of Cattle Trough or Salt Lick (View Facing West). Note the height and density of the matted kikuyu grass and degree to which it obscures the ground surface.



Figure 30: Collapsed Structure of the Shack Camp Shack (View Facing West). The layout and construction of the shack is still recognizable, including the corrugated iron roofing, wooden board and batten walls, nails, and door.





Figure 31: Foundations of the Shack Camp Water Tank Located Adjacent to the Shelter.



Figure 32: Remnant Telephone Line Pole Located North of the Shelter. The location of this pole relative to the shelter is consistent with the line and pole placements shown on the 1921-1922 survey map (Reg. Map 2682, See Fig. 10).





Figure 33: Inspection Team Recording Collapsed Remains of the Shelter and Water Tank (View Facing West). Note the mix of blackberry bushes amongst the kikuyu grass hummocks.



Figure 34: Fruit Trees in Small Orchard Located on a Knoll Southeast of Shelter. Temperate climate timber species, mostly conifers, were also planted adjacent to the orchard and near the shelter.





Figure 35: Forest Reserve Territory of Hawaii (FRTH) Boundary Marker at Mauka Junction of Waipunalei and Laupāhoehoe Ahupua‘a. The location this Forest Reserve Monument is shown on the 1916 and 1922 Maps of the Hilo Forest Reserve (Reg. Maps 2594 and 2682).



Figure 36: Possible Remnants of Pond Depicted at Junction of Mauka Junction Waipunalei and Laupāhoehoe Ahupua‘a Boundaries in 1875, 1916, and 1921-1922 (Register Maps 667, 2594, and 2682). The pond feature is called a waterhole on the 1916 and 1922 Forest Reserve Maps. See Figures 7, 8, 10, 12, and 13.





Figure 37: Distinct Natural Rock Outcrop Next to Base of Very Large, Deteriorating Koa Tree. One of the stones with unusual surface patterns is located near the center of the photograph.



Figure 38: Stone in Natural Outcrop with Unusual Surface Patterns





Figure 39: Open Koa Canopy and Dense Kikuyu Grass Ground Cover in Inland-Most Forest Restoration Site (View Facing Northeast)



Figure 40: Large Patch 'Ākala (Hawaiian Raspberry) Forming a Dense Shrub Understory Component in Major Portions of the Inland-Most Forest Restoration Site (View Facing Southeast). Photograph was taken from the trail leading to the David Douglas Monument.





Figure 40: Plaque for Botanist David Douglas on Stone Monument Erected in His Honor. The plaque was placed on the side of the pillar facing the trail entry.



Figure 41: Rear Face of the Stone and Concrete Mortar Monument. Listed on the rear plaque are names Burns Society members responsible for erecting the monument in 1934.





Figure 42: Setting of David Douglas Monument on a Low Rise between a Ridge and Ravine.



Figure 43: View of David Douglas Monument from Ridge Slope (View Facing Southeast). The monument is visible through the branches on the left side of the photograph.



Draft Environmental Assessment: Laupāhoehoe Forest Draft Management Plan  
Joint HEPA/NEPA document  
March 2016

## **Appendix D: Laupāhoehoe Forest Draft Management Plan**

Available on-line at:

[http://dlnr.hawaii.gov/ecosystems/files/2013/07/DRAFT\\_Laupahoehoe\\_mngt\\_plan\\_04162015\\_small.pdf](http://dlnr.hawaii.gov/ecosystems/files/2013/07/DRAFT_Laupahoehoe_mngt_plan_04162015_small.pdf)

# LAUPĀHOEHOE FOREST

## DRAFT MANAGEMENT PLAN



2015

DEPARTMENT OF LAND AND NATURAL RESOURCES  
DIVISION OF FORESTRY AND WILDLIFE

UNITED STATES DEPARTMENT OF AGRICULTURE  
UNITED STATES FOREST SERVICE



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**April 2015**

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## TABLE OF CONTENTS

TABLE OF CONTENTS .....	i
ACRONYMS .....	iii
ACKNOWLEDGEMENTS .....	1
EXECUTIVE SUMMARY .....	2
INTRODUCTION .....	3
Background .....	3
Guiding Principles .....	3
General Information .....	4
<i>Location</i> .....	4
Management Focal Areas .....	7
<i>Natural Resources</i> .....	7
<i>Research</i> .....	8
<i>Education and Outreach</i> .....	8
<i>Public Access and Recreation</i> .....	9
<i>Infrastructure</i> .....	9
DESCRIPTION AND CURRENT CONDITION .....	10
Land Use .....	10
<i>Land Designation and Management</i> .....	10
<i>Land Use History</i> .....	13
<i>Public Access and Recreation</i> .....	15
Vehicle Access .....	15
Trails .....	17
Mountain Biking .....	17
Hunting .....	17
Camping .....	19
Gathering .....	19
<i>Existing Infrastructure and Facilities</i> .....	19
Roads .....	19
Facilities/Structures .....	19
<i>Regional Partnerships</i> .....	20
Site Description (Physical and Biological Resources) .....	20
<i>Topography, Climate, Geology, and Soils</i> .....	20
<i>Water Resources</i> .....	24
<i>Forest Ecosystems</i> .....	26
<i>Wildlife</i> .....	32
Cultural Resources and Traditional Practices .....	35
THREATS TO NATURAL AND CULTURAL RESOURCES .....	37
Non-Native Plants and Animals .....	37
Disease .....	40
Climate Change and Natural Disturbances .....	40
Illegal Human Activity .....	40
Wildfire .....	41





Threats to Cultural Resources .....	42
OVERVIEW OF EXISTING MANAGEMENT .....	43
Natural Resources .....	43
<i>Forest Protection and Management</i> .....	43
<i>Invasive Non-Native Plant Control</i> .....	43
<i>Rare Species Restoration</i> .....	44
<i>Monitoring</i> .....	44
Research .....	44
Education and Outreach .....	46
Public Access and Recreation .....	46
Infrastructure .....	46
PROPOSED MANAGEMENT PROGRAM .....	47
Natural Resources .....	47
<i>Forest Protection and Management</i> .....	47
<i>Invasive Non-Native Plant Control</i> .....	50
<i>Rare Species Restoration</i> .....	51
<i>Monitoring</i> .....	52
<i>Wildfire Prevention and Response</i> .....	53
Research .....	53
Education and Outreach .....	56
Public Access and Recreation .....	58
Infrastructure .....	63
ADMINISTRATION .....	64
Coordination .....	64
Permitting.....	64
Cultural Resources .....	64
Biosecurity .....	64
Safety .....	65
Budget and Staffing .....	65
REFERENCES .....	71
Appendix A – Other Available Resources .....	77
Appendix B – Biosecurity Protocols.....	78
Appendix C - List of Research Projects to Date .....	80



## ACRONYMS

BLNR	Board of Land and Natural Resources
DAR	Division of Aquatic Resources
DLNR	Hawai‘i Department of Land and Natural Resources
DOCARE	Division of Conservation and Resource Enforcement
DOFAW	Division of Forestry and Wildlife
EA	Environmental Assessment
FIA	Forest Inventory and Analysis Program
FR	Forest Reserve
HIPPNET	Hawai‘i Permanent Plot Network
IPIF	Institute of Pacific Islands Forestry
LAC	Laupāhoehoe Advisory Committee
NAGPRA	Native American Graves Protection and Repatriation Act
NARS	Natural Area Reserves System
OCCL	Office of Conservation and Coastal Lands
PEPP	Plant Extinction Prevention Program
PIPES	Pacific Internship Programs for Exploring Science
PSW	Pacific Southwest Research Station
SHPD	State Historic Preservation Division
UH	University of Hawai‘i
USFS	USDA Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VRPF	Volcano Rare Plant Facility
YCC	Youth Conservation Corps



## ACKNOWLEDGEMENTS

The DOFAW and the USFS would like to thank the numerous stakeholders and community members that provided input and guidance during the writing of this plan. Special thanks in particular to the LAC members who participated in many meetings and field trips during plan writing and contributed a great deal of time and energy to the process.



*Aerial view of Laupāhoehoe Forest*



## EXECUTIVE SUMMARY

The Laupāhoehoe Forest Management Plan seeks to comprehensively protect and preserve Laupāhoehoe Forest while enhancing public use and benefits through education, recreation, outreach, demonstration, and research activities. This plan documents the history of the forest, describes its current condition, provides an overview of current management activities and agency missions, recognizes the role intact forests play in providing clean freshwater for downstream human and wildlife populations and in supporting healthy coastal marine resources, and recommends management actions. The plan is the management vision for approximately fifteen years and provides:

- Guidance and recommendations to the Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) and the US Department of Agriculture, US Forest Service (USFS) from stakeholders including the Laupāhoehoe Advisory Council (LAC)
- Prioritized recommendations on how to protect and preserve the area, as well as continue and enhance human use
- A compilation of natural and cultural history, resources, and research
- Documentation of current forest conditions and threats
- A planning and management tool for the DOFAW and the USFS to use to determine priorities, work plans, staffing requirements, budget requests, and more
- Funding guidance and a document that enables the DOFAW and the USFS to ask for resources necessary to protect Laupāhoehoe Forest

The plan was jointly developed by DOFAW, the USFS, and the Laupāhoehoe Advisory Council (LAC) through a collaborative planning process. Formed in December 2010, the LAC is a community-based advisory council that provides guidance and consultation to DOFAW and USFS on issues of management, research, and education in Laupāhoehoe Forest.

This draft plan includes proposed management actions to protect natural and cultural resources within Laupāhoehoe Forest while also enhancing compatible human uses. Protecting resources includes addressing the threats of invasive non-native species as well as climate change. The plan will be a guiding document for DOFAW and the USFS for management actions, including background information for why those actions were chosen. The management plan identifies objectives and strategic actions related to Natural Resources, Research, Education and Outreach, Public Access and Recreation, and Infrastructure. Objectives Include:

- Natural Resources - Protect, manage and restore native ecosystems and species
- Research - Provide lands for conducting research that serves as a basis for the restoration, conservation and management of tropical forest ecosystems
- Education and Outreach - Serve as a center for forest education, training, demonstration, and outreach on tropical forests, conservation biology, and natural resource management for groups ranging from school children to land managers, scientists and the general public
- Public Access and Recreation - Improve appropriate public access and recreational opportunities consistent with maintaining native natural resources, cultural resources and the wilderness character of these lands
- Infrastructure - Provide and maintain infrastructure and facilities to meet forest goals



## INTRODUCTION

### *Background*

The 12,343 acre (ac) (5,134 hectare (ha)) Laupāhoehoe Forest area consists of two state-managed parcels of land: 4,449 ac of state land designated as Forest Reserve (FR), and 7,894 ac of land designated as a Natural Area Reserve (NAR) (Figure 1). Both of these programs are under the state of Hawai‘i Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW). In addition, the Laupāhoehoe Forest is designated as part of the Hawai‘i Experimental Tropical Forest (HETF).

In 1992, the Hawai‘i Tropical Forest Recovery Act authorized the establishment of the HETF to serve as a center for long-term research and a focal point for developing and transferring knowledge and expertise for the management of tropical forests. In 2007, the HETF was formally established. The HETF consists of two units, one of which is the Laupāhoehoe Forest; the other unit is the Pu‘u Wa‘awa‘a Forest located on the leeward side of Hawai‘i Island (Figure 2).

USDA Forest Service (USFS), Pacific Southwest (PSW) Research Station’s Institute of Pacific Islands Forestry (IPIF), based in Hilo, works cooperatively with the state of Hawai‘i to coordinate research, management, and educational activities and to jointly develop and implement research and education, and management plans for the experimental forest. Land management and protection responsibilities remain with DLNR-DOFAW and these lands are managed under relevant state laws and regulations.

### *Guiding Principles*

The management plan of Laupāhoehoe Forest is based on the overall vision for the area as part of the HETF, as well as the purpose of the land designations for the two parcels of state lands that are part of the Laupāhoehoe Forest. The plan also incorporates the values and interests of community members and stakeholder groups and attempts to balance the need for increased forest protection and management while enhancing compatible human uses.

The HETF vision for Laupāhoehoe Forest is as an important research, education, and demonstration forest where globally relevant activities are conducted to benefit the people and ecosystems of Hawai‘i, all Pacific islands and the tropical world. The forest will provide research, demonstration, training and education opportunities for scientists, post-doctoral fellows, graduate and undergraduate students, K-12 school children who are the future generations of land managers/stewards, forest users, landowners, and scientists in Hawai‘i.

DLNR lands within Laupāhoehoe Forest designated as NAR are managed by DOFAW under the state’s Natural Area Reserves System (NARS). The NARS seeks to protect the best remaining examples of the state’s unique ecosystems and strives to actively manage these reserves in order to preserve the unique characteristics that make these areas an integral part of the natural heritage of Hawai‘i. Reflecting this, the mission of the NARS program is: “The NARS exists to ensure the highest level of stewardship for Hawai‘i’s natural resources through acquisition, active management, and other strategies.”





DLNR lands within Laupāhoehoe Forest designated as FR are managed by DOFAW under the state's Forest Reserve System. The Forest Reserve System was created by the Territorial Government of Hawai'i through Act 44 on April 25, 1903 to protect key forested watersheds. In addition, forest reserves are managed to provide recreational opportunities; aesthetic benefits; native; cultural resources; and threatened and endangered species habitat protection among many other things (cultural use and gathering, hunting).

### Laupāhoehoe Advisory Council (LAC)

Formed in December 2010, the LAC is a community based advisory council that provides guidance and consultation to DOFAW and USFS relating to management, research, and education activities in the Laupāhoehoe Forest. The LAC's mission statement: Within our Hawaiian culture establish community support in the development of strategies for the long-term management, protection and utilization of existing and potential forest resources.



*Laupāhoehoe Advisory Council field trip*

### Management Plan Development Process

The management plan for Laupāhoehoe Forest was jointly developed by DOFAW, USFS and the LAC through a collaborative planning process. The Management Plan is a long-term management vision and covers a time-frame of fifteen years.

This plan serves as a DOFAW site-specific plan for the two state-managed parcels of land within Laupāhoehoe Forest. The plan provides a brief history of the FR and NAR, a description of cultural and natural resources, and proposed management actions for the area.

The plan also serves as the USFS plan for Laupāhoehoe Forest Unit of the experimental forest. The specific management, research, and education objectives and activities for the HETF are described in an overarching USFS Master Plan document and in individual plans for each of the two units: the Laupāhoehoe Forest plan (this document) and the Management Plan for the Ahupua'a of Pu'u Wa'awa'a and the Makai Lands of Pu'u Anahulu (state of Hawai'i 2003).

## ***General Information***

### Location

Laupāhoehoe Forest is situated on the eastern, windward flanks of Mauna Kea in the North Hilo District on the island of Hawai'i (TMK #'s (3) 3-7-001:002, (3) 3-7-001:012). Laupāhoehoe Forest stretches from from about 1,700 to 6,100 feet (ft) (518–1860 meters (m)) elevation and includes several stream drainages (Figure 1). The forest is located on the Hamakua Coast above the town of Laupāhoehoe, which has an estimated total population of 614 (U.S. Census Bureau 2012).



Figure 1

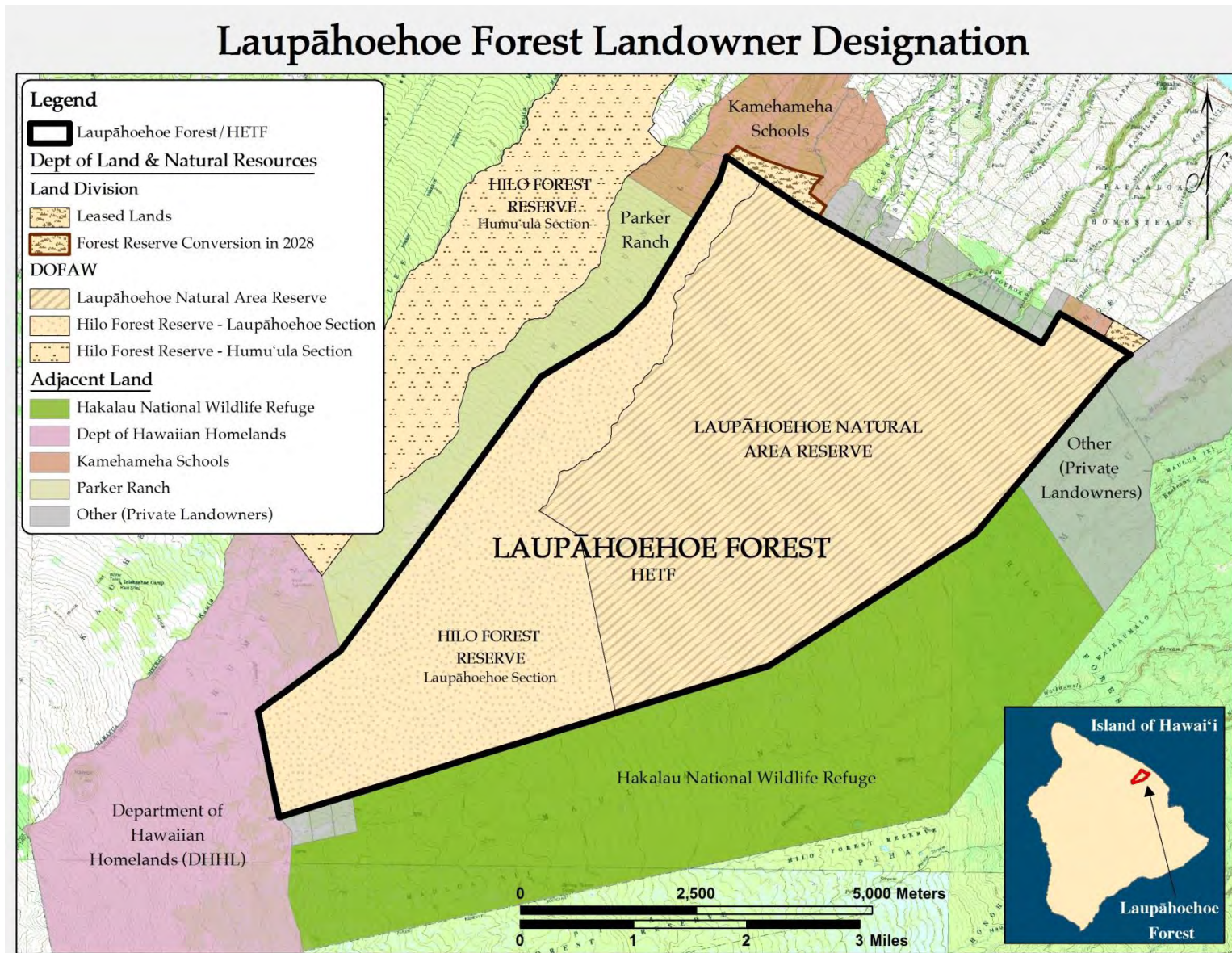
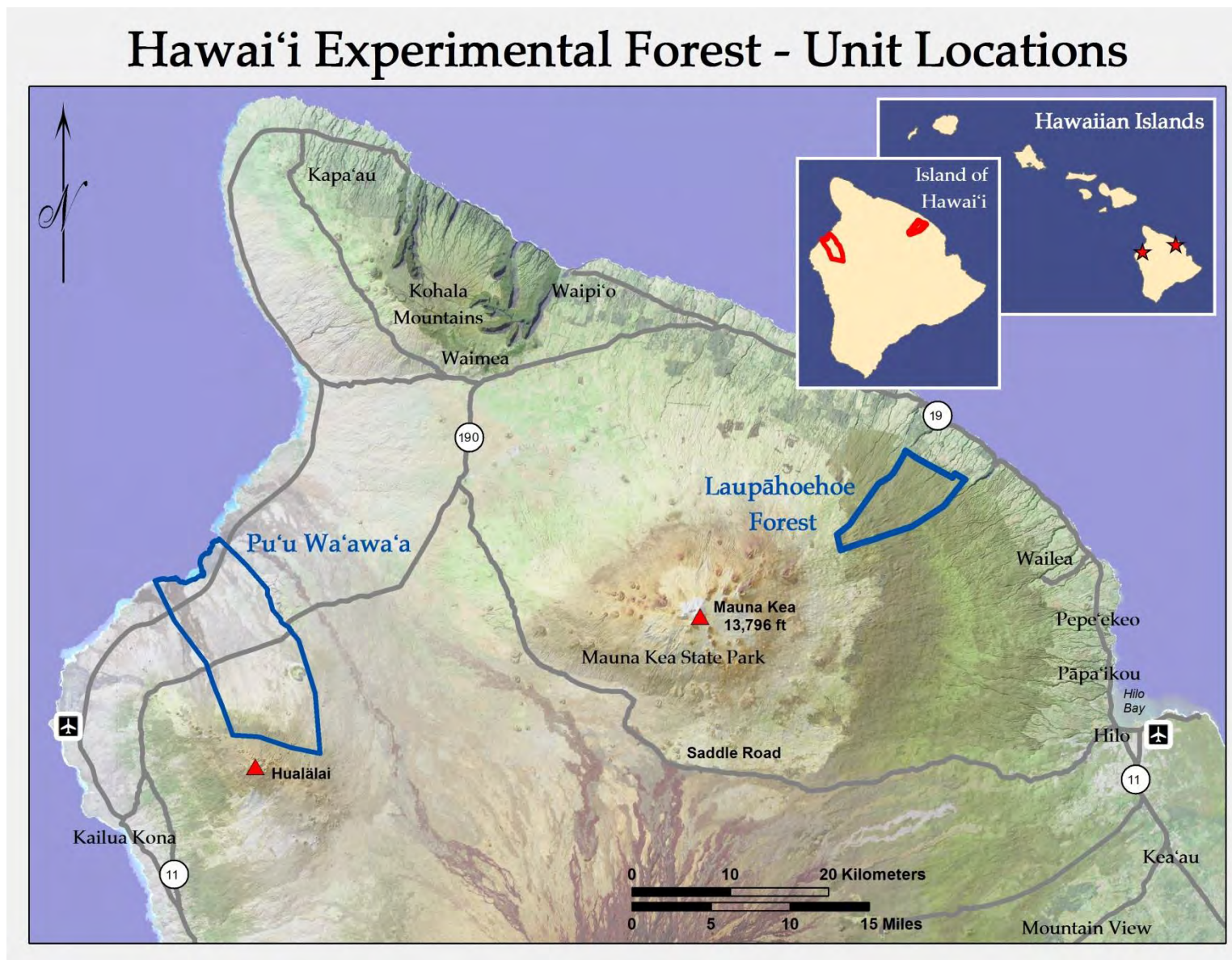




Figure 2



## *Management Focal Areas*

### Natural Resources

The protection and effective management of natural resources particularly forested watersheds, unique native Hawaiian ecosystems and threatened and endangered species are a priority for the two parcels of state lands within Laupāhoehoe Forest, and the original purpose for their designations as state NAR and FR. These natural resources require active management in order to persist for the benefit of current and future generations. Key aspects of natural resources management addressed in this plan include:

- Protection and management of watershed and water resources for downstream human and wildlife populations
- Protection of unimpeded surface and/or groundwater flows to the ocean
- Overview of existing natural resources and description of known threats to those resources
- Description of past and current management actions
- Management actions proposed to effectively address threats to natural resources
- Protection and restoration of native Hawaiian ecosystems and species at Laupāhoehoe Forest, including rare and endangered plants and animals
- Linking management to research to develop more effective management techniques
- Monitoring results to assess the effectiveness of management actions, and adjusting management, if necessary, in an adaptive management approach



*Natural resources in Laupāhoehoe Forest include numerous streams*





## Research

Laupāhoehoe Forest is part of a national network of experimental forests and provides researchers with a globally unique opportunity to study wet tropical ecosystems within a larger landscape that stretches across an environmental gradient ranging from sea level to alpine ecosystems. Information from research is critically needed by land managers to help effectively manage the area, particularly the threats posed by invasive species and changing conditions due to climate change impacts. Research can also help us to better understand basic ecological and evolutionary processes, and develop adaptable approaches and effective ways to sustain, enhance and restore the capacity of ecosystems to provide goods and services under changing environmental conditions. Primary areas of research to be promoted and emphasized at Laupāhoehoe Forest include:

- Long-term trends in native montane tropical forest ecosystem conditions and dynamics
- Montane tropical forest ecosystem structure, dynamics, and threats
- Impacts of climate change on wet tropical ecosystems and the services they provide
- Impacts of invasive, non-native plants and animals on montane tropical forest species, communities and ecosystems
- Methods of restoring and maintaining ecosystem function and services in the face of global change
- Methods of restoration that integrate cultural and scientific knowledge
- Methods and approaches that enhance community based collaborative stewardship of natural resources

## Education and Outreach

Laupāhoehoe Forest will serve as a center for demonstration, education, training, and outreach on tropical forestry, conservation biology, and natural resources research and management. Education and outreach goals will be accomplished through a strong reliance on partnerships. Education and outreach goals span six focal areas:

- *Formal training for professionals:* Provide work experience and professional development in ecology, conservation, and restoration.
- *Community outreach:* Communicate research findings and management goals, and foster a connection to nature and forest stewardship through engagement activities that involve the public through collaboration with partners including K-12 education program partners.
- *Cultural training:* Exposing researchers, students and managers



*Educational programs include hands-on activities such as growing trees for forest restoration projects*





to cultural knowledge directed at managing forest and coastal resources, including native Hawaiian perspectives and approaches.

- *Demonstration for managers*: Delivery of information, tools and techniques to managers through demonstration research, conservation, and restoration projects.
- *Student research*: Foster and support undergraduate and graduate level research opportunities and research internships.
- *Academic education*: Collaborate with universities to integrate college courses and support courses via state and federal facilities.

### Public Access and Recreation

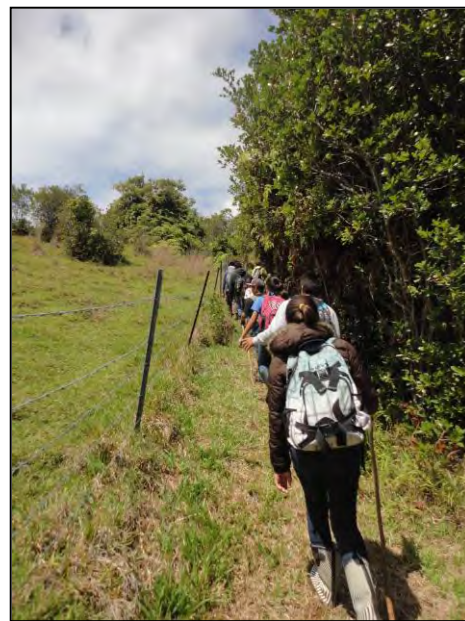
Laupāhoehoe Forest is protected and managed by the state for the benefit of the people of Hawai‘i, and is open to the public for various recreational and cultural uses. The use of Laupāhoehoe Forest for activities such as hiking, hunting and traditional and cultural practices, are high priorities for the local community. Management to encourage and enhance public access and recreation includes:

- Encouraging low-impact recreational activities and improvements such as pedestrian trails that are consistent with the remote, wilderness nature of Laupāhoehoe Forest to minimize recreational impacts on natural and cultural resources.
- Improving recreational opportunities by maintaining existing trails and creating new trails to establish a connected trail system.
- Securing new public access routes and appropriate areas for additional forest protection through easements, land acquisition and/or public access agreements with adjacent landowners.
- Continuing to facilitate public hunting in Laupāhoehoe Forest by securing and improving access and trails.
- Providing trails that offer educational and outreach experiences for the public to highlight conservation, restoration and management demonstration sites.

### Infrastructure

Facilities and infrastructure such as roads and trails are essential to facilitate and support the use of HETF for research and education, for natural resources management activities and for public recreation. Goals for the infrastructure and facilities at Laupāhoehoe Forest include:

- Develop and maintain roads, trails, cabins/shelters and campsites for the functions of the HETF and for resources management actions as well as for public recreational use.
- Ensure facilities and infrastructure has minimal impacts on the environment and natural and cultural resources.



*Laupāhoehoe Forest access trail*



## DESCRIPTION AND CURRENT CONDITION

### *Land Use*

#### Land Designation and Management

State lands in the Laupāhoehoe Forest are under overall administration of DLNR. The Board of Land and Natural Resources (BLNR) sets policies for the Department. DOFAW is the Division of DLNR charged with management of the lands which are designated as both NAR and FR. Other relevant planning documents associated with Laupāhoehoe Forest are provided in Table 1.

Both DOFAW and IPIF have responsibilities in the management of the experimental forest and IPIF activities are authorized under a 2006 Cooperative Agreement between the BLNR and the USDA Forest Service as well as a permit for use of state lands. Land management and protection responsibilities remain with the state and are managed under relevant state laws and regulations. The IPIF participates in the administration of research and education activities; authority for signing of all permits lies with DOFAW. The IPIF administers the research/education infrastructure.

The Hawai‘i State Constitution Article 11 states: “For the benefit of present and future generations, the state . . . shall conserve and protect Hawaii's natural beauty and all natural resources, including land, water, air, minerals and energy sources, and shall promote the development and utilization of these resources in a manner consistent with their conservation and in furtherance of the self-sufficiency of the state. All public natural resources are held in trust by the state for the benefit of the people.”

DOFAW has management responsibility for the 4,449 ac (1,800 ha) Laupāhoehoe section of Hilo FR, which is part of the state Forest Reserve System (Figure 1). Hilo FR was originally established in 1905 for the purpose of watershed protection, and various parcels have been added and withdrawn from the FR since it was established. The FR portion of the Laupāhoehoe Forest is approximately 1,700 to 6,100 ft (518–1,860 m) elevation.

The Forest Reserve System was created by the Territorial Government of Hawai'i through Act 44 on April 25, 1903. With Hawaii's increase in population, expanding ranching industry, and extensive agricultural production of sugarcane and later pineapple, early territorial foresters recognized the need to protect mauka (upland) forests to provide the necessary water for agriculture and surrounding communities. The Forest Reserve System is managed under the guidance of the Hawai‘i Revised Statutes ([Chapter 183](#)) and associated Hawai‘i Administrative Rules ([Chapter 104](#)). Through these directives, DOFAW focuses its resources to protect, manage, restore, and monitor the natural resources of the Forest Reserve System. The Forest Reserve System accounts for over 448,000 acres of state managed land on the island of Hawai‘i.

Laupāhoehoe Forest includes approximately 7,894 ac (3,195 ha) withdrawn from the FR and designated as a NAR in 1983 by Executive Order 3168 (Figure 1). The NAR was designated to protect wet forests of koa (*Acacia koa*) and ‘ōhia (*Metrosideros polymorpha*), wet grasslands and streams, all of which provide important habitat for plants and animals, including rare species. The NAR portion of Laupāhoehoe Forest includes lands from approximately 1,700 to 4,600 ft (518–1,402 m) on the slopes of windward Mauna Kea. The Natural Area Reserves System (NARS) was



created in 1971 by the Hawai‘i State Legislature to “preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawai‘i (HRS § 195-1)”. The legislature further found that these unique natural assets should be protected and preserved, both for the enjoyment of future generations and to provide baselines against which changes to Hawaii’s environment can be measured. The NARS is administered by DLNR-DOFAW. NARS Commission members act in an advisory capacity for the Board of Land and Natural Resources, which sets policies for the Department. Hawai‘i Administrative Rules 13-209 relate to the management of the NARS.

The NARS presently consists of 20 reserves on five islands, encompassing more than 123,000 ac (49,776 ha) of the state’s most unique ecosystems. The diverse areas found in the NARS range from marine and coastal environments to alpine desert, and from fresh lava flows to wet forests. These areas often serve as habitat for rare native plants and animals, many of which are on the verge of extinction. The NARS also include important watersheds, contributing to Hawai‘i’s sources of drinking water. Finally, the NARS forms an important part of the scenic landscape and contributes to the natural beauty of Hawai‘i, contributing to the islands’ overall appeal to visitors. Some of the most recognizable and visited NARS include Mauna Kea Ice Age NAR (Hawai‘i), Ka‘ena Point NAR (O‘ahu), and ‘Āhihi-Kīna‘u NAR (Maui).

The DOFAW website located at <http://dlnr.hawaii.gov/2013dofaw/> provides general information on both NAR and FR programs and policies across the state.

Laupāhoehoe Forest is also designated as part of the HETF, which was formally established in 2007. The HETF currently includes two units: the Laupāhoehoe Forest Wet Forest Unit and the Pu‘u Wa‘awa‘a Dry Forest Unit (Figure 2). The USFS works with the state in the management of the experimental forest.

The purposes of the HETF are to: (1) understand how to restore, preserve, and sustainably manage native tropical forests, streams, and watersheds of the Pacific, and to provide information to those managing these landscapes; (2) provide a center for demonstration, education, training, and outreach on tropical forestry, conservation biology, and natural resources research and management; (3) provide sites dedicated to long-term research on tropical forestry, ecology, hydrology, conservation biology, and natural resource management; and (4) foster research cooperation and collaboration between state and federal agencies, and among agencies and other institutions in tropical forestry research.



*Laupāhoehoe Forest provides a site for long-term research on tropical forests*



Other DLNR Divisions and DOFAW Programs also have various responsibilities related to Laupāhoehoe Forest:

- Division of Conservation and Resource Enforcement (DOCARE) - DOCARE has full police powers and is responsible for the enforcement of state laws and rules at Laupāhoehoe Forest, including laws regulating hunting and protection of resources (e.g. illegal harvesting, vandalism etc.).
- Nā Ala Hele - The Hawai‘i Statewide Trail and Access System is a DOFAW Program that has responsibility for trails and access. This program regulates and manages specific trails and accesses; conducts trail and access inventory; investigates potential and needed trails and accesses; examines legal issues; acts as point of contact for trail and access information and issues; and conducts trail and access advisory council meetings.
- Division of Aquatic Resources (DAR) - Manages marine and freshwater resources through programs in commercial fisheries and aquaculture; aquatic resources protection, enhancement and education; and recreational fisheries.
- State Historic Preservation Division (SHPD) - Works to preserve and sustain reminders of earlier times which link the past to the present. SHPD has three branches - History and Culture, Archaeology, and Architecture.
- Office of Conservation and Coastal Lands (OCCL) - Responsible for overseeing private and public lands that lie within the State Conservation District, including designated Conservation District lands in Laupāhoehoe Forest. Conservation District subzones define identified land uses which may be allowed by discretionary permit or some sort of approval from the DLNR or BLNR. NAR portions of Laupāhoehoe Forest are in the Protective Subzone and lands within the FR are in the Resource Subzone.



**Table 1.** *Related Federal, State and County Planning Documents*

Planning Document	Comment
Hamakua Community Development Plan (plan under development)	County of Hawai‘i plan <a href="http://www.hawaiicountycdp.info/hamakua-cdp">http://www.hawaiicountycdp.info/hamakua-cdp</a>
The Rain Follows the Forest - A Plan to Replenish Hawaii’s Source of Water (DLNR 2011)	Laupāhoehoe Forest is identified as a priority watershed area on the island of Hawai‘i
DOFAW Statewide Assessment and Resource Strategy (SWARS) (DLNR 2010)	Identifies areas of greatest need and opportunity for forests in Hawai‘i and develops a long-term management strategy. Objectives include: 1.1. Identify and conserve high-priority forest ecosystems and landscapes; 2.2. Identify, manage and reduce threats to forest and ecosystem health; 3.3. Enhance public benefits from trees and forests; 3.1. Protect and enhance water quality and quantity; 3.5. Protect and enhance wildlife and fish habitat; 3.7. Manage and restore trees/forests to mitigate and adapt to global climate change.
Draft Mauna Kea Watershed Alliance Management Plan (Stewart 2010)	DOFAW and USFS are members of the Mauna Kea Watershed Alliance and Laupāhoehoe Forest is included in this partnership area. The Mauna Kea Watershed alliance includes major landowners on Mauna Kea with a shared interest to protect the ‘aina by working together to manage threats that occur across common land ownership





Planning Document	Comment
	boundaries, pooling limited resources to achieve conservation goals, and promoting collaboration in protecting vital resources across large landscapes.
U.S. Fish and Wildlife Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006)	Supports recovery actions 1 and 2: protect and manage ecosystems for the benefit and recovery of native forest birds.
Hawai‘i Comprehensive Wildlife Conservation Strategy (DLNR 2005)	Statewide strategy for the conservation of native wildlife and plants. Identifies species of greatest conservation need.
County of Hawai‘i General Plan (County of Hawai‘i 2005)	8.2(c) Protect and promote the prudent use of Hawai‘i’s unique, fragile, and significant environmental and natural resources. 8.2 (d) Protect rare or endangered species and habitats native to Hawai‘i. 8.3 (b) Encourage a program of collection and dissemination of basic data concerning natural resources. 8.3 (e) Encourage an overall conservation ethic in the use of Hawai‘i resources by protecting, preserving, and conserving the critical and significant natural resources of the County. 8.3 (o) Encourage the continued identification and inclusion of unique wildlife habitat areas of native Hawaiian flora and fauna with the NARS.
U.S. Fish and Wildlife Final Designation and Non-designation of Critical Habitat for 46 Plant Species From the Island of Hawai‘i, HI (UFWS 2003)	Provides recommendations for habitat management for <i>Cyrtandra giffardii</i> , <i>Cyanea platyphylla</i> , <i>Clermontia peleana</i> , <i>Clermontia pyrularia</i> , <i>Cyrtandra tintinnabula</i> , and <i>Phyllostegia warshaueri</i>
U.S. Fish and Wildlife Service. Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster (USFWS 1998a)	Describes recovery actions needed for endangered plant species: <i>Cyanea platyphylla</i> , <i>Phyllostegia racemosa</i> , and <i>Phyllostegia warshaueri</i>
U.S. Fish and Wildlife Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998b)	Describes recovery actions needed for the Hawaiian Hoary Bat including protecting and managing current populations.
U.S. Fish and Wildlife Recovery Plan for the Big Island Plant Cluster (USFWS 1996)	Describes recovery actions needed for <i>Clermontia lindseyana</i> , <i>Clermontia peleana</i> , <i>Cyrtandra giffardii</i> , and <i>Cyrtandra tintinnabula</i> .
Hawai‘i Tropical Forest Recovery Action Plan Hawai‘i Tropical Forest Recovery Task Force (1994)	Plan to develop consensus actions needed to recover, manage, and enhance Hawaii's tropical forests
Laupāhoehoe Natural Area Reserve Draft Management Plan (DLNR 1989)	Previous management plan for the NAR

### Land Use History

Laupāhoehoe Forest and the surrounding areas have a rich history that has shaped the way the landscape looks today. In 2006, Kumu Pono Associates prepared *Hilo Palikū - Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe Forest Section, Ahupua‘a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai‘i* (Maly and Maly 2006). This detailed study provides extensive background of the history and cultural resources of the area from ancient Hawaiian uses to the present day and is also discussed further in the Social and Cultural Background portion of this plan. The complete study is available online (see REFERENCES).

In the collection of native and historical accounts, Kumu Pono Associates notes that the lands of the Laupāhoehoe forest region were frequently mentioned in several prominent traditions. Significantly,





the importance of the Laupāhoehoe region koa forests, mountain bird habitats, and the traditional trails which connected the lowlands with the mountain lands and neighboring districts, are frequently referenced in traditions and historical accounts. Also, battles fought on the Laupāhoehoe lands were among those which established the kingdoms of chiefs between the early 1500s to the late 1700s.

In the mid Nineteenth Century the lower elevation portions of fourteen ahupua‘a (traditional land subdivisions encompassing swaths of land running from the coast to the interior mountains) were sought for sugar plantations. By 1876, the Laupāhoehoe Sugar Company and Mill was developed and lowland forests up to about the 2,000-foot elevation were cleared for sugar cultivation, the development of flumes and water resources and homestead lots (Maly and Maly 2006). By the late Twentieth Century sugar production on Hawai‘i was no longer economically competitive with production in other tropical locations and the sugar plantations closed (Maly and Maly 2006).

During the early historic period, the upland section of the Laupāhoehoe forests was impacted by herds of wild sheep and bullocks. By 1825, foreign bullock hunters had established camps on the outer edges of the forest, in the region where Laupāhoehoe and neighboring lands are cut off by the ahupua‘a of Humu‘ula. By the 1850s, the bullock and sheep hunting activities were giving way to formal ranching operations, with the land of Humu‘ula taking in sections of the Laupāhoehoe forests (Maly and Maly 2006).

Timber harvesting has also impacted the landscape. Forests in the area were used by traditional canoe makers and others over many centuries, but the pace of harvesting increased by the middle 1800s when sawmills were established in windward Hawai‘i Island and lumber was harvested and milled for growing island communities and businesses. The negative impacts of logging and grazing on the land were noted by the middle to late 1800s, and government leases began to incorporate conditions meant to conserve forest resources. After establishment of the Hilo FR in 1905, almost no collection of lumber occurred in the Laupāhoehoe section, except for that in direct association with management of the ranch lands. Timber harvest again impacted the area in 1969, when Blair, Inc. received a right of entry permit from DLNR and built a road within Laupāhoehoe FR. A license to harvest timber, primarily koa was awarded to Blair, Inc. in 1971. The Blair logging operation impacted approximately 1,000 acres and was terminated by 1979, when Blair went out of business (Maly and Maly 2006). Research after the logging operation indicated that disturbance from logging stimulated koa regeneration but invasion of banana poka (*Passiflora tarminiana*) was also noted (Scowcroft and Nelson 1976). A later study found impacts of the former logging operation including an increase in invasive tropical ash (*Fraxinus uhdei*), which outcompetes native tree species in disturbed areas (Friday et al. 2008).

In 2006, DOFAW prepared a plan and environmental assessment for reforestation of the timber harvest area (state of Hawai‘i 2006) that included scarification to increase koa (*Acacia koa*) regeneration. DOFAW staff never implemented the project because other management actions including removal of feral cattle and introduction of a biocontrol agent to control the invasive non-native banana poka in the area enhanced natural regeneration of the forest. The biocontrol agent proved successful in reducing banana poka (Trujillo et al. 2001). Native species, particularly koa and ‘ākala (*Rubus hawaiiensis*) are recovering in the former timber harvest area although other invasive non-native plants are still a problem.



### Public Access and Recreation

Laupāhoehoe Forest is open to the public for various recreational and cultural uses. While the public is permitted to access and hike or hunt in any portion of the forest, there are limited legal access points and only a few minimally maintained and marked trails. This area is rough and remote rainforest wilderness and there are currently no amenities for recreational users.

Some uses in the NAR, including hiking or nature study with groups larger than ten, research, scientific collecting, gathering (including Native Hawaiian religious and customary gathering rights) and commercial uses require an HETF permit. Gathering within the FR also requires a permit (see Gathering).

### Vehicle Access

Mauka and makai public access to Laupāhoehoe Forest is currently via two main access points off Spencer Road and Mana Road respectively (Figure 3). These roads provide vehicle access to approximately the forest boundary:

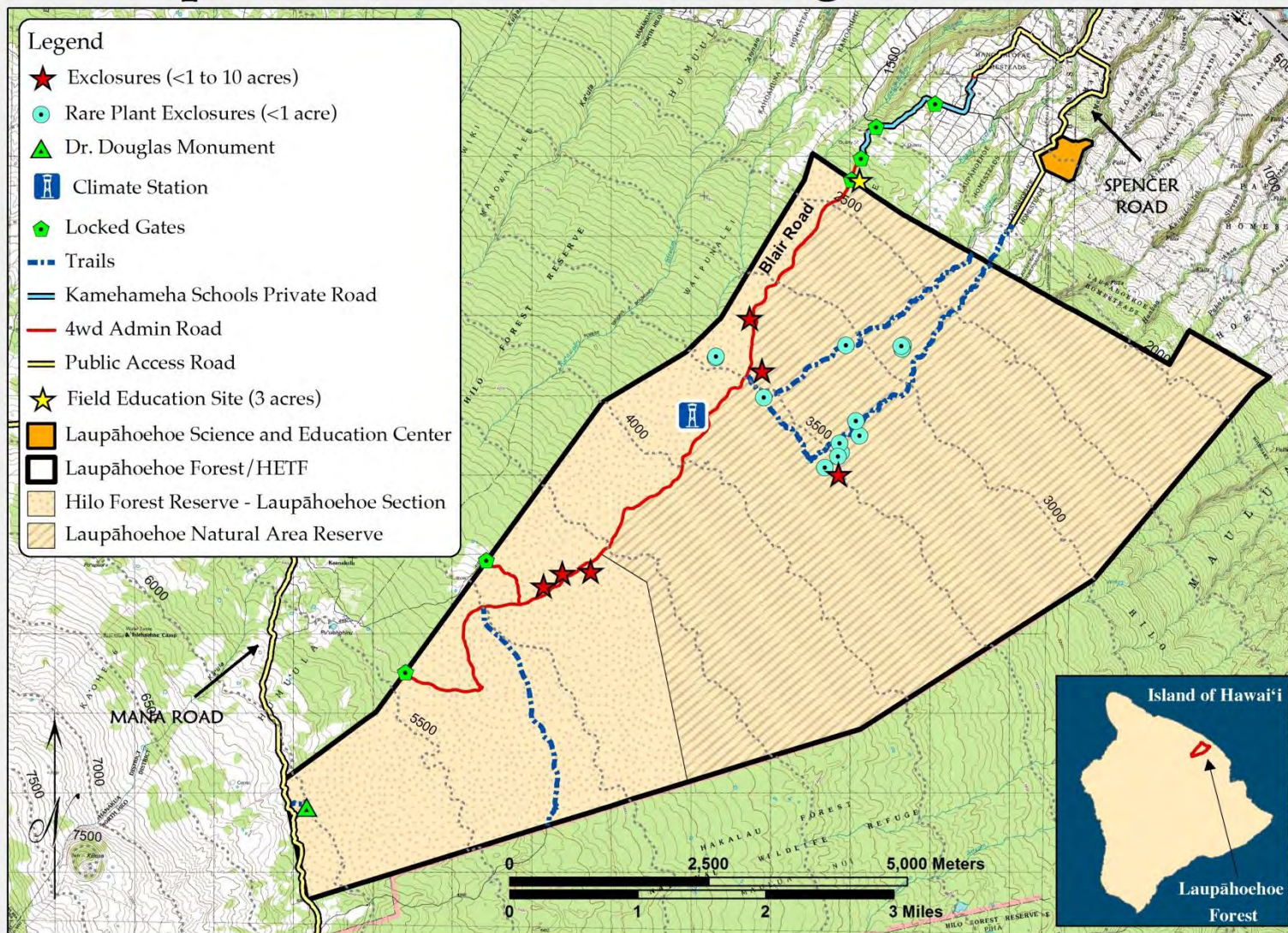
- Spencer Road Access - The state has an easement through private pasture lands at the top of Spencer Road to allow for public pedestrian access to the lower boundary of Laupāhoehoe Forest. Spencer Rd. is a paved County road passable in a two-wheel drive vehicle. There is a small grassy area where vehicles may park mauka of where Spencer Rd. terminates. A primitive, minimally user-maintained trail provides pedestrian access from the parking area to the forest (see other primitive trails below).
- Mana Road Access - Mana Rd. is a 4-wheel drive County road approximately 40 miles long that roughly transverses a contour along Mauna Kea. Mana Rd. is accessed via Mauna Kea Access Rd. (off Saddle Road) on the Hilo side or from the town of Waimea. The first six miles of the road are regularly maintained at both entrances. The road intersects the top of the Laupāhoehoe Forest. A Nā Ala Hele designated trail, Kaluakauka Trail, is accessed via this route (see description under Trails section below).





Figure 3

# Laupāhoehoe Forest Existing Infrastructure



### Trails

Trails within Laupāhoehoe Forest include the following:

- Kaluakauka Trail – The trailhead for this Nā Ala Hele designated trail is on the makai side of the Keanakolu-Mana Rd., 17.7 miles from the junction with Mauna Kea access road. The trail is considered moderately difficult and is unmarked and rarely maintained (as described per the official website, <http://hawaii Trails.ehawaii.gov/>). The trail goes downhill across forested pasture land to a foot gate in the FR boundary fence, then continues to the Dr. David Douglas monument erected in 1934 (approximate death site of Dr. David Douglas, the Scottish botanist for whom the Douglas Fir is named).
- Maulua Trail – A portion of this historic ranching-era trail goes across the upper section of Laupāhoehoe Forest from the boundary near Shack Camp to Waipunalei. Access to this portion of the trail is via Blair Rd.
- Other Trails – Additional trails can be found within Laupāhoehoe Forest, notably Peneki and Spencer trails (Figure 3). These trails are not formally recognized as public access trails and are not marked or maintained. These primitive trails were created by the hunting community from the Spencer Road access point. Trail conditions are hazardous, steep and muddy, and lower elevation portions of the trail within the strawberry guava belt may frequently be ‘tunneled’ in by guava tree windfall.

### Mountain Biking

Mountain biking is legal on FR roads unless otherwise posted. There are no legal public access trails suitable for mountain biking that access Blair Rd. within the FR. Accessing roads or trails across private lands to reach Blair Rd. without landowner permission is illegal.

### Hunting

DOFAW manages public hunting on all state lands and hunting in the Laupāhoehoe Forest is regulated by Chapter 13-122,123, Hawai‘i Administrative Rules (Rules Regulating Game Bird Hunting, Game Mammal Hunting). The Laupāhoehoe Forest includes hunting units B and C in the FR and hunting unit K in the NAR (Figure 4). There is a hunter check station at the Spencer Rd. access. DLNR’s Division of Conservation and Resource Enforcement (DOCARE) carries out enforcement of hunting regulations. Current information regarding hunting rules, seasons and bag limits for all game species can be obtained by contacting the DOFAW Hilo office at 19 East Kawili St. Hilo, Hawai‘i, (808) 974-4221.

All persons are required to have a valid Hawai‘i hunting license on their person to hunt or have a bagged game mammal in their possession. Hunting licenses may be purchased online from <http://www.ehawaii.gov.org/DLNR/hunting/>, from any DOFAW office or from any registered hunting license vendor. All hunting license applicants must show proof of having successfully completed a hunter education course that is recognized by the National Hunter Education Association.









### Camping

There are no designated camping areas and no camping is currently allowed in the Laupāhoehoe Forest.

### Gathering

Small-scale non-commercial harvesting or salvage is allowed in the FR section of Laupāhoehoe Forest, such as materials for cultural uses. Non-timber forest products such as ferns, maile (*Alyxia stellata*), flowers, fruits, and lei-making materials etc. for cultural or personal use may be collected from within the FR. Gathering of forest products is permitted and regulated by DOFAW through Forest Reserve System permit procedures. Permit applications for gathering plant material can be obtained from the DOFAW Hilo office at 19 East Kawili Ave. Hilo, Hawai‘i, (808) 974-4221. These permits are available, upon approval, free of charge (for common, personal use items) or for a fee, depending on the purpose. Gathering of materials from listed endangered species is not permitted. Gathering (including Native Hawaiian religious and customary gathering rights) within the NAR portion of the forest requires an HETF permit.

### Existing Infrastructure and Facilities

#### Roads

Spencer and Mana roads provide public access to the Laupāhoehoe Forest boundary (see Public Access and Recreation). There is an existing road located within Laupāhoehoe Forest used for management, research and educational purposes, but this road is not currently available for public vehicular access as private lands/roads must be traversed in order to reach the road, as well as liability issues and maintenance costs.

- Blair Road - Blair Rd. requires 4-wheel drive and is contained within Laupāhoehoe Forest (Figure 3). This road is used for management, research and education purposes by the state and the USFS. Public pedestrian use of the road on state lands is allowed for people who access the road by hiking through the forest from public access points (Spencer Rd. or Mana Rd. access). The state has an easement trade with Parker Ranch for use of Blair Rd in exchange for use of Parker Ranch roads to access other portions of the Hilo FR (Humu‘ula section). Historically, Blair Road was built and extended between 1969-1973, and used for logging portions of Laupāhoehoe Forest.

#### Facilities/Structures

- USFS Facilities - The Laupāhoehoe Science and Education Center, located approximately 4 miles from the Laupāhoehoe Forest boundary, enhances the ability of the HETF to meet its goals for research, education, and demonstration (Figure 3). This facility serves as the primary support facility and includes a classroom, workshop, bunkhouse, and laundry facilities that can accommodate around 30 visiting scientists, educators or students for day-use and 15 visitors overnight. The facilities on this site are under construction and due to be completed in 2015. In addition the Forest Pavilion (Field Education Site) will be located on a 3-acre (1.2 ha) parcel located adjacent to the Laupāhoehoe Forest (Figure 3). It will consist of a covered pavilion, toilet/comfort station, and parking area, and it will be used primarily as a staging area for research and education trips into Laupāhoehoe Forest. The Forest Pavilion facilities are still in planning phase with completion dates TBD.



- Shack Camp – Shack Camp is located at approximately 5,200 ft (1,585 m) elevation near the intersection of the Laupāhoehoe Forest boundary and the historic Maulua Trail. This site contains the ruins of a historic structure associated with Kukaiau Ranch as well as an opening in the forest due to past cattle grazing.



*USFS Laupāhoehoe Science and Education Center*

### Regional Partnerships

DOFAW and USFS are both members of the Mauna Kea Watershed Alliance and the Laupāhoehoe Forest is included in this partnership area. This partnership includes approximately 484,000 ac (195,868 ha) on the mountain of Mauna Kea. The Mauna Kea Watershed Alliance seeks to manage critical watersheds on a landscape-level by initiating planning for priority areas with the goal of implementing management actions for threats such as feral ungulates, fire, and invasive non-native plants. Coordinated management of these watershed lands is critical to sustain adequate quality and quantity of water and provide important habitat for a wide diversity of native plants and animals, including many that are endangered. The Mauna Kea Watershed Alliance is currently working on several projects related to the HETF including sharing of cultural awareness and protocols for IPIF staff, providing review of the HETF Master plan as it is developed, and planning and implementing restoration of the Laupāhoehoe Science and Education Center grounds.

### ***Site Description (Physical and Biological Resources)***

#### Topography, Climate, Geology, and Soils

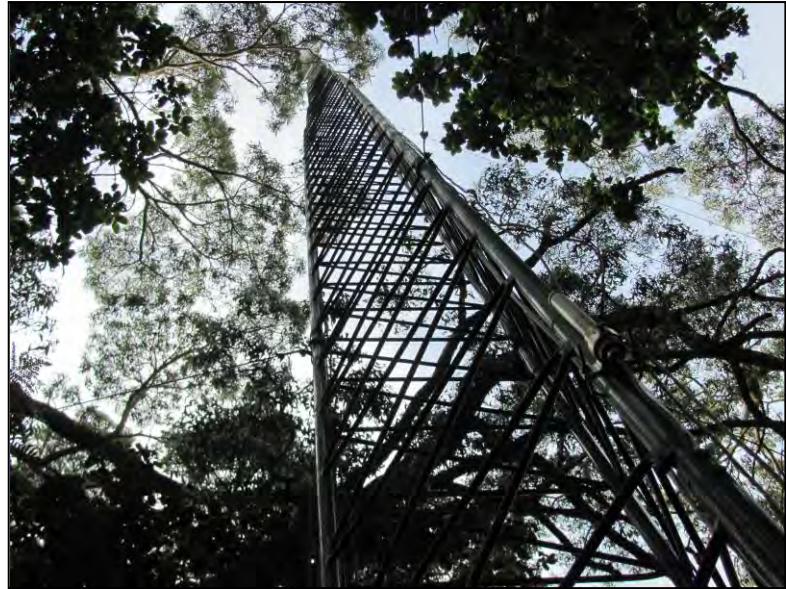
Laupāhoehoe Forest is located on the eastern, windward flanks of Mauna Kea from about 1,700 to 6,100 ft (518–1860 m) elevation. As the trade winds off the Pacific Ocean strike the mountain, moist air is elevated and cooled, resulting in cloudy weather, high rainfall rates and afternoon fog and mist in the area. Condensation from ground-level clouds (fog drip) contributes additional



moisture at higher elevations. Average annual rainfall in the lower elevations is about 160 inches (in) (418 centimeters (cm)) and ranges from 60 to 100 in (157 to 261 cm) in the upper elevations (HETF Establishment Record 2007).

Temperatures decrease with elevation. At sea level the average monthly day time temperatures range from 79 to 82 °F (26-28 °C) and the night time temperatures range from 62 to 70 °F (17-21 °C). At highest elevations, the temperature could be more than 20 °F (13 °C) colder than in the lowlands.

There is a climate station (maintained by the USFS) at Laupāhoehoe Forest within the FR recording a variety of information including: air temperature, relative humidity, solar radiation, soil moisture and temperature (Figure 3).



*Climate station at Laupāhoehoe Forest*

Laupāhoehoe Forest is located on Mauna Kea, a dormant volcano and the second oldest volcano on the island. Figure 5 depicts substrate age, which ranges from 5,000 years before the present to 300,000 years before the present (Sherrod et al.

2007). The terrain and soils varies with the age and type of surface lava flows and the depth of volcanic ash deposited over these flows (Wolf and Morris 1996). The terrain in the highest elevation areas is the youngest and the roughest. Surface flows in this area are grouped with the youngest of Mauna Kea's post-shield formation flow series and are characterized as predominantly a'a or blocky a'a flows which are generally free of the wind-blown volcanic ash deposits that cover the older Mauna Kea flows (Wolf and Morris 1996:13; Sheet 2). These younger a'a flows form a series of pronounced ridges that give the upper areas of Laupāhoehoe Forest a distinct ridge and swale topography. Soils on these flows are described as very stony loam (Sato et al. 1973: 15, Sheet 40).

In the upper mid-elevation of Laupāhoehoe Forest, the surface lava flows are older but are still grouped with those erupted during the younger, post-shield phase of Mauna Kea's development (Wolf and Morris 1996: 13; Sheet 2). These flows are also predominantly a'a or blocky a'a flows but are partially mantled by volcanic ash deposits. Soils on these flows are described as silt loam formed from volcanic ash (Sato et. al. 1973: 14 and 50, Sheets 33 and 40). These ash-derived soils are more weathered in the lower elevations where rainfall is slightly greater. Some areas can also be rocky where volcanic ash deposits are discontinuous. Natural Resources Conservation Service Soil Classifications are depicted in Figure 6.





Figure 5

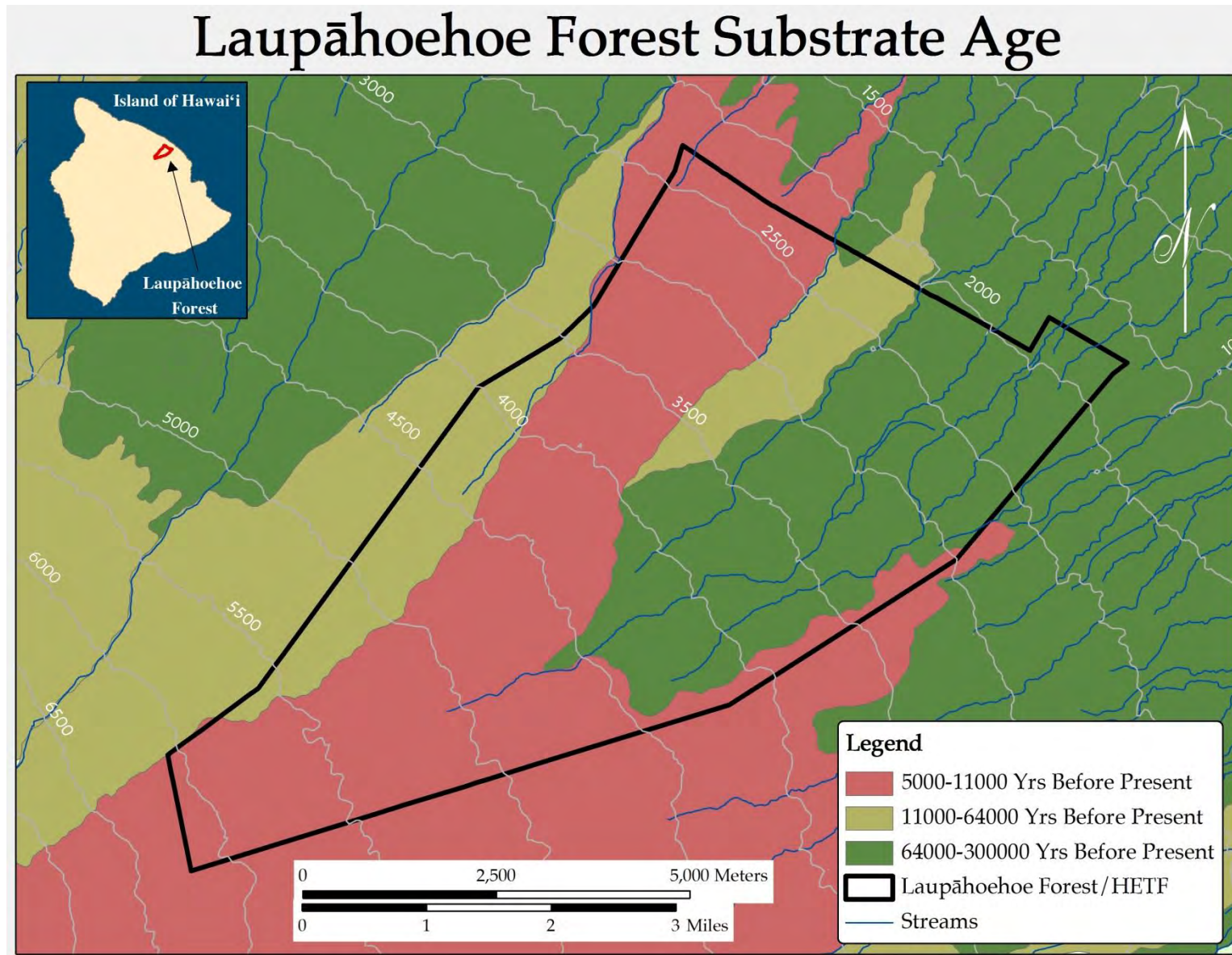
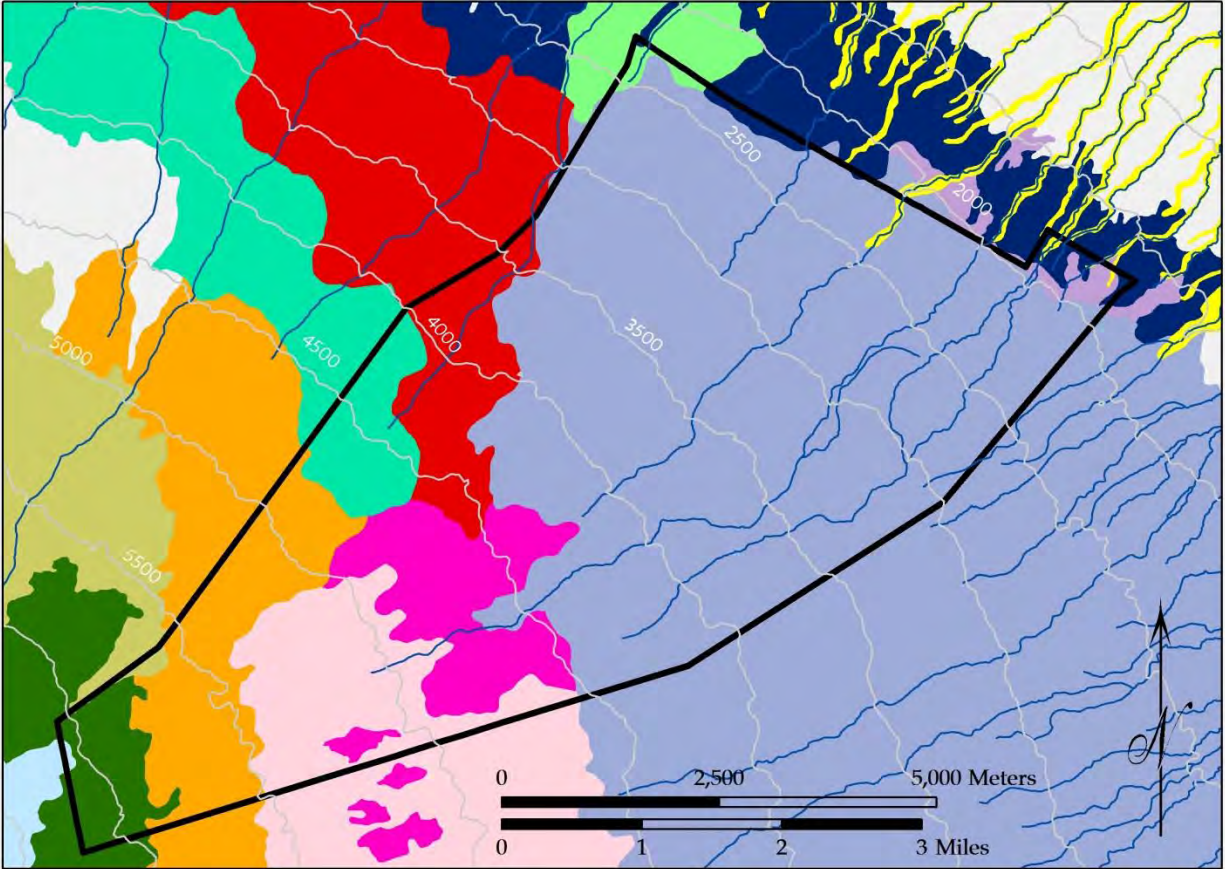

















Figure 6

# Laupāhoehoe Forest Soil Types



## Legend

- |   |  |
|---|--|
|  'Akaka Soils  |  Streams                 |
|  Apakuie Very Fine Sandy Loam, 12-20% slopes             |  Laupāhoehoe Forest/HETF |
|  Hanipoe Silt Loam, 12-20% slopes                        |  |
|  Hanipoe Very Stony Loam, 12-20% slopes                  |  |
|  Honoka'a Silty Clay Loam, 10-20% slopes                 |  |
|  Kaiwiki Silty Clay Loam, 10-20% slopes                  |  |
|  Kaiwiki Silty Clay Loam, 20-35% slopes                  |  |
|  Kiloa Extremely Stony Muck, 6-20% slopes                |  |
|  Maile Silt Loam, 6-20% slopes                           |  |
|  Pi'ihonua Extremely Stony Silty Clay Loam, 6-20% slopes |  |
|  Pi'ihonua Silty Clay Loam, 6-20% slopes                 |  |
|  Pu'u O'o Silt Loam, 6-12% slopes                        |  |
|  Rough Broken Land                                       |  |





## Water Resources

The Hilo FR (Laupāhoehoe section) was originally established in 1905 to protect the water supply of the district, and Laupāhoehoe Forest continues to provide important watershed services for the community. Native Hawaiians recognized the importance of forests in water production and water quality, as reflected in the Hawaiian proverb, “Haihai ka ua i ka ulu la au” (The rain follows after the forests). Early foresters also recognized the importance of Hawaiian forests as watersheds. Ralph Hosmer, the first Territorial Forester stated "In Hawai‘i, the most valuable product of the forest is water, rather than wood".

Laupāhoehoe Forest is an important source of fresh surface and ground water that supports downstream populations of humans and wildlife as well as supports healthy nearshore resources. Other watershed services provided by Laupāhoehoe Forest include: provision stream habitat for native waterbirds, fish, and invertebrates, forest habitat for native plants, birds, and bats, flood control, mitigation of climate change impacts, and economic, social, recreational and educational opportunities for the human communities in the area.

Numerous streams are found in the Laupāhoehoe Forest, including Ka‘awali‘i Stream, Laupāhoehoe Stream, Kīlau Stream, Kaiwilahilahi Stream, Ha‘akoa Stream, and Pāhale Stream (Figure 7, Table 2). The Atlas of Hawaiian Watersheds and Aquatic Resources (Parham et al. 2008) notes all these streams as perennial. However, the upper portions of these streams within Laupāhoehoe Forest are often intermittent. While the lack of surface water in these upper reaches makes it appear some of these streams within the forest may not necessarily be flowing year-round, subsurface groundwater flows from the forest maintain freshwater inputs to streams below Laupāhoehoe Forest. Stream gauges, used to measure natural stream flows, water quality and sediment in a non-destructive manner, are located in Manowai‘ōpai, Kaiwilahilahi, and Ka‘awali‘i streams below Laupāhoehoe Forest and are maintained by the USFS.



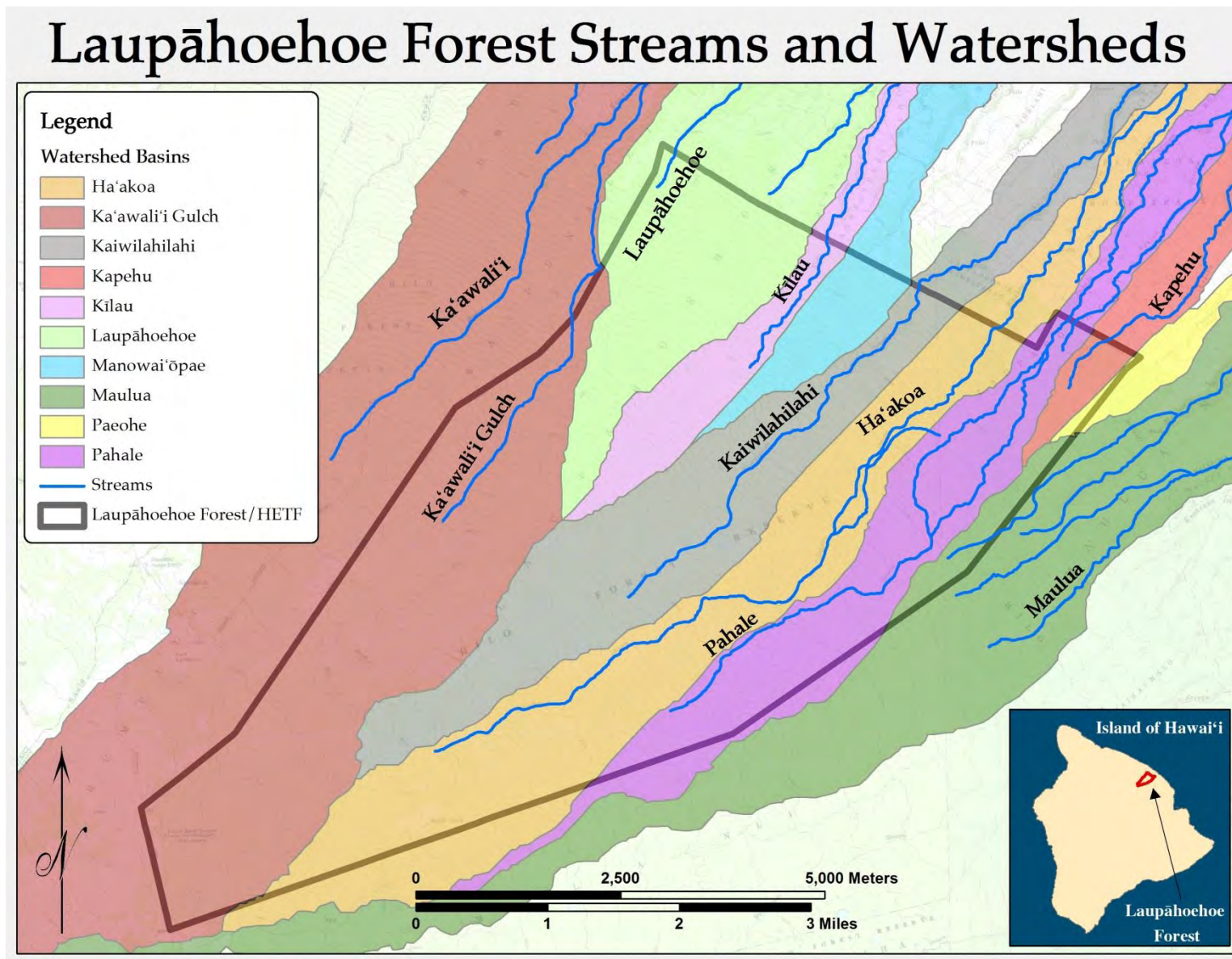
*Trees capture moisture from mist which adds to watershed recharge*

**Table 2.** Streams and Watershed Basins of Laupāhoehoe Forest (Parham et al. 2008)

Watershed Basin Name	Streams	Watershed Basin Name	Streams
Ka‘awali‘i Gulch	Ka‘awali‘i	Ha‘akoa	Ha‘akoa
Laupāhoehoe	Laupāhoehoe	Ka‘alau	Pāhale
Kīlau	Kīlau	Kapehu	Kapehu
Manowai‘ōpai	Manowai‘ōpai	Paeohe	Paeohe
Kaiwilahilahi	Kaiwilahilahi	Maulua	Maulua



Figure 7





## Forest Ecosystems

Laupāhoehoe Forest contains native-dominated forested landscapes from lowland forest at 2,300 ft (701 m) above sea level extending to almost 6,500 ft (1,981 m) in elevation. It is part of the largest remaining native dominated forest in Hawai‘i and largely dominated by ‘ōhi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*), the two most widespread tree species in native forest remaining in Hawai‘i. Laupāhoehoe Forest contains five primary native communities, as well as significant areas between 1,700 ft (518 m) elevation and



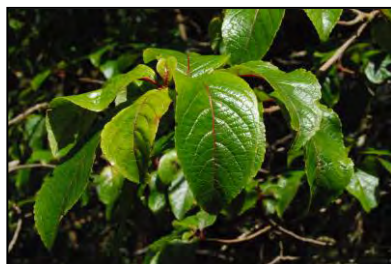
‘Ōhi‘a (*Metrosideros polymorpha*) and koa (*Acacia koa*)

~3,000 ft (914 m) of highly altered, non-native dominated vegetation cover (Figure 8). Forestry plantings along the lower boundary and in the lower east corner include non-native trees such as toon (*Toona ciliata*) and *Ficus rubiginosa*, and in the upper north corner, tropical white ash (*Fraxinus uhdei*). The tropical ash has invaded significant portions of higher elevation areas of the Laupāhoehoe Forest. Other non-native species occupy large areas. Banana poka (*Passiflora tarminiana*), an introduced vine, occurs throughout mid to high elevation areas and forms thickets in the swales. At the lower edge of this community type, below 3,000 ft (914 m) elevation, the understory is heavily invaded by several non-native plants including strawberry guava (*Psidium cattleianum*), thimbleberry (*Rubus rosifolius*), Koster’s curse (*Clidemia hirta*), Himalayan ginger (*Hedychium gardnerianum*), various grasses, and three species of parasitic strangler fig. A number of these species occur into mid or even high elevation areas of the Laupāhoehoe Forest. Non-native grasses and herbs are primarily pasture species (e.g., kikuyu grass, *Holcus lanatus*, and *Ehrharta stipoides*) and the vine, German ivy (*Delairea odorata*).

## Native Plant Communities

### a. Koa/‘Ōhi‘a Lowland Wet Forest

This forest type dominates in the lowest elevation area up to about 3,000 ft (914 m) elevation, where the Montane Wet Forest takes dominance. Lower elevation portions of this forest type are badly invaded by invasive, non-native species. In addition, some mixed non-native tree plantings occur at the lower boundary of the area in the east corner. Under the 80 ft (24 m) tall closed to open canopy of koa and ‘ōhi‘a, is a secondary tree layer in which olomea (*Perrottetia sandwicensis*), mehame (*Antidesma platyphyllum*), ālani (*Melicope clusiifolia*), and kōpiko



Olomea, kanawao, and mehame (from left to right)



(*Psychotria hawaiiensis*) are common. Other trees, such as ‘ōlapa (*Cheirodendron trigynum*) and kāwa‘u (*Ilex anomala*) are present, but not as common.

Hāpu‘u (*Cibotium glaucum*) is present, but of lower stature than in the Koa/‘Ōhi‘a Montane Wet Forest, and forms a discontinuous layer. Common shrubs include manono (*Hedyotis terminalis*), kanawao (*Broussaisia arguta*), ‘ōhelo (*Vaccinium calycinum*), and saplings of kāwa‘u and ‘ōlapa. The vines ‘ie‘ie (*Freycinetia arborea*) and maile (*Alyxia stellata*) are present, and ‘ie‘ie is sometimes abundant. Native ferns include wahine noho mauna (*Adenophorus* spp.), *Lycopodium cernuum*, *Athyrium* spp., *Elaphoglossum* spp., *Sphenomeris chinensis*, and others.

Rare plants observed in this forest type in surveys in the 1980’s include *Cyrtandra giffardii*, *Cyanea tritomantha*, *Gardenia remyi* and *Platydesma remyi*.

#### b. Koa/‘Ōhi‘a Montane Wet Forest

This montane wet forest distributes in areas from about 3,000 ft (914 m) elevation up to 4,500 ft (1372 m) elevation. It differs from the Koa/‘Ōhi‘a Lowland Wet Forest on its subcanopy species composition. Koa and ‘ōhi‘a form an open to closed canopy (about 100 feet (30 m) in height) with a very well-developed subcanopy of tree ferns (*Cibotium glaucum*, *C. chamissoi*, and *C. hawaiiense*). Trees in the secondary tree layer include ‘ōlapa, kāwa‘u, kōlea (*Myrsine lessertiana*), and pilo (*Coprosma rhynchocarpa* and *C. pubens*).

In the understory, native shrubs include ‘ōhelo, ‘ākala (*Rubus hawaiiensis*), *Cyrtandra* spp., *Clermontia parviflora*, māmaki (*Pipturus albidus*), manono, and saplings of ‘ōlapa, ‘ōhi‘a, pilo, and kāwa‘u. Ferns are often the prevalent ground cover, including *Asplenium* spp., *Dryopteris wallichiana*, ‘ākōlea (*Athyrium microphyllum*), *Ophioglossum pendulum* subsp. *falcatum*, and *Lepisorus thunbergianus*. The rare mint, *Stenogyne macrantha*, is known from the area between Kaiwilahilahi Stream and the NAR's western boundary.



‘Ōhelo, māmaki and ‘ākolea (from left to right)

#### c. ‘Ōhi‘a/Hāpu‘u/Uluhe Montane Wet Forest

This vegetation cover type occurs on the east side between 3,500 and 4,500 ft (1067-1372 m) elevation, almost bisecting the upper area of Koa/‘Ōhi‘a Montane Wet Forest. A tall (approximately 80 ft (24 m)) open to scattered canopy of ‘ōhi‘a with a secondary layer of native trees such as olomea, mehame, ‘ōlapa, and pilo and hāpu‘u grow over a layer composed largely of uluhe fern (*Dicranopteris linearis*). Under the hāpu‘u, there is a mix of native shrubs, such as manono, young ‘ōlapa, pilo, *Cyrtandra* spp., and *Clermontia parviflora*. Hō‘i‘o (*Athyrium*





*sandwichianum*) is the most abundant native fern, although *Asplenium* spp., *Vandenboschia davallioides*, wahine noho mauna, *Elaphoglossum* spp., and *Lepisorus thunbergianus* are also present.

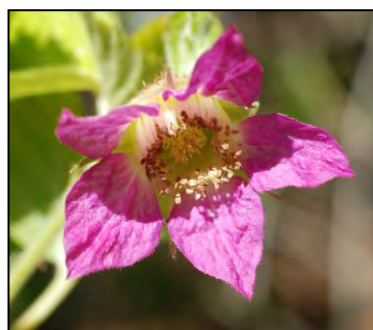
d. *Carex alligata* Montane Wet Grassland

Much of the mid elevation area in Laupāhoehoe Forest, between about 4,000 and 4,500 ft (1220-1370 m), is poorly drained, and several low-lying, very wet sections are dominated by *Carex alligata*. Species from the surrounding natural communities, such as scattered ‘ōhi‘a, ‘ōlapa, and ‘ōhelo, are also found in this community type.

e. Koa/‘Ōhi‘a Montane Forest

This forest type has been significantly altered by past land uses, including ranching and logging, and has also been heavily impacted by feral cattle. Compared to the Montane Wet Forest, the Montane Forest receives less rainfall; the annual rainfall is about 39.3-74.7 in (100-190 cm). The forest consists of scattered-to-open uneven canopy of 115 ft (35 m) tall koa emergent above 82 ft (25 m) tall ‘ōhi‘a . The tall-stature trees tend to grow along the ridge formations. Swales between the ridges and open areas are dominated primarily by thick patches of ‘ākala (*Rubus hawaiiensis*).

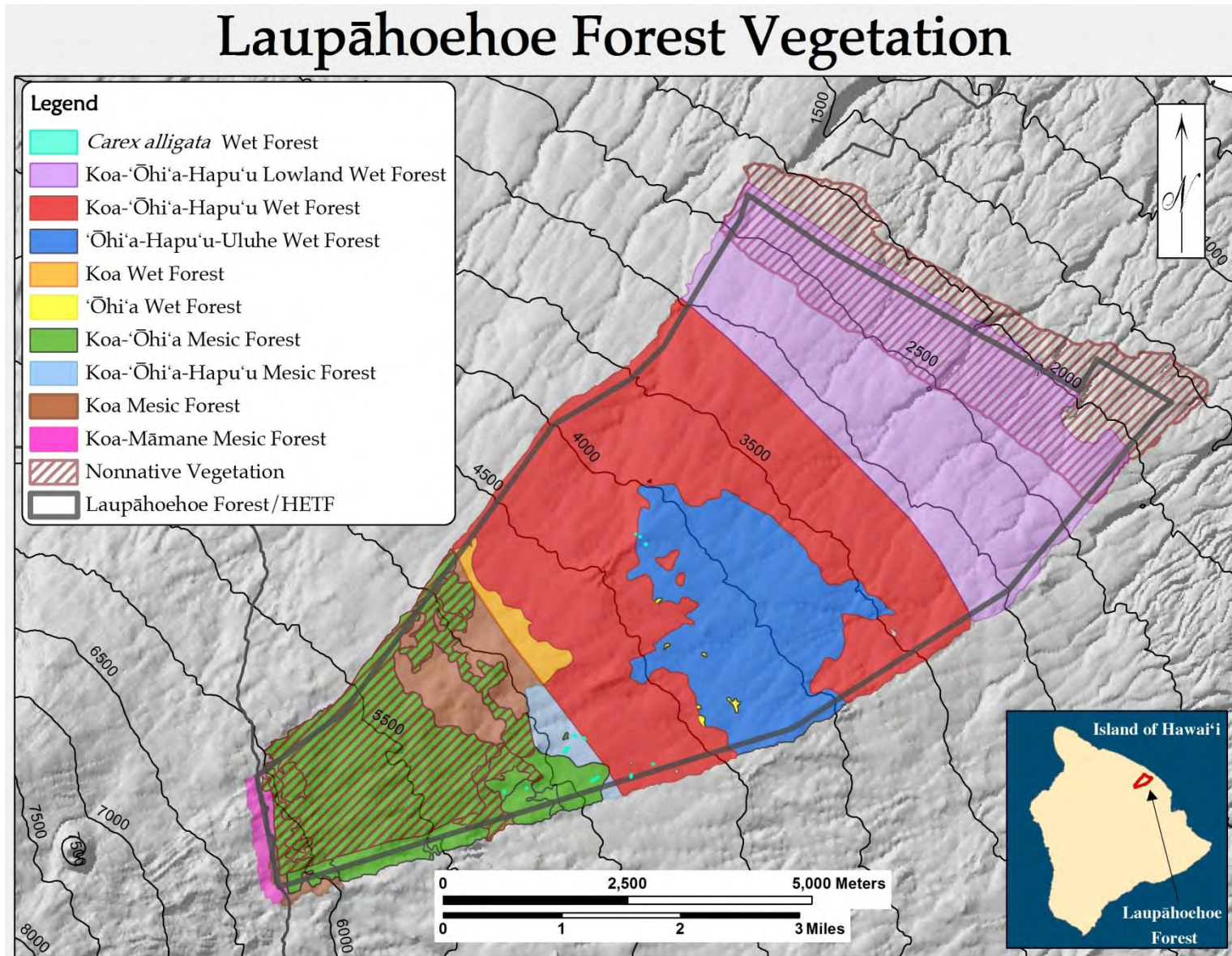
The understory has many species in common with Koa/‘Ōhi‘a Montane Wet Forest, but the distinct hāpu‘u tree fern layer of the latter is absent. Species more characteristic of drier areas may also be components here. Ground cover is often dominated by native ferns, especially laukahi (*Dryopteris wallichiana*). Species found in this forest type include: ‘ōlapa, pilo, manono, kāwa‘u, *Myoporum sandwicense*, kōlea, alani, *Ranunculus hawaiiensis*, *Sophora chrysophylla*, *Styphelia tameiameia* and ‘ōhelo.



‘Ākala fruits and flower



Figure 8





### Rare Plants

A diversity of native plants, including rare species are found within Laupāhoehoe Forest, and there is critical habitat for six species (Table 3). Table 3 also includes species that may not have been found within Laupāhoehoe Forest, but are known from similar habitat in nearby areas. The U.S. Endangered Species Act defines Critical Habitat as areas that may or may not be occupied by a threatened or endangered species, but are essential to the conservation of the species. These areas may require special management considerations or protection (16 U.S.C. § 1532 (5)).



*Rare plants include 'oha, jewel orchid and 'oha wai (clockwise from top left)*



**Table 3.** Rare Plants with habitat in or near Laupāhoehoe Forest

<i>Species</i>	<i>Common Name</i>	<i>Federal Status*</i>	<i>Critical Habitat</i>	<i>Known From Laupāhoehoe Forest**</i>	<i>Known From Adjacent Areas</i>	<i>Outplanted in Laupāhoehoe Forest</i>
<i>Anoectochilus sandvicensis</i>	<i>jewel orchid</i>	<i>SOC</i>		<i>X</i>		
<i>Asplenium schizophyllum</i>	-	<i>SOC</i>		<i>X</i>		
<i>Clermontia lindseyana</i>	<i>'oha wai</i>	<i>LE</i>		<i>X</i>	<i>X (Piha/Hakalau)</i>	<i>X</i>
<i>Clermontia peleana</i>	<i>'oha wai</i>	<i>LE</i>	<i>X</i>		<i>X (Upper Hilo FR)</i>	<i>X</i>
<i>Clermontia pyrularia</i>	<i>'oha wai</i>	<i>LE</i>	<i>X</i>	<i>X (Historic)</i>		<i>X</i>
<i>Cyanea fernaldii</i>		<i>No Status***</i>		<i>X</i>		
<i>Cyanea platyphylla</i>	<i>'akū 'akū</i>	<i>LE</i>	<i>X</i>	<i>X</i>		
<i>Cyanea shipmanii</i>	<i>hāhā</i>	<i>LE</i>			<i>X</i>	<i>X</i>
<i>Cyanea tritomantha</i>	<i>'akū</i>	<i>LE</i>		<i>X</i>		<i>X</i>
<i>Cyrtandra giffardii</i>	<i>ha 'iwale</i>	<i>LE</i>	<i>X</i>	<i>X</i>		
<i>Cyrtandra tintinnabula</i>	<i>ha 'iwale</i>	<i>LE</i>	<i>X</i>	<i>X</i>	<i>X (Hakalau)</i>	
<i>Cyrtandra wagneri</i>	<i>ha 'iwale</i>	<i>LE</i>		<i>X</i>		
<i>Deparia kaalaana</i>	-	<i>SOC</i>		<i>?</i>		
<i>Gardenia remyi</i>	<i>nānū</i>	<i>C</i>		<i>X</i>		
<i>Huperzia manni</i>	-	<i>LE</i>		<i>X</i>		
<i>Huperzia stemmermannii</i>	-	<i>C</i>		<i>X</i>		
<i>Joinvillea ascendens</i>	<i>'ohe</i>	<i>C</i>		<i>X</i>		
<i>Melicope zahlbruckneri</i>	<i>alani</i>	<i>LE</i>		<i>X (Historic)</i>		<i>X</i>
<i>Ochrosia haleakalae</i>	<i>hōlei</i>	<i>C</i>		<i>X</i>		
<i>Phyllostegia brevidens</i>	-	<i>SOC</i>		<i>X (Historic)</i>		
<i>Phyllostegia floribunda</i>	-	<i>LE</i>		<i>X (Historic)</i>		<i>X</i>
<i>Phyllostegia macrophyllum</i>	-	<i>SOC</i>		<i>X</i>		
<i>Phyllostegia racemosa</i>	<i>kīponapona</i>	<i>LE</i>			<i>X (Hakalau)</i>	
<i>Phyllostegia warshaueri</i>	-	<i>LE</i>	<i>X</i>	<i>X</i>		<i>X</i>
<i>Platydesma remyi</i>	-	<i>LE</i>		<i>X</i>		<i>X</i>
<i>Pritchardia lanigera</i>	<i>loulu</i>	<i>LE</i>		<i>X</i>		
<i>Ranunculus hawaiiensis</i>	<i>makou</i>	<i>C</i>			<i>X (Mauna Kea FR)</i>	
<i>Stenogyne macrantha</i>	<i>mā 'ohi 'ohi</i>	<i>SOC</i>		<i>X</i>		
<i>Strongylodon ruber</i>	<i>nuku 'i 'iwi</i>	<i>C</i>		<i>X historic</i>	<i>X</i>	
<i>Trematolobelia grandifolia</i>	<i>koli 'i</i>	<i>SOC</i>		<i>X</i>		<i>X</i>

\* Key to Federal Status: Listed Endangered (LE) = Taxa listed as endangered. Candidate (C) = Taxa for which substantial information on biological vulnerability and threat(s) support proposal to LE. Species of Concern (SOC) = Taxa for which available information meets the criteria for concern and the possibility to recommend C.

\*\* Current (wild plants currently present), Historic (historic records describe presence in area); \*\*\*newly described or resurrected species





## Wildlife

### Birds

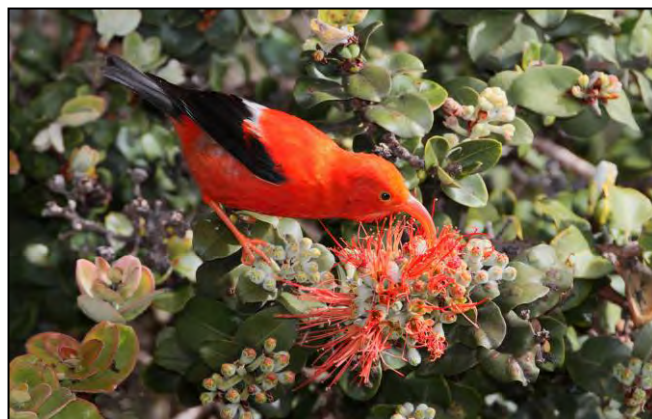
Laupāhoehoe Forest was surveyed for forest birds as part of the Hamakua Study Area during the Hawai‘i Forest Bird Survey (1976-1983). This survey and several subsequent surveys of the area have provided information on the bird species present and their distribution.

The forest provides habitat for six honeycreepers (Subfamily Drepanidinae) endemic to the Hawaiian Islands. These include three endangered species: Hawai‘i ‘ākepa (*Loxops coccineus*), Hawai‘i creeper (*Oreomystis mana*) and ‘akiapōlā‘au (*Hemignathus munroi*). The non-endangered honeycreepers found in the project area include: ‘apapane (*Himatione sanguinea*), Hawai‘i ‘amakihi (*Hemignathus virens*), and ‘i‘iwi (*Vestiaria coccinea*). U.S. Fish and Wildlife Service (USFWS) is currently reviewing the status of ‘i‘iwi to determine whether it should be listed as endangered or threatened. Other native forest birds reported from the project area include, ‘elepaio (*Chasiempis sandwichensis*), and ‘ōma‘o or Hawaiian thrush (*Myadestes obscurus*). Native forest birds are primarily found in the upper elevations (above 4,000 ft (1,219 m)) where lower numbers of mosquitoes and the effects of cooler temperatures on plasmodium parasite reduce the incidence of diseases such as avian malaria and pox. It is important to note that Hakalau Forest National Wildlife Refuge is adjacent to Laupāhoehoe Forest where these species are seen regularly along with many other native species.

Other native bird species listed as endangered by the USFWS, have been reported from the Laupāhoehoe Forest area including the Hawaiian duck or koloa maoli (*Anas wyvilliana*), and the Hawaiian hawk or ‘io (*Buteo solitarius*). Koloa maoli are generally found in a wide variety of natural and artificial wetland habitats including freshwater marshes, flooded grasslands, streams, montane pools, irrigation ditches, reservoirs, etc.

Laupāhoehoe Forest is considered a recovery area for Hawai‘i creeper, Hawai‘i ‘ākepa, and ‘akiapōlā‘au in the USFWS forest bird recovery plan and in the State Comprehensive Wildlife Strategy. Recovery areas are habitat that will allow for the long-term survival and recovery of endangered Hawaiian forest birds.

The most widespread non-native birds observed at Laupāhoehoe Forest include hwamei (*Garrulax canorus*), Japanese white-eye (*Zosterops japonicus*), red-billed leiothrix (*Leiothrix lutea*), northern cardinal (*Cardinalis cardinalis*) and kalij pheasant (*Lophura leucomelana*). Other non-native birds observed in the area are summarized in Table 4 below.



‘Akiapōlā‘au and ‘i‘iwi (courtesy of Jack Jeffrey Photography)



**Table 4.** Laupāhoehoe Forest bird species

Species	Common Name	Status
<i>Acridotheres tristis</i>	Common myna	Non-native
<i>Alauda arvensis</i>	Eurasian skylark	Non-native
<i>Anas wyvilliana</i>	Hawaiian duck, koloa maoli	Endemic (Endangered)
<i>Asio flammeus sanwicensis</i>	Short-eared owl, pueo	Endemic
<i>Buteo solitarius</i>	Hawaiian hawk, 'io	Endemic (Endangered)
<i>Cardinalis cardinalis</i>	Northern cardinal	Non-native
<i>Carpodacus mexicanus</i>	House finch	Non-native
<i>Cettia diphone</i>	Japanese bush warbler	Non-native
<i>Chasiempis sanwicensis sandwichensis</i>	'Elepaio	Endemic
<i>Francolinus erckelli</i>	Erkel's francolin	Non-native
<i>Garrulax canorus</i>	Hwamei	Non-native
<i>Hemignathus munroi</i>	'Akiapola'au	Endemic (Endangered)
<i>Hemignathus virens virens</i>	'Amakihi	Endemic
<i>Himatione sanguinea sanguinea</i>	'Apapane	Endemic
<i>Leiothrix lutea</i>	Red-billed leiothrix	Non-native
<i>Lonchura punctulata</i>	Nutmeg mannikin	Non-native
<i>Lophura leucomelana</i>	Kalij pheasant	Non-native
<i>Loxops coccineus coccineus</i>	Hawai'i 'ākepa	Endemic (Endangered)
<i>Meleagris gallopavo</i>	Wild turkey	Non-native
<i>Myadestes obscurus</i>	Hawai'i thrush, 'oma'o	Endemic
<i>Nycticorax nycticorax hoactli</i>	Auku'u or black crowned night heron	Indigenous
<i>Oreomystis mana</i>	Hawai'i creeper	Endemic (Endangered)
<i>Passer domesticus</i>	House sparrow	Non-native
<i>Phasianus colchicus</i>	Ring-necked pheasant	Non-native
<i>Pluvialis fulva</i>	Kolea or pacific golden plover	Indigenous
<i>Serinus mozambicus</i>	Yellow fronted canary	Non-native
<i>Streptopelia chinensis</i>	Spotted dove	Non-native
<i>Tyto alba</i>	Barn owl	Non-native
<i>Vestiaria coccinea</i>	'I'iwi	Endemic
<i>Zosterops japonicus</i>	Japanese white-eye	Non-native

### Mammals

Laupāhoehoe Forest is considered very important habitat for Hawai'i's only native land mammal, the 'ōpe'ape'a – the endemic and endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), which uses the area for roosting, reproduction and foraging. U.S. Geological Survey (USGS) Biological Resources Division Hawaiian Hoary Bat Project has monitored bats for five years and has found high levels of bat activity and occupancy. The Hawaiian hoary bat is the



only native terrestrial mammal from the Hawaiian archipelago (USFWS 1998). It is a medium-sized, nocturnal, insectivorous bat with short, thick, rounded ears and a furry tail. "Hoary" refers to the white-tinged, frosty appearance of the bat's grayish brown or reddish brown fur.

A variety of non-native mammals such as feral pigs (*Sus scrofa*), rats (*Rattus* spp.), mice (*Mus musculus*), cats (*Felis catus*), wild dogs (*Canis lupus familiaris*) and mongoose (*Herpestes auropunctatus*) are present in Laupāhoehoe Forest.



Photo by: Corinna A. Pinzari

'Ōpe'ape'a.

### Invertebrates

Native invertebrates known from Laupāhoehoe Forest include numerous species of *Drosophila*. Species including *D. sproati*, *D. murphyi*, *D. tanythrix*, and *D. yooni* are relatively common. One notable collection was of a female specimen believed to be *D. papala*, taken at 4,800 ft (1,463 m) elevation. In 2012, a researcher cataloging *Drosophila* species noted a small patch of *Pisonia brunoniana* at about 4,000 ft (1,219 m) elevation within the FR as the most diverse site sampled. Although too small to support any picture-wing species, this disjunct grove of mesic trees has a community of smaller *Drosophila* species not found elsewhere in Laupāhoehoe Forest. Some of these are associated with *Pisonia* in particular (*D. kambysellisi*, *D. nr. dissita*), while others are associated with other plants but seem to be attracted to the site. This spot is worthy of greater conservation attention, especially since *Pisonia* is relatively rare in the Hamakua area. Table 5 provides a list of *Drosophila* species found during the 2012 survey. Several picture-wing species that breed in *Charpentiera*, *Pisonia*, and *Urera* were formerly known from lower elevations (~2,500 ft (762 m)), but this area now appears to be largely non-native, and no flies were found there.

Laupāhoehoe Forest also contains habitat for four endemic species of pinao or Hawaiian damselfly. *Megalagrion calliphya* and *Megalagrion hawaiiense* breed in small pools or seeps in the forest, whereas *Megalagrion blackburni* breeds in streams. *Megalagrion xanthomelas* is a candidate for listing as an endangered species and is known from Kaiwilahilahi Stream (Parham et al. 2008), below the lower boundary of Laupāhoehoe Forest.

**Table 5.** Laupāhoehoe Forest *Drosophila* species found during 2012 Survey

<i>Drosophila basisetae</i>	<i>Drosophila murphyi</i>	<i>Drosophila sordidapex</i>
<i>Drosophila brunneicrus</i>	<i>Drosophila neutralis</i>	<i>Drosophila sproati</i>
<i>Drosophila canipolita</i>	<i>Drosophila nr. ancyla</i>	<i>Drosophila tanythrix</i>
<i>Drosophila cnecopleura</i>	<i>Drosophila nr. dissita</i>	<i>Drosophila tendomentum</i>
<i>Drosophila cracens</i>	<i>Drosophila nr. medialis</i> #2	<i>Drosophila trichaetosa</i>
<i>Drosophila dasyncemia</i>	<i>Drosophila nr. medialis</i> #3	<i>Drosophila yooni</i>
<i>Drosophila hawaiiensis</i>	<i>Drosophila papala</i>	<i>Scaptomyza (Elmomyza) tumidula</i>
<i>Drosophila imparisetae</i>	<i>Drosophila percnosoma</i>	
<i>Drosophila kambysellisi</i>	<i>Drosophila propiofacies</i>	
<i>Drosophila kikalaeleele</i>	<i>Drosophila seclusa</i>	
<i>Drosophila latigena</i>	<i>Drosophila setosimentum</i>	
<i>Drosophila medialis</i>	<i>Drosophila silvestris</i>	



### Aquatic Species

Streams provide habitat for endemic waterbirds, four gobies, two crustaceans, one snail, and several aquatic insects (e.g., damselflies, chironomids) that are noted in the Hawai‘i Stream Atlas (Parham et al. 2008). There are also two species of invasive amphibians that have been observed in or near streams in Laupāhoehoe, *Rana catesbeiana* (American bullfrog) and *Rhinella marina* (Cane toad). Both of these species lay eggs in water and have a tadpole stage to their lifecycle.

Surface and groundwater that originate from the Laupāhoehoe Forest also support healthy populations of native nearshore fish assemblages. Many of these fish are an important component of the subsistence-based economy in the region.

**Table 6.** Native aquatic species known from at least a portion of the 10 Laupāhoehoe streams (Parham et al. 2008)

<u>Native Fish</u> <i>Awaous guamensis</i> <i>Lentipes concolor</i> <i>Sicyopterus stimpsoni</i> <i>Eleotris sandwicensis</i> <i>Kuhlia xenura</i>	<u>Native Aquatic Insects</u> <i>Megalagrion blackburni</i> <i>Megalagrion xanthomelas</i> <i>Telmatogeton sp.</i>	<u>Native waterbirds</u> <i>Anas wyvilliana</i>
<u>Native Crustaceans</u> <i>Atyoida bisulcata</i>	<u>Native Snails</u> <i>Neritina granosa</i>	

### ***Cultural Resources and Traditional Practices***

The 2006 cultural historical study prepared by Kumu Pono Associates is an important reference for cultural resources management in the Laupāhoehoe Forest (Maly and Maly 2006). It references the ethnographical and historic uses of the region, and identifies several historic, ethnographic, and archaeological site types and features that may be found in the area. Excerpts from this study are included below, and the complete study is available online (see REFERENCES).

“The lands of the Laupāhoehoe Forest are part of an ancient region, traditionally known to the Hawaiians as the wao akua (region of the gods), wao ma‘ukele (wet forest zone) and wao nahele (forest zone). In traditional times—pre-western contact in 1778, and in subsequent years through the early 1800s—these forested regions, particularly the wao akua, were considered sacred, the abode of the gods. Travel through the forest lands, undertaking collection of resources—gathering woods and other plant materials, collection of feathers and catching birds, and even travel through the forests, simply to reach another destination beyond the forest—was undertaken with prayer, caution, and respect. Damage to the living forests was often punished by acts of nature—heavy rains might wash the careless traveler from the path; dense mists or sudden growth of such plants as uluhe or ‘ōpiko, might cause the trail to be lost from view, and the traveler to wander aimlessly through the forests.

In this collection of native and historical accounts we also find that the lands of the Laupāhoehoe forest region are frequently mentioned in several prominent traditions.





Significantly, the importance of the Laupāhoehoe region koa forests, mountain bird habitats, and the traditional trails which connected the lowlands with the mountain lands and neighboring districts, are frequently referenced in traditions and historical accounts. Also, battles fought on the Laupāhoehoe lands were among those which established the kingdoms of chiefs between the early 1500s to the late 1700s. While many of the accounts cited in the study relate to the lower lands of the Laupāhoehoe vicinity—those lands situated below the 2,000 foot elevation—there are occasional references to travel through the upland forests to the mountain region. There are also specific references to the traditional significance of Laupāhoehoe, and the occurrence of numerous heiau (ceremonial sites) of local and regional significance, though the record is seemingly silent on the location of heiau that might have occurred in the forest region.”

### Archaeological and Historic Sites

The 2006 cultural historical study prepared by Kumu Pono Associates also identifies types of archaeological sites that might be found in the Laupāhoehoe Forest (Maly and Maly 2006).

“These include, but are not limited to—trails extending from the shore to the mountain lands; shelters and resting places along trail sides; shrines used by travelers, bird catchers, canoe makers and other practitioners; battle sites and hiding places; and possible burial sites. Traditional features would include several forms, ranging from stone platforms, terraces, cairns, and walls; and shelter features—called pāpa‘i by the ancient Hawaiians—generally made of wood, leafy branches and ferns. Many of the features would naturally deteriorate and evidence of them would return to the earth. Other features of stone might still be visible in the understory, though only found upon careful search. Another feature of importance would be stone filled fractures or crevices, and caves. Such features were sometimes used for shelters over generations, or as burial sites, and as places in which to hide valued cultural artifacts.”

The historic resources study prepared for the aforementioned 2006 reforestation project sampled transects in the proposed project area of potential effect (and found no historic properties (e.g. no stone surface features, potential shelter caves or overhangs, subsurface cultural deposits) in the Laupāhoehoe Forest portion of the proposed project (Carpenter et al. 2006).

Historical sites identified in the region include the following (Carpenter et al. 2006, Maly and Maly 2006):

- The sheep ranch station at Keanakolu (in the original place of that name, near the Laupāhoehoe-Humu‘ula boundary). There remain on the land in the present-day, the ruins of stone shelters, pens, and foundations.
- Noted places such as Keanakolu (not the same location of the present-day cabin of that name), Lahohinu, and Keahua-ai (Douglas Pit), are considered significant features of the historical landscape.
- Laupāhoehoe-Waipunalei Trail
- Maulua Trail, established as an old pack trail.



## THREATS TO NATURAL AND CULTURAL RESOURCES

### *Non-Native Plants and Animals*

#### Invasive Non-Native Plants

Invasive non-native plants constitute a severe threat to the native ecosystems in Laupāhoehoe Forest. Certain non-native plants are considered invasive because they can establish and survive in undisturbed native forest, disperse long distances via wind or birds, affect large portions of land, displace native vegetation, grow and reproduce rapidly, and convert a diverse native forest plants to a monoculture of alien species. Invasive non-native plants can displace distinctive native flora, resulting in a loss of species diversity and eventually in changes to ecosystem function such as nutrient cycling. Many invasive non-native plants completely replace native vegetation by preventing any regeneration of native species or in the case of strangler figs – direct replacement of native trees, resulting in total loss of native habitats thereby negatively affecting native birds and invertebrates (Cuddihy and Stone 1990; Vitousek 1992). Invasive species can also encourage fire by increasing the amount of available fuels or decrease water input to streams and ground water. For example, forests severely invaded by invasive non-native plants such as strawberry guava show increased evaporation of water to the atmosphere, which reduces the amount of water available for human use (Giambelluca, unpublished research).

Only a small portion of Laupāhoehoe Forest has had systematic surveys for invasive non-native plants. In general, upper forested areas between 3,500 - 4,500 ft (1,067-1,372 m) elevation contain relatively low densities of invasive non-native plants described below. However, below 3,500 ft (1,067 m) forests become heavily invaded by strawberry guava, clidemia or Koster's curse, yellow Himalayan raspberry, and kahili ginger. Above 4,500 ft (1,372 m) forests are heavily invaded by grasses, banana poka, and tropical ash. Throughout the entire forest Australian tree fern (*Sphaeropteris cooperi*) can be found at low densities, although populations are increasing. *Ficus* spp. is concentrated in the northern portion of the forest, near Blair Rd., at about 2,800 ft (853 m) and is spreading into adjacent areas.

Invasive non-native plants with great potential for spreading and causing habitat modification are identified in this plan as high priority for control. Invasive non-native plant species were prioritized based on observed invasiveness and other criteria including growth form, dispersal mechanisms, ability to displace native vegetation and ability to alter ecosystem cycles (water, nutrients and succession). High priority invasive non-native plants currently present in Laupāhoehoe Forest include:

- Australian tree fern (*Sphaeropteris cooperi*)
- Banana poka (*Passiflora tarminiana*)
- Florida blackberry (*Rubus argutus*)
- Cane tibouchina (*Tibouchina herbacea*)
- Clidemia or Koster's curse (*Clidemia hirta*)
- *Ficus* spp.
- Himalayan ginger (*Hedychium gardnerianum*)
- Mules foot fern (*Angiopteris evecta*)
- Palm grass (*Setaria palmifolia*)
- Passion fruit (*Passiflora edulis*)



- *Polygonum chinensis*
- Strawberry guava (*Psidium cattleianum*)
- Tropical ash (*Fraxinus uhdei*)
- Yellow Himalayan raspberry (*Rubus ellipticus*)
- German ivy (*Delairea odorata*)

There are additional invasive non-native plants species of serious concern to land managers that are present in adjoining areas but have not yet been detected in Laupāhoehoe Forest. It is a high priority to prevent the establishment of these species, which include but are not limited to miconia (*Miconia calvescens*), faya (*Morella faya*), gorse (*Ulex europaeus*), firethorn (*Pyrocantha angustifolia*), *Cotoneaster pannosus*, and New Zealand flax (*Phormium tenax*). Other invasive non-native plant species may be added to the priority invasive non-native plant list if monitoring shows their range and abundance increasing in native ecosystems targeted for management.

### Ungulates

Ungulates are hooved animals such as pigs, sheep, goats and cattle. The primary ungulate in Laupāhoehoe Forest is the wild pig (*Sus scrofa*), which is found throughout the forest except in the small fenced areas (35 total acres) that currently exist. Feral ungulates can pose a threat to native ecosystems, species and watersheds because they eat and trample native plants (Cooray and Mueller-Dombois 1981), and disperse the seed of invasive non-native plants. These changes can cause increased erosion and soil runoff. Hawaiian plants evolved without such animals and so some have lost defenses such as thorns and chemical compounds in leaves. The rooting and wallowing behavior of pigs can increase the inputs of pollutants to streams (i.e. animal waste), stream water turbidity due to soil erosion (Stone 1985, Dunkel 2009, Bruland et al. 2010), and wallows can result in breeding areas for disease carrying mosquitoes (Baker 1979, USGS 2005, USGS 2006c). Pigs also eat some invasive plant fruits, such as strawberry guava, which they can transport and then defecate in new areas (Aplet et al. 1991). In addition, feral pigs have been shown to spread root-rot fungi (Baker 1979), and can carry parasites and diseases transmittable to humans and dogs, such as leptospirosis (Warner 1959-1969, Sasaki et al. 1993) and tuberculosis (Giffin 1978).

Pigs were originally brought to Hawai‘i by the first Polynesian settlers as a domesticated species (Tomich 1986). After the arrival of Captain Cook, the larger European wild boar was introduced as a game species and quickly became feral. Today, feral pigs in Hawai‘i are generally smaller in size than mainland varieties as a result of over 200 years of interbreeding between the smaller Polynesian pig and the larger European boar (Tomich 1986).

Feral cattle have been a problem in Laupāhoehoe Forest in the past; however, all feral cattle were removed from the area by 2003. Feral cattle are still a potential future threat as they are still present in adjoining areas (Waipunalei and Humu‘ula) and occasionally get into the forest.

### Other Non-Native Animals

A variety of non-native mammalian predators are serious pests to the biodiversity found in Laupāhoehoe Forest. Mongoose, feral cats, rats, but also mice prey upon native species and have a severe impact on native birds. In addition, small mammals serve as vectors of diseases and can



affect the water quality and cause human and wildlife diseases. Leptospirosis and cryptosporidiosis are potentially fatal illnesses caused by water-borne microorganisms spread by non-native mammals (Sasaki et al. 1993).

Feral cats kill forest birds as well as native sea birds and other species that nest on the ground or in burrows (USGS 2006a). Cats are the host of a potentially fatal disease called toxoplasmosis. In Hawai‘i, toxoplasmosis has killed native Hawaiian birds such as the ‘alalā, the endangered nēnē and even seabirds such as the red-footed booby (*Sula sula*). Because the organism that causes toxoplasmosis (*Toxoplasma gondii*) can complete an important part of its life cycle in seawater, this disease also poses a threat to marine mammals such as the endangered Hawaiian monk seal (*Monachus schauinslandi*) and spinner dolphin (*Stenella longirostris*). In addition to threatening wildlife, toxoplasmosis poses a significant health risk to pregnant women (USGS 2006a).

Rats prey on native bird eggs, nestlings, native land snails and also eat the fruits/seeds and strip the bark of native plants. Similarly, mice consume the seeds of native plants; seed predation can be a major factor contributing to species decline (Atkinson 1985, Cole et al. 2000, Cuddihy and Stone 1990, Shiels and Drake 2011)

Laupāhoehoe Forest has been invaded by non-native forest birds; however their impacts on native species have not been determined. The non-native kalij pheasant occur in high densities through the forest and can disturb soils, as well as transport non-native seeds. Non-native birds may compete with native forest birds for food and other resources and act as vectors for avian diseases. Non-native birds also contribute to the spread of invasive non-native plants by eating the fruits and spreading seeds – especially strangler figs, clidemia and ginger.

Non-native invertebrates are present, but largely undocumented, and can consume native plants, interfere with plant reproduction, predate or act as parasites on native species, transmit disease, affect food availability for native birds, and disrupt ecosystem processes. The invasion of the yellow jacket wasp (*Vespula pennsylvanica*), voracious predators of numerous species of native invertebrates, is of concern. Other non-native parasitoids adversely impact native moth species, and ants are a significant mortality factor for native invertebrates. Slugs (*Milax gagates*, *Limax maximus*, and *Veronicella* spp.) consume fruit from native plants and prey on seedlings and mature plants. Black-twist borer (Coleoptera: Scolytidae) is a threat to koa. The two-spotted leafhopper (*Sophonia rufofascia*) is a major concern for the uluhe fern, which is particularly sensitive to leafhopper feeding. Mosquitoes (*Aedes albopictus* and *Culex quinquefasciatus*) transmit deadly diseases to native birds and humans. Little fire ant (*Wasmannia auropunctata*) is known from the community below Laupāhoehoe Forest and could pose a threat to forest resources if it spreads mauka.

Both Jackson’s chameleon (*Chamaeleo jacksonii*) and coqui frog (*Eleutherodactylus coqui*) have growing populations on the island, and these species can consume native invertebrates, such as insects, spiders, and small snails. Coqui frogs are known from pastures below Laupāhoehoe Forest as well as from streams within the town of Laupāhoehoe. Cane toads and American bullfrogs, have also been observed in or near streams in Laupāhoehoe Forest. However, it is unclear how these species might be impacting native ecosystems in the forest.





### *Disease*

Introduced diseases and pathogens threaten native animals and plants. Given the lack of biosecurity in Hawai‘i, the introduction of new diseases and pathogens is highly likely. Avian pox and avian malaria are mosquito-transmitted diseases that currently kill or weaken many native Hawaiian birds and are thought to be responsible for the extinction of numerous forest bird species. In the extreme isolation of the Hawaiian Islands, birds evolved in the absence of these diseases and lost their natural immunity. Avian pox is caused by a virus (Avipoxvirus) and avian malaria by a single-celled parasite (*Plasmodium relictum*). For many native forest bird species, infection with these diseases is almost always fatal (USGS 2005, USGS 2006c).

Introduced plant diseases such as ‘ōhi‘a rust (*Puccinia psidii*) and koa wilt (caused by the fungus *Fusarium* sp.) could potentially impact the most common native trees within Laupāhoehoe Forest. ‘Ōhi‘a rust affects ‘ōhi‘a as well as other plants in the same family (Myrtaceae) (HEAR 2010). In severe infections, growing tips wither and die back. Koa wilt is a serious, often fatal disease of the native tree, koa. Trees affected with the disease rapidly lose their canopies and may die within a few months (UH-CTAR 2010).

### *Climate Change and Natural Disturbances*

Climate change may affect the Laupāhoehoe Forest by altering rainfall patterns and amounts. Changing climate may affect the abundance and seasonality of precipitation, thereby altering forest composition, growth and structure (Iwashita et al. 2013). Rare ecosystems and species may be negatively affected by relatively rapid changes in precipitation, temperature, and humidity that result from a rapid and drastic change in regional or local climate patterns (e.g. prolonged drought, higher temperatures). Detrimental invasive species may change their distribution and abundance due to changes in the climate (e.g. mosquitoes may be more frequently found at higher elevations due to warming temperatures). Monitoring and relating climate and any climate change to the ecology of the Laupāhoehoe Forest is a major goal of the HETF.

Although natural disturbances such as hurricanes, droughts, flooding are regular occurrences in Hawai‘i, wide spread insect-driven defoliation can also impact the forest (koa moth (*Scotorythra paludicola*)). Similarly, ‘ōhi‘a undergoes periodic declines where entire stands of ‘ōhi‘a die off at the same time (Akashi and Mueller-Dombois 1995, Anderson et al. 2001, Mueller-Dombois 1980). Native species and ecosystems may have evolved under these disturbance regimes, but today, they may not be able to recover from such disturbances as readily due to small populations, changing climate, introduced diseases (‘ōhi‘a rust), and/or competition with non-native plant species. Further, these types of natural disturbances may increase as a result of climate change.

### *Illegal Human Activity*

Illegal human activity occurs on a small scale, primarily in the form of illegal camping, off-road all-terrain vehicle use, dumping, unpermitted harvesting (koa, maile, hāpu‘u, and other native trees and plants), poaching, marijuana cultivation, and vandalizing signs and fences. These activities destroy infrastructure and native species. Some illegal activities create openings in the forest that can be invaded by invasive non-native plants.



## *Wildfire*

Fire poses a threat to Laupāhoehoe Forest, particularly in the drier upper elevation during times of drought and in areas adjacent to human activity. Hawai‘i’s flora evolved with infrequent, naturally-occurring fire, so most native species are not fire-adapted and are unable to recover quickly after wildfires. Wildfires leave the landscape bare and vulnerable to erosion and non-native weed invasions (D'Antonio et al. 2000, Dunkell et al. 2011, Smith and Tunison 1992). Continued feral ungulate damage to native ecosystems can convert native forest to non-native grasses and shrubs, which provide more fuel for fire (Ainsworth Kauffman 2010, Cabin et al. 2000, Chynoweth et al. 2013, Cole et al. 2012, Nogueira-Filho et al. 2009, Scowcroft and Giffin 1983, Thaxton et al. 2010). Invasive non-native plants, particularly grasses, are often more fire-adapted than native species and will quickly exploit suitable habitat after a fire (D'Antonio et al. 2000, Mack and D'Antonio 1998). The principal human-caused ignition threats are from catalytic converters and other hot surfaces of vehicles or heavy equipment and illegal campfires. The principal natural ignition source is lightning.

There have been three fires recently in the vicinity of Laupāhoehoe Forest. The Piha Fire in 2008 started off Mana Rd. from a vehicle parked in dry grass. The fire burned 2,800 acres (1133 ha) of non-native grasses and koa canopy from Hopuwai Corral above Piha FR across to Laupāhoehoe FR and up to Mauna Kea FR. The Waipunalei Fire in 2012 was probably started from a lightning strike. The fire burned 22.2 acres (9 ha) near the koa mill in Waipunalei, between Laupāhoehoe Forest and the Humu‘ula section of Hilo FR. Fuels were mainly kikuyu grass with koa, ‘ōhi‘a and sugi pine canopy. The Keanakolu fire in 2013 started from an abandoned campfire below Keanakolu Cabins in the Humu‘ula Section of Hilo FR and burned approximately 3 acres (~1.2 ha).



*2013 Keanakolu fire*





### *Threats to Cultural Resources*

Threats to cultural resources are in large part the same as the threats to biological and physical resources described below in excerpts from Maly and Maly 2006.

“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 plateau lands, watered valleys and lava plains, and to the shoreline and ocean depths are believed to be embodiments of Hawaiian gods and deities.

The forest lands of this region represent significant native (endemic and indigenous) resources, and are part of a unique cultural landscape—in that the native flora, fauna, mist, rains, water, natural phenomena and resources, are all believed to be *kino lau* (the myriad body-forms) of gods, goddesses, and lesser nature spirits of Hawaiian antiquity. Knowledge of the environment and respect for the resources ensured a sustainable life upon the land. And in their evolving relationship with natural resources such as those of this region, Hawaiians came to consider everything about them as godly manifestations. Care for, and respect of the earth, meant that in-turn, the earth would care for the *kānaka* (people).”

Threats to resources such as stone features (walls, terraces, mounds, platforms, shelters, caves, trails or boundary *ahu*) and burials include vandalism and destruction during ground altering activities such as construction. The Hawai‘i State Historic Preservation Statute (Chapter 6E), affords legal protection to historic sites, including traditional cultural properties of ongoing cultural significance.



*Cultural Resources in Laupāhoehoe Forest include maile and palapalai*



## OVERVIEW OF EXISTING MANAGEMENT

Numerous management actions have been completed and/or are ongoing in Laupāhoehoe Forest. The section below summarizes these actions and accomplishments.

### *Natural Resources*

#### Forest Protection and Management

To date, DOFAW staff has built small fenced enclosures to protect approximately 35 acres (14 ha) of native forest habitat and rare and endangered plant species from feral ungulates (3 enclosures: Kilau Uka, Loulu, and Scowcroft units are each approximately 10 acres, and 10 enclosures are < 1/4 acre). The Kilau Uka enclosure near Blair Rd. was completed in 2008; the Loulu enclosure was completed in 2010, and the Scowcroft enclosure was installed in 2014. These enclosures are also used for restoration of rare plants through outplanting.

#### Invasive Non-Native Plant Control

DOFAW staff control priority non-native invasive plants in rare plant enclosures, along roadsides and in other priority areas. Staff spends approximately 30 person days/year working on weed control, with additional work scheduled in the summer when Youth Conservation Corps (YCC) crews are available.



*DOFAW staff installs fencing to protect the forest*





### Rare Species Restoration

DOFAW staff work cooperatively with other organizations and agencies on rare plant recovery including the Hawai‘i State Plant Extinction Prevention Program (PEPP) and the Volcano Rare Plant Facility (VRPF) of the University of Hawai‘i. Management actions specific to rare plant recovery include rare plant surveys to locate wild individuals, protection of wild plants in fenced exclosures, collection of propagation and genetic storage materials and reintroduction through outplanting in fenced, protected exclosures. PEPP is focused on preventing the extinction of taxa with fewer than 50 individuals in the wild.

DOFAW staff follow rare plant collection and reintroduction guidelines recommended by the Hawai‘i Rare Plant Restoration Group (interagency group of rare plant experts)

<http://hear.org/hrprg/>. DOFAW staff tag and map the locations of all outplanted plants and monitor their survival and growth. Rare plants reintroduced into Laupāhoehoe Forest in fenced, protected exclosures through outplanting include: *Anoectochilus sandvicensis*, *Clermontia lindseyana*, *Clermontia pyralaria*, *Joinvillea ascendens*, *Ochrosia haleakalae*, *Phyllostegia macrophyllus*, *Phyllostegia warshaueri*, *Stenogyne macrantha* and *Trematolobelia grandifolia* (see Table 3 for species status and common (Hawaiian) names).



*DOFAW staff monitor rare plants in Laupāhoehoe Forest*

### Monitoring

In 1982, a rare plant survey of the proposed NAR noted the presence or absence of certain priority invasive non-native plants (Cuddihy et al. 1982). More intensive invasive non-native plant monitoring was completed across 9 transects in the NAR portion of Laupāhoehoe Forest in 1988, to gather information for the 1989 management plan. These transects were re-monitored in 1998. In addition, in 2008 NAR staff monitored vegetation plots along new transects which included invasive non-native plant monitoring.

Forest birds in Laupāhoehoe Forest were surveyed as part of the Hawai‘i Forest Bird Survey (Hamakua Study Area) from 1976-1983 (Scott et al. 1986). These same transects were re-surveyed in 1993. In 2013, additional surveys were conducted to assess the status of forest birds as part of this management plan. Recent survey data has not yet been analyzed; however, four species of endangered bird species were detected: ‘akiapōla‘au, Hawai‘i ‘ākepa and Hawai‘i creeper was present above 4,500 ft (1,372 m), and ‘Io was also detected during the survey.

### Research

Research conducted in the Laupāhoehoe Forest is a combination of long-term monitoring of environmental conditions and biotic responses, and directed research to address key questions about forest ecosystem function, health, and sustainability. Research in the Laupāhoehoe Forest is conducted by universities, government agencies including the USFS, and private organizations. Projects vary in focus, scope and length. Research projects proposed for the



Laupāhoehoe Forest are subject to review and permitting prior to access being granted for project implementation. A complete list of projects that have been conducted in Laupāhoehoe Forest to date can be found in on page 80 and is also available in HETF annual reports at [www.hetf.us](http://www.hetf.us).

### Long-Term Data Collection

Long-term monitoring is an integral component of research field sites such as the HETF. In the Laupāhoehoe Forest, long-term monitoring infrastructure has been established for vegetation, climate, and stream monitoring. The Hawai‘i Permanent Plot Network (HIPNET), a collaborative project between the University of Hawai‘i, the USFS, and University of California Los Angeles, has established a co-located vegetation plot and climate station in the Laupāhoehoe Forest that is part of a worldwide study of tropical forests with the Smithsonian Tropical Research Institute’s Center for Tropical Forest Science ([www.ctfs.si.edu](http://www.ctfs.si.edu)). Climate conditions in the forest are monitored by a weather station installed in 2009. The climate station extends 10 feet (3.3 m) above the forest canopy and collects data on rainfall, temperature, relative humidity, wind-speed, solar radiation (sunlight), soil moisture, soil temperature, and wind direction. The Laupāhoehoe climate station is part of the EPSCoR-ENDER (Experimental Program to Stimulate Competitive Research - Environmental Dynamics and Ecosystem Responses) Climate Network, an island-wide network of climate stations at locations across the island of Hawai‘i. Research conducted in the HIPNET will enable advancement in the studies of global change, ecohydrology, ecosystem services, remote sensing, restoration, community structure and organization, population genetics, comparative forest ecology and biogeochemical processes.

The Forest Inventory and Analysis Program (FIA) is a nationwide USFS program aimed at collecting, analyzing, and reporting information on the status and trends of America's forests. The Laupāhoehoe Forest includes 29 FIA plots (12 in the FR and 17 in the NAR) which represent a portion of the approximately 600-700 plots proposed for all of Hawai‘i. With the support and coordination of numerous entities in Hawai‘i, Hawai‘i’s FIA program collects additional information on the presence of invasive plants and other disturbances such as feral pigs to provide a baseline assessment of the current state of forests all over Hawai‘i. Plots are scheduled to be re-measured every 10 years to provide insights into changes in forest extent, composition, structure, and disturbances.

The hydrology of native forests and watersheds is an integral part of long-term sustainability of forest ecosystems, including aquatic biota. Freshwater availability for a variety of human uses and for its contribution to nearshore marine ecosystems is also critical. One facet of understanding forest hydrology is by monitoring flow in major streams through the use of stream gauges. One stream gauge has been established in Manowai‘ōpai Stream for monitoring Laupāhoehoe Forest and the gauge is currently maintained by the USFS.

### Short Term Research Projects

In addition to long term data collection, the HETF supports a range of research projects that contribute to the greater ecological understanding of Hawai‘i’s forests and species. Research topics include species identification, monitoring, ecosystem services and life history studies, koa productivity, biodiversity and invasive species impacts and control. Representative examples of the diversity of topics include:

- Hawaiian hoary bat habitat occupancy, reproduction and diet



- Acoustic variability and loss of song complexity in Hawaiian honeycreepers
- Adaptive radiation in Hawaiian spiders
- *Drosophila* bar coding project as a method to determine species
- Native and non-native snail surveys
- 'Ōhi'a rust monitoring
- Assessing the *Scotorythra paludicola* (Lepidoptera: Geometridae) outbreak on koa: population abundance, rates of parasitism and patterns of spread
- Comparative nutritive values of traditional and exotic foraging substrates for upper elevation forest birds
- Quantifying the effects of ungulate and vegetation on the hydrology of Hawaiian tropical forests
- Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics

### ***Education and Outreach***

Educational activities associated with Laupāhoehoe Forest currently include support for internships that focus on restoration and education (AmeriCorps, Youth Conservation Corps (YCC), and Pacific Internship Programs for Exploring Science (PIPES)), and securing national, regional, and local grants that fund educational programs. Further, IPIF staff collaborations with teachers at local middle and high schools have resulted in classroom field trips into the forest to learn about botany, ecology, natural resources management, traditional ecological knowledge and cultural geography. Many of the educational activities involve substantial contributions from additional partners including Mauna Kea Watershed Alliance, the USFWS, and the University of Hawai'i (UH) at Hilo and UH-Mānoa.

### ***Public Access and Recreation***

Public access for recreational and cultural uses is ongoing in Laupāhoehoe Forest in accordance with existing rules and policies described earlier in this plan (see DESCRIPTION AND CURRENT CONDITION section). Current public access routes are shown Figure 3.

### ***Infrastructure***

Plans for development of two facilities for education and research outside the forest boundary were finalized in the Laupāhoehoe Construction Project EA. The Laupāhoehoe Science and Education Center is currently in the final stages of construction for building commissioning in 2015. The Forest Pavilion (Field Education Site) will be located on a 3-acre (1.2 ha) parcel located adjacent to the Laupāhoehoe Forest (Figure 3). It will consist of a covered pavilion, toilet/comfort station, and parking area, and it will be used primarily as a staging area for research and education trips into Laupāhoehoe Forest. See the Laupāhoehoe Construction Project EA ([http://www.hetf.us/page/projects\\_plans/](http://www.hetf.us/page/projects_plans/)) for more detailed information regarding the project.



## PROPOSED MANAGEMENT PROGRAM

The proposed management program outlined in this section includes new proposed actions as well as ongoing research, management and education projects. This section provides background information on projects within the main management focal areas, management objectives, and proposed actions to accomplish the objectives. In addition, some sections provide rationale for the proposed actions in cases where there were alternative actions considered.

### *Natural Resources*

#### Forest Protection and Management

**Background:** The protection and management of forested watersheds and unique native Hawaiian ecosystems is a priority for Laupāhoehoe Forest. Effective management of forested watersheds provides fresh water for public use, improves water quality, reduces soil erosion, improves coastal water quality, and maintains native ecosystems. In addition, many native, threatened and endangered species rely on forested watersheds for their survival. These forested watersheds require active management to effectively address threats in order to persist for the benefit of current and future generations.

- Locations for conservation units were chosen in consultation with the LAC and high use hunting areas were avoided where possible.
- The areas planned for fencing have some of the highest quality, most intact native habitat in Laupāhoehoe Forest.
- Planned conservation units will protect existing populations of rare plants and animals and can also be used as restoration sites for rare species recovery.

**Objective:** Protect, manage and restore native ecosystems and species at Laupāhoehoe Forest by effectively managing conservation units and implementing forest restoration practices.

#### **Proposed Actions:**

1. Fence and remove feral pigs from two conservation units (Figure 9) to protect the biological and water resources and limit damage to native Hawaiian ecosystems. Without fencing, ungulate control requires ongoing effort, due to reproduction of existing populations and continued ingress from adjacent properties.
  - Conduct field surveys of final fence alignment to avoid any impacts to botanical, faunal, and archaeological resources.
  - Construct fencing of two conservation units (342 acres (138 ha) and 2,317 acres (938 ha) (subdivided by a cross fence (location to be determined))).
  - Install gates and walkovers for pedestrian access into fenced conservation units.
  - Implement feral pig control using approved methods following fencing to remove all pigs from within conservation units. Public hunting will be encouraged initially, but additional control methods including drives, trapping/release, staff control, and snaring, may be needed to remove all the ungulates not removed by active hunting within the conservation units.
  - Monitor fenced conservation units for pig ingress, and control pigs, if necessary.





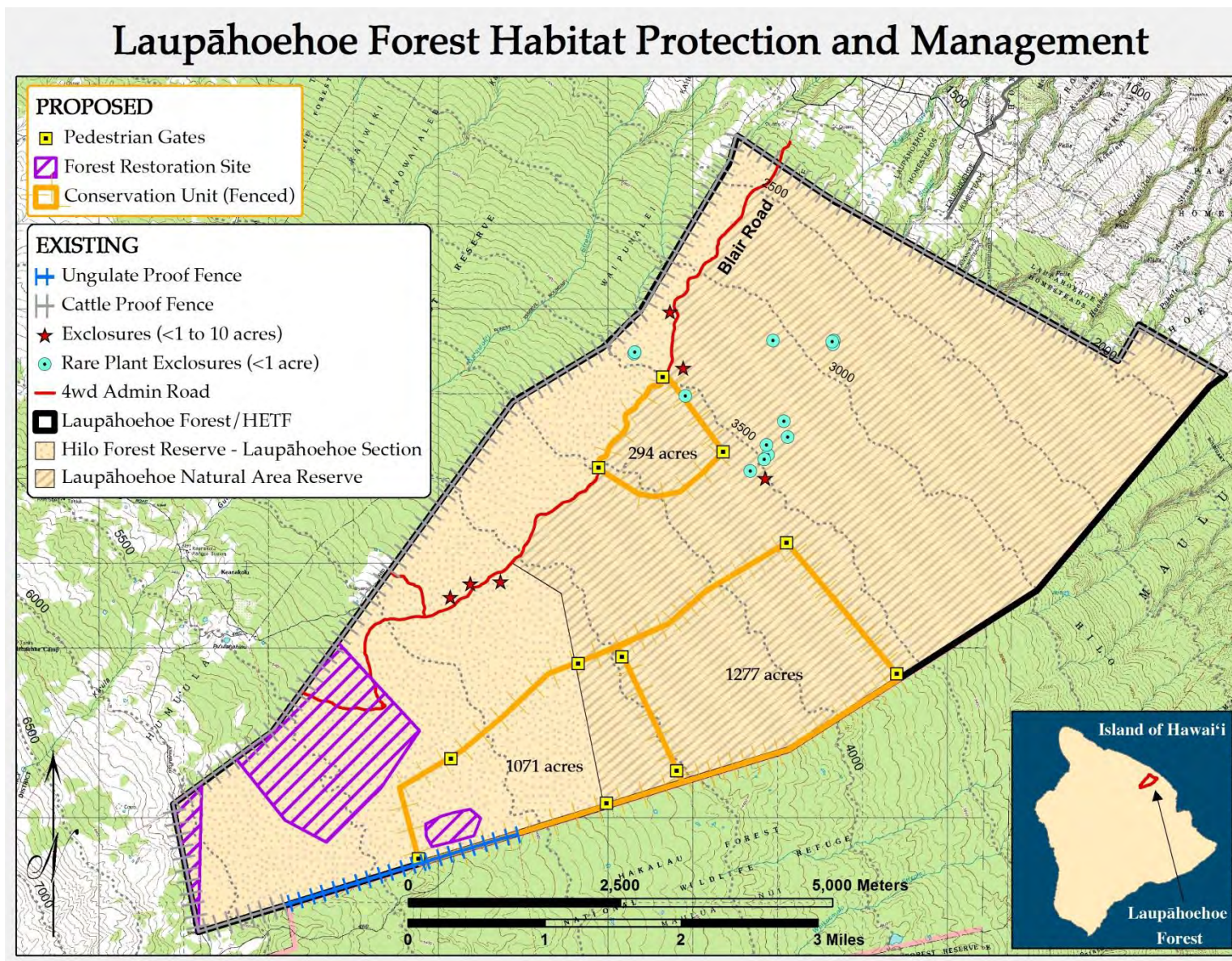
2. Maintain all fences through regular inspection and maintenance and replace fences, when needed, including perimeter fencing to prevent cattle ingress from adjacent ranch lands.
3. Restore forested ecosystems in areas that have been disturbed (e.g. formerly logged areas, areas disturbed by cattle) through tree plants and invasive non-native plant control.
4. Plant koa and other native trees to restore native forest. Priority areas are depicted in Figure 9. Priorities include the following: 1) within the FR section along Mana Rd. and inward; 2) Shack Camp; and 3) section off Blair Rd. toward Waipunalei. Restoration is not limited to these areas and additional areas may also be restored. These priority sites were chosen because they have past damage from logging and feral cattle. They are also accessible for staff and volunteers, particularly with proposed infrastructure improvements at Shack camp (shelters and camping sites discussed in public recreation and access section below).
5. Control non-native pasture grasses and other non-native invasive weeds in restoration areas to enhance the natural regeneration of native trees and shrubs and prevent fire.
6. Construct emergency rare plant exclosures between 1-5 acres in size, when needed to protect individuals or populations of endangered plants.
7. Pursue potential land acquisitions of adjacent lands for protection and restoration of a large conservation landscape in cooperation with conservation partners (when applicable).

**Rationale:** Community and LAC member feedback related to conservation units in Laupāhoehoe Forest ranged widely from fencing the entire forest for protection to desires for no additional fences. As mentioned throughout this plan, the protection and management of forested watersheds and unique native Hawaiian ecosystems is a priority for the state within Laupāhoehoe Forest as only 35 acres are currently protected. Through discussion with the LAC and community members, the importance of Laupāhoehoe Forest to the community for hunting opportunities was also documented. Across Hawai‘i Island, state land managers are facing tough choices when tasked with protecting valuable native resources while still providing hunting opportunities. In particular with feral pigs, the negative impacts to the forest are well documented. The proposed conservation units in this plan attempt to meet conservation needs while considering hunting community desires. High quality native forest habitat areas that are less heavily used for public hunting were purposely selected. The proposed conservation units also provide suitable habitat for the recovery of rare and endangered species and are more feasible to manage because they are not dominated by invasive species, as is the case in lower elevation portions of the forest. One conservation unit with high quality native forest habitat includes an area dominated by tropical ash but this area has high restoration potential once fenced and the tropical ash controlled. When this plan is fully implemented, approximately 2,694 acres (1090 ha) or 22% of Laupāhoehoe Forest will be protected through conservation unit fencing.

In conjunction to Action 7 above, the state is also pursuing the development of additional access and/or acquisition of lands to expand hunting opportunities on appropriate lands.



Figure 9





### Invasive Non-Native Plant Control

**Background:** Invasive non-native plants are a major threat to Laupāhoehoe Forest, and species with high potential for spreading and modifying habitat are a high priority for control. The overall approach includes preventing the establishment of new habitat modifying species that are either not currently present (e.g. miconia) or are still localized through biosecurity measures. For priority weeds already present, the goal is to identify control areas, eliminate all known occurrences within targeted control areas and/or to contain the further spread.

**Objective:** Protect intact native forest by preventing the establishment and/or removing high priority non-native, invasive plants and other invasive species.

#### **Proposed Actions:**

1. Regularly monitor and map the distribution of high priority invasive non-native plants, develop a comprehensive control strategy and revise control strategy, as needed, based on monitoring data.
  - Regularly compile transect monitoring data, incidental observations and reconnaissance surveys to map changes in invasive plant distribution and abundance and detect new species.
  - Cooperate with research on new mapping technologies (high resolution aerial imagery) to assist in monitoring and/or locating priority weeds for control.
2. Control priority non-native invasive plants in identified areas using approved methods.
  - Control invasive non-native plants in high quality native forest, particularly within fenced, ungulate-free management units. These areas are a high priority for more intensive management, and the recovery of native vegetation, reductions in ground disturbance and the spread of weeds by ungulates may increase the effectiveness of invasive plant control.
  - Target control of certain incipient invasive non-native plants (just beginning to invade) in unfenced areas to prevent their establishment and spread.
  - Focus control efforts in disturbed areas such as roads and trails as these often serve as corridors for weed establishment and spread.
  - High priority species present in Laupāhoehoe Forest include Australian tree fern, banana poka, Florida blackberry, cane tibouchina, *Clidemia*, *Ficus*, Himalayan ginger, mules foot fern, palm grass, passion fruit, *Polygonum chinensis*, strawberry guava, tropical ash, and yellow Himalayan raspberry.
  - A combination of control techniques including manual, mechanical and approved herbicides will be used to remove weeds. The technique selected will be based on the characteristics of the target species, the sensitivity of the area in which the species is found, and the effectiveness of the control technique.
  - Due to widespread and heavy infestations of certain weeds and limited resources, DOFAW will use approved biocontrol agents within the forest, when available, and if shown to be effective.
3. Monitor non-native invasive plants to determine whether weed control measures are effective and to detect changes in long term distribution and abundance.



4. Maintain procedures to prevent introduction of new weeds (see biosecurity section).
  - Avoid and/or reduce the inadvertent introduction and spread of weeds by staff, researchers and the general public working through education regarding biosecurity and implementation of biosecurity protocols for staff and research/education permittees.
  - Prevent the establishment of high priority invasive non-native plants species that are present in adjoining areas but not yet detected in Laupāhoehoe Forest. These species include miconia, faya, gorse, firethorn, *Cotoneaster pannosus*, and New Zealand flax.

### Rare Species Restoration

**Background:** Landscape-scale habitat protection and management through management actions described in the habitat protection and management section are critical to the long-term integrity and recovery of native ecosystems including rare plants, forest birds and other native species. Such management actions, along with non-native invasive plant management and the prevention of new habitat-modifying weeds and harmful non-native species are the most critical actions needed to protect existing native habitat and rare species. However, in some instances, these actions are not enough to recover certain rare and endangered plants and animals. These species may have wild populations that are so small that the species cannot survive and recover without additional species-specific management.

**Objective:** Protect threatened and endangered plants and animals in Laupāhoehoe Forest and restore populations of these species in appropriate habitat to assist with the overall recovery of these species.

### **Proposed Actions:**

1. Maintain the integrity of high quality forest ecosystems to the extent possible through fencing, feral ungulate control, non-native invasive plant control and preventing the introduction and establishment of other habitat-modifying species and new threats.
2. Map, monitor and protect existing wild populations of rare and endangered species to contribute to their population recovery and stabilization. Identify and remove threats to these species and ensure their long-term survival in secure and self-sustaining wild populations.
3. Re-introduce certain species of rare and endangered plants Table 3 in appropriate protected habitat through outplanting. Over the past decade, numerous species of rare plants have been propagated and reintroduced into fenced, ungulate-free areas to contribute to their overall recovery in the wild.
  - Coordinate rare plant management actions with the PEPP, VRPF and other agencies and organizations working on rare plant recovery.
  - Survey rare plants to locate wild individuals, collect propagation and genetic storage materials and reintroduce through outplanting.
  - Follow rare plant collection and reintroduction guidelines recommended by the Hawai'i Rare Plant Restoration Group.
  - Tag and map the locations of all outplanted plants and monitor survival and growth.





- Provide additional management of wild and/or reintroduced populations if needed (e.g. small fences around wild plants and populations that are not within fenced management units, control of damaging weeds, insects, slugs, plant disease and/or mammalian predators).
4. Determine additional actions needed to protect rare invertebrates. Previously discussed habitat management will also benefit rare native invertebrates, as they are generally dependent on native plants for food and as host plants.
    - Perform additional invertebrate surveys to inventory species, identify important habitat for rare species, and determine threats and needed recovery actions.
  5. Enhance habitats for native species through small mammalian predator removal and other habitat management actions.
    - Small mammalian predator removal (e.g., removal of rats, mongoose, cats) may provide significant benefits to endangered birds, plants, and endemic invertebrates, but is extremely difficult and costly to implement. DOFAW staff may implement predator removal in certain high priority areas (e.g. endangered bird nesting sites, rare plant restoration sites) using approved methods.
    - Other management may be implemented, as feasible. These include removal of larval habitats (e.g standing water providing mosquito breeding habitat) that may be responsible for seasonal epizootics of avian pox and malaria. Reducing or eliminating vespid wasps (yellow jackets) may also provide benefits to forest birds, as these wasps prey on insects that provide food for forest birds.

### Monitoring

**Background:** DOFAW staff will continue to implement basic monitoring programs which are directly informing ongoing management. DOFAW staff regularly monitor ungulates, non-native invasive plants, rare plants and forest birds and are planning on continuing these monitoring programs. Additional monitoring is described under research, and will primarily be implemented by USFS staff and other researchers.

**Objective:** Monitor current status and trends of natural resources throughout Laupāhoehoe Forest as part of a long-term monitoring program.

### **Proposed Actions:**

1. Continue ongoing monitoring programs for ungulates, non-native invasive plants and rare plants to measure the success of management and detect changes in abundance and distribution.
  - Monitor ungulates in fenced management units to detect the presence or absence of ungulates. Units that are free of ungulates will be regularly monitored to detect ingress animals. Units with active ungulate control programs will be monitored to assess the success of and/or direct control efforts.
  - Continue non-native invasive plant monitoring along transects to detect changes in distribution and abundance over time as well as detect incipient invaders. Control areas are monitored to determine the success of management efforts.



- Rare plant monitoring is conducted to assess the survival and growth of wild and re-introduced rare plants. DOFAW and PEPP program staff monitor rare plants to assess their survival and reproduction, collect propagation materials, search for additional wild individuals and determine if additional management is necessary.
2. Continue ongoing monitoring program for forest birds. Provide monitoring data to the Hawai'i Forest Bird Interagency Database Project for analysis of bird population densities and trends.
  3. Develop improved monitoring protocols, data management and analysis for existing monitoring programs and review and summarize past monitoring data and inventories.
  4. Develop and/or identify appropriate monitoring protocols and implement monitoring for key community indicators that are not currently being monitored (e.g., native vegetation communities, invertebrates, etc.).

### Wildfire Prevention and Response

**Background:** Fire is a threat to the drier upper elevation portions of the Laupāhoehoe Forest. Many fires are caused by humans, so fire prevention measures will include increased educational efforts. DOFAW staff will respond to fires in Laupāhoehoe Forest using measures that result in the least amount of impact or disturbance to natural and archeological resources. The method of suppression will be determined by the on-site situation, with special regard to the potential expansion of fire damage to natural resources. Minimum impact methods of suppression will be applied whenever such methods are sufficient. Bulldozing is justified when a fire cannot be otherwise controlled and potential bulldozing damage is outweighed by a probable greater loss of natural and archeological resources.

**Objective:** Employ appropriate fire management strategies including pre-suppression, suppression, and post-suppression rehabilitation to reduce wildfire occurrence and minimize wildfire impacts.

#### **Proposed Actions:**

1. Implement fire prevention measures, including educational outreach to neighbors and signage along roads and road or area closures in the event of extreme fire danger.
2. Control invasive plants, particularly non-native grasses and plant common native species to restore certain disturbed areas to prevent fire and/or following damage from fire.
3. DOFAW staff to suppress fires safely and aggressively using appropriate means to minimize wildfire impacts.
4. Continue DOFAW staff training and certifications for effective and safe fire response.
5. Maintain access and fuelbreaks for fire pre-suppression and suppression.

### *Research*

**Background:** The USFS and state of Hawai'i, along with the consortium of institutions and agencies involved with the HETF, will continue to encourage and facilitate research in Laupāhoehoe Forest. Research projects that contribute to the greater purpose of the HETF, that are relevant to land management issues and that are compatible with existing research and



management will be encouraged. USFS will support facilities to enhance the ability of the experimental forest to meet its goals for research and science. In addition, the USFS will facilitate access to basic biological, physical, and climatological data for the experimental forest through readily accessible web-based platforms and tools for researchers and the public to provide a foundation on which research projects can be built. All research within the HETF requires a valid permit.

Laupāhoehoe Forest provides many opportunities for research. Information on the basic natural history and abundance of the many endemic and often endangered plants and animals associated with Laupāhoehoe Forest is needed to understand how species may respond to changing environmental conditions (e.g., as a result of climate change) and how management and conservation measures can be used to help enhance adaptation. With its mixture of native and non-native dominated landscapes, Laupāhoehoe Forest provides an ideal site in which to test hypotheses about how invasive species impact ecosystems and determine the most effective methods of controlling or eliminating invasive species. Research aimed at effective ecosystem restoration is of great relevance not only in Hawai‘i and the Pacific Islands, and throughout the wet tropics.

**Objective:** Provide lands for conducting research that serves as a basis for the restoration, conservation and management of tropical forest ecosystems in Hawai‘i and across the tropics.

**Proposed Actions:**

1. Promote applied research with direct relevance to land management issues such as effective management of invasive species, forest restoration and climate change impacts on Laupāhoehoe Forest.
  - Host semi-annual meeting with land managers and community members to outline pressing information needs.
  - Host semi-annual meetings with research community to identify opportunities for collaboration and funding.
  - Bring together research institutions and conservation land stewards on Hawai‘i Island (e.g., US Fish and Wildlife Service, US Park Service, Nature Conservancy, Kamehameha Schools) to establish a network of field sites that together can be used to promote research on a broader suite of questions about tropical ecosystem conservation.
  - Offer stimulus funding in the form of modest awards to promote research in key areas.
  - Host theme-based research discussions and symposia at the Laupāhoehoe Science and Education Center, or elsewhere, that is sponsored by the experimental forest.
  - Promote and support dissemination of research conducted in association with the experimental forest (e.g., research highlights, presentations, acknowledgements in publications and presentations).
2. Effectively administer and coordinate the research application process including review of applications, issuance of research permits, research compliance with permit conditions and relevant land designation statutes and rules.
  - Provide administrative support to research permit review and approval process.



- Provide research expertise and management guidance to address potentially controversial or complex research proposals.
  - Promote timely and efficient processing of requests to encourage use.
3. Establish and maintain a system for archiving research data and reports to facilitate the exchange and transfer of information among agencies, scientists, and the community.
    - Maintain a publically available, web-based archive of baseline monitoring data, historical data and descriptions of all research activities. Historical data includes archive of maps, land-use histories, cultural practices and historical data relating to the HETF.
    - Require all permitted researchers to make appropriate contributions to the data archive, including project descriptions, project reports, sampling locations, and publications that have resulted from research.
    - Maintain an electronic library of publically available reports, research and publications that pertain to the HETF available on the Internet. Materials protected through copyright would be available by request.
    - Publish syntheses of research and monitoring activities and results from HETF to provide information and findings more readily accessible to research, conservation, and local community members.
  4. Improve dissemination of scientific research information and results to land managers and the local community.
    - Provide presentation series, workshops and seminars in association with the experimental forest to disseminate information to the local community.
    - Partner with University of Hawai‘i, Hawai‘i Community College, and local K-12 schools to jointly host field trips and field courses.
    - Host annual open houses at the experimental forest units to highlight research activities, associated knowledge gained, and opportunities for community involvement.
    - Develop a diversity of outlets for information in non-technical formats (e.g., calendars, posters, computer apps).
  5. Promote cultural research including information on traditional Hawaiian use/presence in the forest, oral histories, cultural impacts of management actions and archeological studies.
    - Collaborate with cultural researchers at University of Hawai‘i and other schools to use Laupāhoehoe Forest as a focus of cultural research.
    - Seek funding for cultural research including integration of culture into scientific research as well as archeological and ethnographic studies.
  6. Link ongoing research to education programs by encouraging researchers to work with local schools such as the Laupāhoehoe Community Public Charter School and universities.
    - Collaborate with University of Hawai‘i and Hawai‘i Community College to develop courses and seminars that incorporate field site visits to the experimental forest.
    - Collaborate with local educators to develop course curricula and materials that highlight or utilize research findings associated with the experimental forest.





7. Encourage basic research and monitoring to establish historical baselines of all natural resources.
  - Collect data on vegetation as part of a global tropical forest monitoring network, to monitor the status and condition of vegetation at Laupāhoehoe Forest and to develop vegetation maps.
  - Maintain a weather station as part of a larger island-wide network of climate stations across the island of Hawai‘i to collect data on rainfall, temperature, relative humidity, wind-speed, solar radiation (sunlight), soil moisture, soil temperature, and wind direction.
  - Establish and maintain stream gauges to monitor natural stream flows, water quality and sediment in a non-destructive manner. Hydrologic information can be used as a foundation for research on aquatic ecology, watershed dynamics, and climate change.
  - Perform regular surveys that systematically document and describe plant and animal species distribution and status to provide a baseline for research and assist with developing management actions and assessing their success.

### *Education and Outreach*

**Background:** Education and outreach are key component of the overall vision for Laupāhoehoe Forest. Education and outreach goals span six focal areas: formal training for professionals; community outreach; cultural training; demonstration for natural resources managers; student research; and academic education. Educational goals will be accomplished through a strong reliance on partnerships and will be integrated with other aspects of research and natural resource management.

**Objective:** Serve as a center for forest education, training, demonstration and outreach on tropical forests, conservation biology, and natural resource management for groups ranging from school children to land managers, scientists and the general public.

### **Proposed Actions:**

1. Encourage appropriate educational and cultural uses of Laupāhoehoe Forest through the development of general criteria, priorities and rules to effectively manage multiple educational uses.
2. Provide general orientation and training (e.g. on-line video) for all new research permittees and educational programs that includes recommendations on forest stewardship and invasive species prevention protocols as well as cultural components.
3. Collaborate with universities and relevant non-governmental organizations to integrate classes, student research/internships and provide support via Center facilities.
  - Host courses from local and visiting universities.
  - Co-develop courses with local and off-island universities that incorporate the HETF into the field component of classroom courses or where the HETF and perhaps other field sites are the focus of field courses.
  - Work with instructors from various universities to formulate courses that also contribute to our understanding of tropical ecosystems.



4. Foster and support undergraduate and graduate student research opportunities and research internships through partnerships with the University of Hawai‘i, other universities and local research agencies and organizations.
  - Identify research projects suitable for undergraduate and graduate students.
  - Sponsor students (e.g., projects, mentoring, equipment, funding) in conducting research pertinent to the HETF.
  - Invite researchers from other institutions to come to the HETF to conduct their research.
5. Provide a connection to nature and promote forest stewardship through engagement activities that involve the public and through collaboration with K-12 education program partners and other community partners including but not limited to the Laupāhoehoe Community Public Charter School. Educational activities include:
  - Educator workshops and programs
  - Field projects geared toward kids
  - Partnering with schools, educators, community and other non-governmental organizations to create and implement activities that facilitate forest stewardship
6. Communicate research findings, land use, and management goals to the community via:
  - Community field trips
  - Informational materials suitable for non-professionals of all ages
  - Participation in community events
  - Service learning opportunities
  - Interpretive trails and guided walks
  - Public participation in scientific research
7. Provide work experience and formal professional development training to land management professionals in ecology, conservation, and restoration of natural and cultural resources.
  - Provide opportunities for students in internship programs, such as PIPES to join research teams for short periods of time.
  - Provide opportunities for young professionals in YCC programs to understand research needs and management applications.
  - Enable emerging professionals in AmeriCorps programs to experience working alongside research scientists and natural and cultural resource managers.
  - Provide short-courses (0.5 to 5 days) designed for working professionals to help integrate new information and ideas into agency activities and approaches.
8. Serve as a demonstration site for land managers by providing information, tools and techniques through demonstration research, conservation, and restoration projects.
  - Engage managers in the design and implementation of research to understand effective conservation and restoration approaches.
  - Engage managers in the design and implementation of biophysical monitoring programs and projects.



- Engage managers in the design and implementation of science based restoration projects.
  - Engage managers in the role of traditional ecological knowledge in land management.
9. Provide readily accessible scientific information through web-based platforms and tools.
  10. Encourage researchers to share research results with the local community through informational presentations to schools and community groups and popular articles.
  11. Hire staff and/or establish volunteer positions to facilitate educational and outreach experiences (e.g. education staff, rangers).
  12. Serve as a site for alternative educational activities for non-profit groups and organizations (e.g. search and rescue training, orienteering, survival skills, back-country travel, hunter education programs, forest stewardship, Junior Youth Council, recreational and/or life skills, cultural immersion and traditional ecological knowledge training).

### ***Public Access and Recreation***

**Background:** Laupāhoehoe Forest is protected and managed by the state for the benefit of the people of Hawai‘i, and is open to the public for various recreational and cultural uses. While the public is allowed to access and hike or hunt in any portion of the forest, there are limited legal access points and only a few minimally maintained and marked trails. This area is a rough and remote rainforest wilderness and there are currently no amenities for recreational users. The access and recreational improvements proposed are intended primarily for local residents and to improve staff management access rather than for large-scale ecotourism. Large groups (over ten people) accessing the NAR require an HETF permit. The LAC is also supportive of improving public access elsewhere in the broader region, which has similar access issues.

**Objective:** Improve public access and recreational opportunities in Laupāhoehoe Forest consistent with maintaining natural resources and the wilderness character of these lands.

#### **Proposed Actions:**

1. Improve Public Access
  - Work with adjacent landowners to survey roads through private and state-leased lands depicted on some maps (“paper roads”) and/or work on alternative access to the forest.
  - Work with the County to ensure all future subdivision plans in the area include public access to the forest.
  - Pursue potential land acquisitions through fee-simple purchase (e.g. possible purchase of Waipunalei from Parker Ranch to connect forest reserve sections increasing access by eliminating private land barriers).
  - Consider DOFAW acquisition of long-term leases of state and/or private lands adjacent to the forest when current leases expire.
  - Consider adding appropriate trails and accesses (e.g. Maulua Trail) to the Nā Ala Hele Statewide Trail and Access System to improve overall management.



2. Trail Maintenance (Pedestrian) - Maintain existing trails (Spencer, Maulua & Peneki) as primitive trails (minimally maintained and marked) (Figure 10).
  - Peneki can serve as a connector trail from Spencer to Blair Rd. for both public recreational and research use.
  - Spencer can provide both public recreational and research use.
  - Maulua Trail can be used for education and outreach, public recreation and research and management.
  - Exclosure trail is used by DOFAW staff for management purposes and can also be used as a connector trail by the public.
  - Control spread of non-native invasive plants by providing boot brushes and informational signage at all trailheads and access points.
3. Trail Improvement (Pedestrian) - Improve existing and/or create and maintain new trails. Trail improvement is a lower priority than maintenance of existing trails; however the trails below would be minimally maintained and marked in a similar fashion to the maintained trails above. Specific alignments for new trails generally described below have not yet been determined on the ground and may vary depending on the vegetation and terrain (Figure 10).
  - Create trail along the north fence line (upper boundary) from Mana Rd. to Blair Rd. This would provide a public trail from Mana Rd. to Blair Rd. and would also be useful for management access. This trail would be relatively easy to create because it would be along an existing fence line.
  - Improve Spencer trail to Peneki and Peneki to Blair. These improvements would provide the public a legal connector within the forest boundary from Spencer to Peneki as well as fulfill the public interest in connecting Spencer-Peneki-Blair-Mana Rd.
  - Improve Maulua Trail to the south boundary/fence line. This improvement would provide an education/outreach trail for community forest restoration projects and would also be useful for management access. This trail can easily be improved given terrain and existing vegetation.
  - Create trail from Mana Rd. to Maulua roughly parallel to the southern forest boundary (specific location to be determined). This would create a loop trail for the upper area for the public and education/outreach opportunities as well as being useful for management access.
  - Create a trail at the FR/NAR boundary (specific location to be determined). This would provide a public trail through high quality forest and would help with management and research site access for management, monitoring and research, particularly for invasive non-native plants.
4. Hunting - Maintain and improve public hunting opportunities in Laupāhoehoe Forest.
  - Secure and improve/create access and trails as outlined above.
  - Facilitate additional hunter education classes in the Laupāhoehoe region.
  - Consider changing permitted hunting method for Unit C (currently rifle only) if desired by the hunting community.
  - Work with DOCARE to address hunting community concerns about illegal activities at Laupāhoehoe Forest and elsewhere on the island.





5. Camping and Shelters - Establish designated camping area at Shack Camp with primitive camp sites (Figure 10).
  - Construct a shelter or cabin at Shack Camp for both public recreational and management staff use. Cabin would be open to the public using a permitted reservation system.
  - Establish other infrastructure needed for camping and shelters at Shack Camp (composting toilet, fire pits, helicopter landing zone).

**Rationale:** Community and LAC member feedback related to public access in Laupāhoehoe Forest ranged widely from comments that current public access is adequate and no additional management actions are needed, to recommendations for expansion and enhancement of vehicular, mountain biking and pedestrian access.

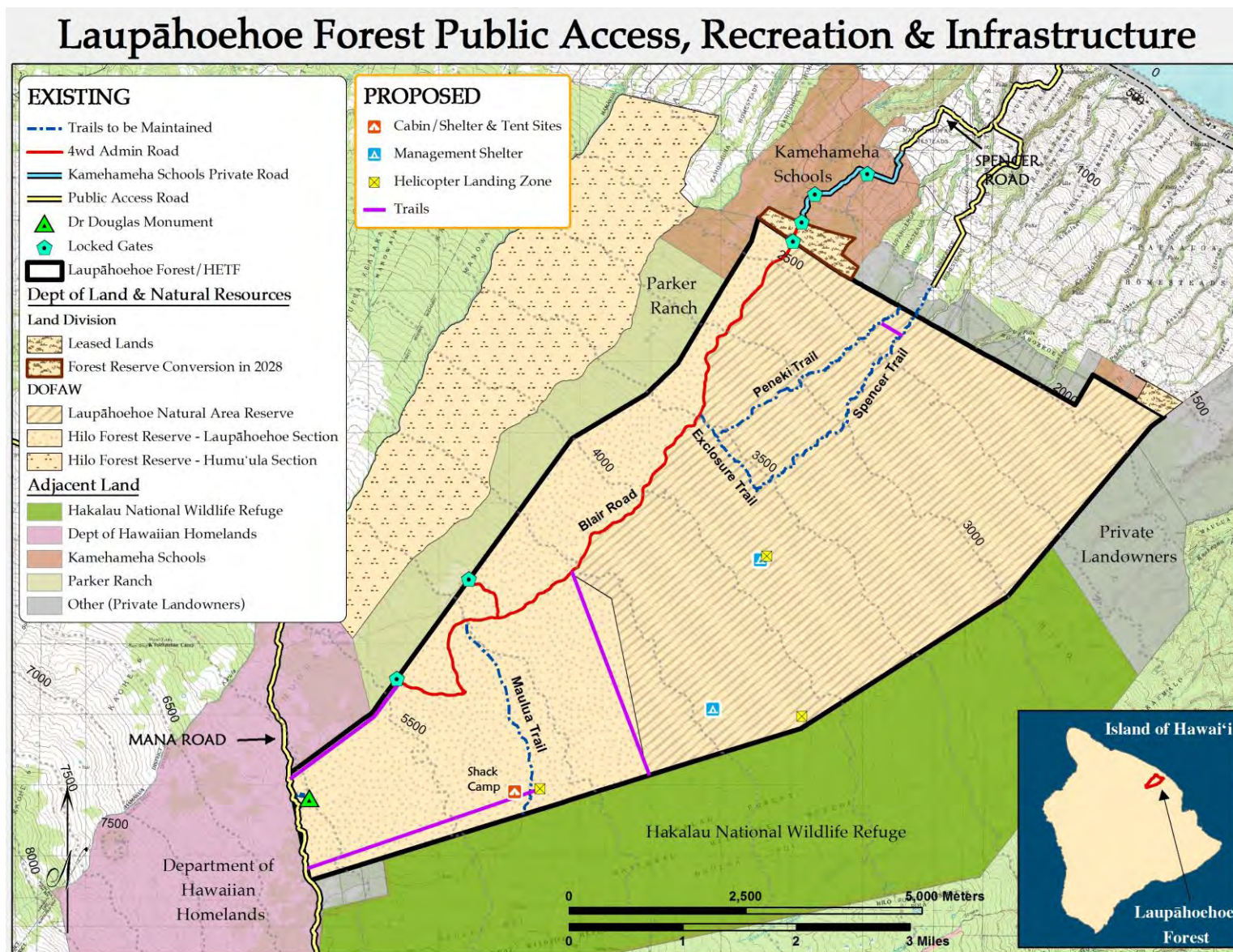
- **Pedestrian access within the forest** – Feedback ranged from current pedestrian opportunities are adequate and no additional management actions are needed, to recommendations to consider the development of highly developed and maintained trails. A majority of comments recommended improving pedestrian access to allow a pedestrian to follow a recognized trail through the forest that would connect to Blair Rd. Due to the rugged terrain of Laupāhoehoe Forest and financial resources needed to create and maintain trails, the proposed actions primarily focus on improving existing primitive trails to allow pedestrians to traverse the forest and enter and exit at existing legal access points. There are numerous primitive trails throughout Laupāhoehoe Forest created and used by the hunting community, but only three of these existing trails would be identified as recognized public trails.
- **Vehicular access to and within the forest** – Feedback ranged from recommendations to dismantle Blair Rd., to opening Blair Rd. to public vehicular access. Blair Rd. is a valuable resource for management, research and education/outreach opportunities in Laupāhoehoe Forest and for these reasons dismantling Blair Rd. was not considered as an action. Opening Blair Rd. to public vehicular access was not considered as an action considering entry is through private lands, road maintenance considerations, and increased risks associated with transport of invasive species. Feedback from LAC members included holding an annual open house where this could be accommodated or agencies offering chaperoned trips for the public. While an annual open house is not feasible or realistic due to public vehicular access restrictions across neighboring private lands, both USFS and DOFAW currently offer agency chaperoned service learning/outreach opportunities and these types of activities are also proposed for expansion.
- **Mountain biking** – Feedback ranged from mountain biking should not be allowed, to trails should be maintained/created to accommodate mountain biking. Biking is legal on FR roads including Blair Rd. but currently the only way to reach Blair Rd. on a bike is through private property, which is not legal. An alternative considered was multi-use trails that would allow for legal entry; however this was not selected as a plan action because there were only a small number of trails proposed for pedestrian improvement, concerns about user conflicts, and bicycle damage to trails.



- **Hunting** – Feedback from LAC hunter working group members included a desire for the state to pursue game management in the unfenced conservation units within Laupāhoehoe Forest primarily to allow for closures to create recovery periods coupled with DOCARE enforcement. Game management to increase game mammal populations for hunting conflicts with DOFAW management priorities for Laupāhoehoe Forest, as well as with federally designed critical habitat for endangered species. As mentioned elsewhere in this document, the proposed conservation units in this plan attempt to meet conservation needs while also considering hunting community desires. High quality habitat that is less heavily used for public hunting due to remoteness was purposely selected for the conservation units. This plan seeks to increase public hunting opportunities in more accessible areas outside the fenced conservation units through improvements in access. Once this plan is fully implemented, approximately 9,649 acres (3905 ha), or 78% of Laupāhoehoe Forest will be available for public hunting.



Figure 10



### *Infrastructure*

**Background:** Infrastructure is needed to improve management, research and education and public recreational uses in Laupāhoehoe Forest. Infrastructure includes roads, facilities, helicopter landing zones and structures, cabins/shelters and equipment.

**Objective:** Provide and maintain infrastructure and facilities to enhance the ability of the Laupāhoehoe Forest to meet its goals for management, research, education, and demonstration.

#### **Proposed Actions:**

1. Develop and maintain roads, cabins/shelters and campsites and helicopter landing zones for resources management actions, the functions of the HETF and for public recreational use and safety (Figure 10).
  - Develop facilities at Shack Camp (described above in public access and recreation section).
  - Establish a forest management shelter and landing zone at 3,500 feet (1067 m) elevation on the south east side of the NAR (specific location to be determined). This shelter will also be available for the public.
  - Establish approximately three other forest management shelters, as needed - locations to be determined.
  - Establish additional helicopter landing zones to be used for management and search and rescue operations - locations to be determined. Helicopter landing zones will use existing natural openings to avoid any damage to natural resources.
2. Ensure the development and maintenance of facilities and infrastructure has minimal impacts on the environment and natural and cultural resources.





## ADMINISTRATION

### *Coordination*

The HETF Cooperative Agreement states that "owing to the many values and benefits that arise from research, education and demonstration on the HETF and elsewhere, the Parties (the USFS and the state of Hawai‘i) further agree they will consult and reach agreements with each other to coordinate research, management, and education activities." Coordination of research, management and education is managed by the HETF Planning Group, which includes IPIF and DOFAW staff and two to three external partners. The HETF Planning Group is facilitated by the USFS and meets quarterly. The USFS produces an annual report for the BLNR and NARS Commission summarizing research, management and monitoring actions in the HETF.

### *Permitting*

Permit applications for research and education activities Laupāhoehoe Forest are reviewed by agency staff in the HETF Planning Group as well as the LAC (which provides comments and/or recommendations). Permit processing and tracking is administered by the USFS. Signing authority for all permits lies with the Hawai‘i Island DOFAW Branch Manager (permit approval authority for the NAR was delegated to the Branch Manager by the NARSC on May 21, 2007). All research permits are valid for one year and require an annual report.

### *Cultural Resources*

All state and federal employees, permittees and the public are required to comply with state and federal laws relating to the protection of cultural resources. All cultural and historical sites should be left alone and artifacts should not be collected. Burial sites and archeological sites are often accidentally disturbed either by nature (erosion) or by human activity through projects that involve excavation. Chapter 13-300, Hawai‘i Administrative Rules addresses rules of practice and procedure relating to burial sites and human remains. If a burial site is discovered, activity in the immediate area must be stopped and remains left in place. Reporting a burial site disturbance is required by law (Hawai‘i Revised Statutes, Chapter 6E) and reports of burial sites or other cultural resources should be made to the state Department of Land and Natural Resources, [Historic Preservation Division](#) Kakuhihewa Building, 601 Kamokila Blvd., Suite 555, Kapolei, HI 96707; Ph: (808) 692-8015.

All Federal agencies are subject to The [Native American Graves Protection and Repatriation Act](#) (NAGPRA), a Federal law passed in 1990. NAGPRA provides a process for museums and Federal agencies to return certain Native American cultural items -- human remains, funerary objects, sacred objects, or objects of cultural patrimony -- to lineal descendants, and culturally affiliated Indian tribes and Native Hawaiian organizations. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items and penalties for noncompliance and illegal trafficking.

### *Biosecurity*

Biosecurity is a set of precautions that aim to prevent the introduction and spread of harmful organisms (pests, pathogens or invasive species) into Laupāhoehoe Forest. New plants and animals arrive in the islands on a continual basis. On average, 100 new plants, 20 species of insects, plus the occasional disease are introduced to Hawai‘i each year (Nature Conservancy of



Hawai‘i 2003). The source population of an invasive species can be the mainland, another island in the Hawaiian archipelago or even another area from the same island. Preventing the introduction of new invasive species into Laupāhoehoe Forest by staff, researchers and the general public is a high priority as these introductions only serve to increase the funding needed to control these species and further put Hawai‘i’s native forests at risk.

Organism introduction in Laupāhoehoe Forest can occur via transportation by animals or humans, the wind and/or through species nearby expanding their range (e.g., coqui frog and little red fire ant). There is also the risk of introductions from management work such as outplanting native plants grown in a nursery or road maintenance with heavy equipment that is not clean. Staff and individuals approved for research or education permits are provided information and protocols to help minimize or eliminate the introduction and spread of alien organisms into Laupāhoehoe Forest (Appendix B – Biosecurity Protocols). Staff and permittees are responsible for making sure that clothing, equipment, and vehicles are free of seeds, dirt, or organisms to lessen the chance of introducing any non-native plants or animals. Boots soles should be brushed and all equipment thoroughly cleaned prior to entry into Laupāhoehoe Forest.

Sightings of new alien organisms within Laupāhoehoe Forest or existing high risk organisms seen in previously un-infested areas should be reported to DOFAW or the HETF.

### *Safety*

Overall Laupāhoehoe Forest terrain is very rugged and existing trails are primitive, uneven and muddy. The weather can be variable and conditions for heat stroke and hypothermia are possible given the elevation and weather patterns in this forest. Cell phone service is intermittent. Hunting with rifle is permitted in the upper portion and hunting with dogs is permitted in the lower portion. Forest visitors/users should dress appropriately for variable weather conditions, wear highly visible attire in consideration of hunting, and travel with adequate food and water. Other hazards include but are not limited to flash floods and falling trees and/or branches.

Vehicle access to the makai forest boundary currently includes traveling over a low water crossing. Heavy rains in the mauka areas of the forest can create flash floods and hazardous conditions at the low water crossing.

Forest visitors are advised to always identify a person to check in and out with that knows their planned route and can alert search and rescue teams should the forest visitor not check in when expected.

### *Budget and Staffing*

NAR staff for the island of Hawai‘i work on all eight NAR on the island, including Laupāhoehoe. Currently, NAR staff include six DOFAW staff, six University of Hawai‘i contractors (Pacific Cooperative Studies Unit) and 2 year-round interns.

Forestry staff works on all nineteen forest reserves on the island. Currently there are eight staff (1 Botanist, 4 Foresters and 3 Technicians).



USFS staff works across the Hawaiian Islands and the Pacific. Staff dedicated to the HETF currently includes two full time administrative positions and the IPIF Director. Education and outreach goals are currently met via contributions to partner programs such as YCC, PIPES and watershed partners as well as through USFS volunteers.

Table 7 outlines estimated expenses related to specific projects and activities such as equipment, supplies, additional staff or contractor time. Costs are very broad estimates and will vary considerably over the time-frame of the plan. Existing staff costs are considered fixed and outlined above, although these may change due to state and federal budget fluctuations. Costs described as ‘to be determined’ or ‘TBD’ are unknown at this time. Funding to implement the estimated budget will be sought from various state, federal and private entities through annual budget requests as well as grants and/or other funding sources.



*Youth Conservation Corps (YCC) interns assist staff with management actions while getting education and training in natural resources management*



Table 7. Estimated costs

ACTION	DESCRIPTION	Periodic estimated costs		Annual estimated costs	ESTIMATED TOTAL COST (15 years)
		Amount	Time scale		
<b>Natural Resources</b>					
<u>Forest Protection and Management</u>					
1. Fence Construction and pig removal from conservation units	Fence construction (materials and contractual labor)	\$5,000,000.00	one time	\$0.00	\$5,000,000.00
	DOFAW staff feral pig removal	\$350,000.00	one time	\$0.00	\$350,000.00
2. Inspect/Maintain/Replace all fences	DOFAW staff, supplies/materials	\$0.00	n/a	\$15,000.00	\$225,000.00
3. Restore forested ecosystems	DOFAW staff, supplies/materials	\$0.00	n/a	\$20,000.00	\$300,000.00
4. Construct emergency rare plant exclosures	DOFAW staff, supplies/materials	\$0.00	n/a	\$5,000.00	\$75,000.00
5. Pursue potential land acquisitions for protection and restoration of a large landscape	DOFAW and USDA-FS Staff – No additional Costs	\$0.00	n/a	\$0.00	\$0.00
<u>Invasive Non-native Plant Control</u>					
1. Monitor/ map high priority invasive non-native plants and develop a control strategy	DOFAW staff, supplies/materials	\$0.00	n/a	\$5,000.00	\$75,000.00
2. Control priority non-native invasive plants in identified areas using approved methods	DOFAW staff, supplies/materials	\$0.00	n/a	\$35,000.00	\$525,000.00
3. Monitor to determine whether control is effective and detect change in distribution/ abundance.	Costs included in #1 (invasive non-native plant control)	\$0.00	n/a	\$0.00	\$0.00
4. Maintain procedures to prevent introduction of new weeds (biosecurity)	DOFAW and USDA-FS Staff – No additional Costs	\$0.00	n/a	\$0.00	\$0.00
<u>Rare Species Restoration</u>					
1. Maintain the integrity of high quality forest ecosystems	Costs included in #1 (forest protection and management and invasive non-native plant control)	\$0.00	n/a	\$0.00	\$0
2. Map, monitor and protect existing wild populations of rare and endangered species	DOFAW staff, supplies/materials - \$5,000/year	\$0.00	n/a	\$5,000.00	\$75,000
3. Re-introduce rare and endangered plants in appropriate protected habitat through outplanting.	DOFAW staff, supplies/materials - \$5,000/year	\$0.00	n/a	\$5,000.00	\$75,000
	Contractor Costs (VRPF and PEPP) - \$5,000/year	\$0.00	n/a	\$5,000.00	\$75,000
4. Determine addition actions needed to protect rare invertebrates	Costs to be determined	TBD	TBD	TBD	TBD





ACTION	DESCRIPTION	Periodic estimated costs		Annual estimated costs	ESTIMATED TOTAL COST (15 years)
		Amount	Time scale		
5. Enhance habitats for native species through small mammalian predator removal and other management	Costs to be determined	TBD	TBD	TBD	TBD
<b>Monitoring</b>					
1. Continue ongoing monitoring programs for ungulates, non-native invasive plants and rare plants	DOFAW staff, supplies/materials; Additional Costs included in #1 (invasive non-native plant control), #2 (rare species restoration)	\$0.00	n/a	\$5,000.00	\$75,000
2. Continue monitoring program for forest birds.	DOFAW staff and contractor monitoring/ data analysis costs - every five years (years 2019, 2024 and 2029)	\$35,000.00	\$3.00	\$0.00	\$105,000
3. Develop improved monitoring protocols, data management and analysis	Contractor staff costs - \$10,000/year	\$0.00	\$0.00	\$10,000.00	\$150,000
4. Develop appropriate monitoring protocols and implement monitoring for key community indicators	Costs included in #3 (Monitoring)	\$0.00	\$0.00	\$0.00	TBD
	Other costs TBD	TBD	TBD	TBD	
<b>Wildfire Prevention and Response</b>					
1. Implement fire prevention measures	DOFAW Staff – No additional Costs	0	n/a	0	0
2. Control invasive plants to restore disturbed areas to prevent fire and/or following damage from fire.	Costs included in #2 (invasive non-native plants)	0	n/a	0	0
3. DOFAW staff to suppress fires to minimize wildfire impacts.	TBD – dependent on size, location and intensity of fire	TBD	TBD	TBD	TBD
4. Continue DOFAW staff training and certifications for fire response.	DOFAW Staff – No additional Costs	0	n/a	0	0
5. Maintain access and fuelbreaks for fire pre-suppression and suppression.	DOFAW Staff – No additional Costs	0	n/a	0	0
<b>Research</b>					
1. Promote applied research with direct relevance to land management issues	Potential monetary incentives to promote work through competitive proposals and/or grants as well as contract work to target specific goals.	\$0.00	n/a	\$20,000.00	\$300,000.00
2. Effectively administer and coordinate the research application process	USDA-FS and DOFAW staff – no additional costs	\$0.00	n/a	\$0.00	\$0.00
3. Establish and maintain system for archiving research data and reports to facilitate exchange and transfer of information	USDA-FS – no additional costs; possible tie in with education/outreach staff see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
4. Improve dissemination of scientific results to land managers and the local community.	USDA-FS – no additional costs; tie in with education/outreach costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00



ACTION	DESCRIPTION	Periodic estimated costs		Annual estimated costs	ESTIMATED TOTAL COST (15 years)
		Amount	Time scale		
5. Promote cultural research including information on traditional Hawaiian use/presence, oral histories, cultural impacts of management actions and archeological studies.	Promote work through competitive proposals and/or grants as well as contract work to target specific goals.	\$0.00	n/a	\$20,000.00	\$300,000.00
6. Link ongoing research to education programs	USDA-FS staff – no additional costs; possible tie in with education/outreach staff costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
7. Encourage basic research and monitoring to establish historical baselines of all natural resources.	USDA-FS staff – no expected additional staff costs; potential monetary incentives to promote work through competitive proposals and/or grants	\$0.00	n/a	\$0.00	\$0.00
<b>Education and Outreach</b>					
1. Encourage appropriate educational and cultural uses through the development of general criteria, priorities and rules.	DOFAW and USDA-FS Staff – No additional Costs; possible tie in with education/outreach staff costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
2. Provide general orientation and training for all new research permittees and educational programs.	USDA-FS staff – no additional costs; possible tie in with education/outreach staff costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
3. Collaborate with universities and non-governmental organizations to integrate classes, student research/internships and provide support.	USDA-FS staff– no additional costs; possible tie in with education/outreach staff see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
4. Foster and support undergraduate and graduate student research opportunities and research internships.	USDA-FS staff – no additional costs; apply for funding to support training positions	\$0.00	n/a	\$20,000.00	\$300,000.00
5. Provide a connection to nature through educational activities that involve the public and K-12 partners.	USDA-FS and DOFAW staff – no additional costs; possible tie in with education/outreach staff costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
6. Communicate research findings, land use, and management goals to the community	DOFAW and USDA-FS staff– no additional costs; possible tie in with education/outreach staff costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
7. Provide work experience/professional development training to land management professionals	DOFAW and USDA-FS Staff – No additional Costs; tie in with EDU/OUTREACH #11; apply for funding to support training positions such as YCC and 21 CSC \$50K+ annually	\$0.00	n/a	\$50,000.00	\$750,000.00
8. Serve as a demonstration site for land managers by providing information, tools and techniques	DOFAW and USDA-FS staff– no additional costs; possible tie in with education/outreach staff costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00



ACTION	DESCRIPTION	Periodic estimated costs		Annual estimated costs	ESTIMATED TOTAL COST (15 years)
		Amount	Time scale		
9. Provide readily accessible scientific information through web-based platforms and tools.	USDA-FS staff– no additional costs; tie in with education/outreach costs see EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
10. Encourage researchers to share research results with the local community	DOFAW and USDA-FS Staff – No additional Costs	\$0.00	n/a	\$0.00	\$0.00
11. Hire staff and/or establish volunteer positions to facilitate educational and outreach experiences	\$75,000/year for contract staff salary/benefits, materials/supplies and volunteer program	\$0.00	n/a	\$75,000.00	\$1,125,000
12. Serve as a site for alternative educational activities for non-profit groups and organizations	Costs included under EDU/OUTREACH #11	\$0.00	n/a	\$0.00	\$0.00
<b>Public Access and Recreation</b>					
1. Improve Public Access	DOFAW and USDA-FS staff – no additional costs; TBD funds to purchase or lease adjacent lands	TBD	TBD	TBD	TBD
2. Trail Maintenance (Pedestrian) - Maintain existing trails (Spencer, Maulua & Peneki)	DOFAW and USDA-FS staff – no additional costs; apply for funding to support training positions such as YCC and 21 CSC – see EDU/OUTREACH #7	\$0.00	n/a	\$5,000.00	\$75,000.00
3. Trail Improvement (Pedestrian) - Improve existing and/or create new trails and maintain	DOFAW and USDA-FS staff – no additional staff costs; apply for funding to support training – see EDU/OUTREACH #7	\$0.00	n/a	\$5,000.00	\$75,000.00
4. Hunting - Maintain and improve public hunting opportunities in Laupāhoehoe Forest	TBD funds to purchase or lease adjacent lands	TBD	TBD	TBD	TBD
5. Camping and Shelters - Establish designated camping area at Shack Camp with primitive camp sites	\$50K/shelter; \$8K camping pavilion; 3 campsites @ \$1500/each; \$2,500/year to maintain shelter(s)/ campsites	\$62,500.00	one time	\$0.00	\$62,500.00
<b>Infrastructure</b>					
1. Develop and maintain roads, cabins/shelters and campsites and helicopter landing zones	USDA-FS staff– no additional costs; materials and labor associated with project completion – see PUBLIC ACCESS/REC #5; \$5,000/year to maintain shelter(s), camping sites and LZ's	\$0.00	n/a	\$5,000.00	\$75,000.00
2. Ensure the development/maintenance of facilities and infrastructure has minimal impacts	DOFAW, USDA-FS, and MKWA staff – no additional costs; apply for funding to support cabins/shelters and campsites; road maintenance costs \$3K/year	\$0.00	n/a	\$3,000.00	\$45,000.00

TOTAL COST OVER 15 YEARS

**\$10,212,500.00**

## REFERENCES

- Ainsworth, A. and J. B. Kauffman. 2010. Interactions of Fire and Nonnative Species Across an Elevation/Plant Community Gradient in Hawaii Volcanoes National Park. *Biotropica* 42(6): 647-655.
- Akashi, Y. and D. Mueller-Dombois. 1995. A landscape perspective of the Hawaiian rain forest dieback. *Journal of Vegetation Science* 6: 449-464.
- Anderson, R. C., et al. 2001. Dieback of *Acacia koa* in Hawaii: ecological and pathological characteristics of affected stands. *Forest Ecology and Management* 5576: 1-14.
- Aplet, G. H., S.J. Anderson and C.P. Stone. 1991. Association between feral pig disturbance and the composition of some alien plant assemblages in Hawai'i Volcanoes National Park. *Vegetation* 95: 55-62.
- Atkinson IAE. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on avifaunas. In: Moors PJ (ed) *Conservation of Island birds*. ICBP Technical Publication, Cambridge, pp 35–81.
- Baker, J. K. 1979. The feral pig in Hawai'i Volcanoes National Park, *Proceedings: First Conference on Scientific research in the National Parks*, pp. 365-367.
- Bruland, G. L., Browning, C. A., & Evensen, C. I. (2010). Effects of feral pigs (*Sus scrofa*) on watershed health in Hawai'i: A literature review and preliminary results on runoff and erosion. In J. Roumassett, K. Burnett, & A. Balisacan (Eds.), *Sustainability science for watershed landscapes* (pp. 251–277). Singapore: Institute of Southeast Asian Studies.
- Cabin, R. J., et al. 2000. Effects of long-term ungulate exclusion and recent alien species control on the preservation and restoration of a Hawaiian tropical dry forest. *Conservation Biology* 14(2): 439-453.
- Carpenter, A., McEldowney, H. and Yent, M. 2006. *Historic Properties Identification and Field Report Upper Laupahoehoe and Humu'ula Sections Hilo Forest Reserve Reforestation Project*. Report prepared for Division of Forestry and Wildlife, Department of Land and Natural Resources.
- Chynoweth, M. W., et al. 2013. Biology and Impacts of Pacific Island Invasive Species. 9. *Capra hircus*, the Feral Goat (Mammalia: Bovidae). *Pacific Science* 67(2): 141-156
- Cole, R. J., et al. 2012. Vegetation Recovery 16 Years after Feral Pig Removal from a Wet Hawaiian Forest. *Biotropica* 44(4): 463-471.
- Cole, F.R., Loope L.L., Medeiros A.C., Howe C.E., and L.J. Anderson. 2000. Food habits of introduced rodents in high-elevation shrubland of Haleakala National Park, Maui, Hawaii. *Pacific Science* 54:313–329.





Cooray, R. G. and D. Mueller-Dombois. 1981. Island Ecosystems: Biological Organization in Selected Hawaiian Communities, Hutchinson Ross Publishing Co., Stroudsburg, PA, pp. 309-317.

County of Hawai'i. 2014 (draft plan under development). Hamakua Community Development Plan. Available at: <http://www.hawaiicountycdp.info/hamakua-cdp>

County of Hawai'i. 2005. General plan. Available at: <http://www.cohplanningdept.com/community-planning/general-plan/>

Cuddihy, L. W., J. A. Davis, and S. J. Anderson. 1982. A Botanical Survey of the Proposed Laupāhoehoe Natural Area Reserve, Hawai'i. Endangered Plant Species Program. Division of Forestry and Wildlife, Department of Land and Natural Resources, Hilo, Hawai'i.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation: effects of humans, their activities and introductions. University of Hawaii Press, Honolulu, Hawaii

D'Antonio, C. M., et al. 2000. Variation in the impact of exotic grasses on native plant composition in relation to fire across an elevation gradient in Hawaii. *Austral Ecology* 25(5): 507-522.

Dunkell, D. O., et al. 2011. Runoff, Sediment Transport, and Effects of Feral Pig (*Sus scrofa*) Exclusion in a Forested Hawaiian Watershed. *Pacific Science* 65(2): 175-194.

Friday, J. B., Scowcroft, P.G., and A. Ares. 2008. Responses of native and invasive plant species to selective logging in an *Acacia koa*-*Metrosideros polymorpha* forest in Hawai'i. *Applied Vegetation Science* 11: 471-482.

Giambelluca, T.W., Nullet, M.A., and Schroeder, T.A. 1986. Hawai'i Rainfall Atlas, Report R76, Hawai'i Division of Water and Land Development, Department of Land and Natural Resources, Honolulu. vi + 267 p.

Giffin, Jon. 1978. Ecology of the feral pig on the island of Hawai'i. *Elepaio* 37 (12): 140-142.

Gillespie, Rosemary G. 1992. Distribution and diversity of an endemic lineage of invertebrate predators in the Natural Area Reserves of Hawai'i. Report to the Natural Area Reserves System.

Hawai'i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife. 1983. (1) Abundance and Distribution of Koloa on Island of Hawai'i. (2) Movements, Survival, Reproductive Success and Habitat of Koloa on the Island of Hawai'i. Project # W-18-R-8. Job # R-III-H. July 1, 1981 to July 31, 1983.

Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1989. Laupāhoehoe Draft Management Plan. Available at: <http://dlnr.hawaii.gov/ecosystems/files/2013/07/Laupahoehoe-Management-Plan.pdf>



Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2003. Management Plan for the Ahupua‘a of Pu‘u Wa‘awa‘a and the Makai Lands of Pu‘u Anahulu.

Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2005. Hawaii’s comprehensive wildlife conservation strategy. Available at: <http://dlnr.hawaii.gov/wildlife/cwcs/hawaii/>

Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2006. Final Environmental Assessment for the Hilo Forest Reserve Reforestation Project. Available at: [http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Hawaii/2000s/2006-10-08-HA-FEA-HILO-FOREST-RESERVE-REFORESTATION.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Hawaii/2000s/2006-10-08-HA-FEA-HILO-FOREST-RESERVE-REFORESTATION.pdf)

Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2007. Technical Report No. 07-01. Review of methods and approach for control of non-native ungulates in Hawai‘i.

Hawai‘i Department of Land and Natural Resources. 2012. The rain follows the forest - a plan to replenish Hawaii’s source of water. Available at: <http://dlnr.hawaii.gov/rain/plan/>

Hawai‘i Tropical Forest Recovery Task Force. 1994. Hawai‘i Tropical Forest Recovery Action Plan. Available at: <http://www.fs.fed.us/psw/ef/hawaii/documents/HITropicalForestRecoveryPlan.pdf>

Iwashita, D. K., et al. 2013. Coarse woody debris carbon storage across a mean annual temperature gradient in tropical montane wet forest. *Forest Ecology and Management* 291: 336-343.

Jacobi , J.D. 1989. Vegetation maps of the upland plant communities on the islands of Hawai‘i, Maui, Molokai, and Lanai. Cooperative National Park Resources Studies Unit Technical Report 68. University of Hawai‘i at Manoa and National Park Service.

Mack, M. C. and C. M. D'Antonio. 1998. Impacts of biological invasions on disturbance regimes. *Tree* 13(5): 195-198.

Maly, K. and O. Maly. 2006. Hilo Palikū - Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe Forest Section, Ahupua‘a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai‘i. Kumu Pono Associates, LLC.

Mueller-Dombois, D. 1980. The ‘ōhia dieback phenomenon in the Hawaiian rain forest. The recovery process in damaged ecosystems. J. Cairns, Jr. Ann Arbor, Ann Arbor Science Publishers Inc.

Nature Conservancy of Hawai‘i and member agencies of the Coordinating Group on Alien Pest Species (CGAPS). 2003. Silent Invasion.



- Nogueira-Filho, S. L., et al. 2009. Ecological impacts of feral pigs in the Hawaiian Islands. *Biodiversity and Conservation* 18(14): 3677-3683.
- Palmer, D. D. 2003. *Hawai'i's ferns and fern allies*. University of Hawai'i Press. Honolulu.
- Parham, J.E., G.R. Higashi, E.K. Lapp, D.K. Kuamo'o, R.T. Nishimoto, S. Hau, J.M. Fitzsimons, D.A. Polhemus, and W.S. Devick. 2008. *Atlas of Hawaiian Watersheds and Their Aquatic Resources, Island of Hawai'i*. Bishop Museum and Division of Aquatic Resources. 1262 p.
- Paton, P. W. C. 1981. The Koloa (Hawaiian Duck) on the Island of Hawai'i. *'Elepaio* 41(12):131-133.
- Price, J. S. M. Gon III, J. D. Jacobi, and D. Matsuwaki, 2007 Mapping Plant Species Ranges in the Hawaiian Islands: Developing a Methodology and Associated GIS layers. Hawai'i Cooperative Studies Unit Technical Report HCSU-008. University of Hawai'i at Hilo. 58 pp., incl. 16 Figures and 6 Tables.
- Pukui, Mary Kawena and Samuel H. Elbert. 1986. *Hawaiian Dictionary*. University of Hawai'i Press: Honolulu.
- Sasaki, D.M., L. Pang, H.P Minette, C.K Wakida, W.J. Fujimoto, S.J. Manea, R. Kunioka, C.R. Middleton. 1993. Active surveillance and risk factors for Leptospirosis in Hawai'i. *The American Journal of Tropical Medicine and Hygenics*. January 1993, 48(1):35-43.
- Scott, M.J., S. Mountainspring, F.L Ramsey, and C.B. Kepler. 1986. *Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation*. Studies in Avian Biology No. 9, Cooper Ornithological Society. Allen Press, Lawrence, Kansas.
- Scowcroft, P. G. and J. G. Giffin. 1983. Feral herbivores suppress mamane and other browse species on Mauna Kea, Hawaii. *Journal of Range Management*: 638-645.
- Scowcroft, P.G. and R.E. Nelson. 1976. Disturbance during logging stimulated regeneration of koa. USDA-FS Pacific Southwest Forest and Range Experiment Station. Research Note PSW-306.
- Shiels A.B. and D.R. Drake. 2011. Are introduced rats (*Rattus rattus*) both seed predators and dispersers in Hawaii? *Biological Invasions* 13:883–894
- Sherrod, David R., Sinton, John M., Watkins, Sarah E., and Brunt, Kelly M., 2007, Geologic map of the State of Hawai'i: U.S. Geological Survey Open-File Report 2007-1089. Available at: <http://pubs.usgs.gov/of/2007/1089/>
- Smith, C.W. and T. J. Tunison. 1992. Fire and alien plants in Hawaii: research and management implications for native ecosystems. *Alien plant invasions in native ecosystems of Hawaii: management and research*. Stone, C. P., C. W. Smith, and J. T. Tunison (eds.). Honolulu, Cooperative National Park Resources Studies Unit: 394–408



State of Hawai‘i. 2013. Office of Planning. State GIS database.

Stewart, Carolyn. 2010. Draft Mauna Kea Watershed Management Plan. Plan prepared for the Mauna Kea Watershed Alliance.

Stone, C.P. 1985. Feral ungulates in Hawai‘i: Toward controlling the adverse effects of introduced vertebrates. In Stone, C.P. and J.M. Scott (eds.). *Hawaii’s Terrestrial Ecosystems: Preservation and Management*.

Stone, C.P., Cuddihy, L.W., and J.T. Tunison. 1992. Responses of Hawaiian ecosystems to the removal of feral pigs and goats. Pp. 666-704 in C.P. Stone, C.W. Smith, and J.T. Tunison (eds.). *Alien Plant Invasions in Native Ecosystems of Hawai‘i: Management and Research*. University of Hawai‘i Cooperative National Park Resources Studies Unit, University of Hawai‘i Press, Honolulu.

Thaxton, J. M., et al. 2010. Native Species Regeneration Following Ungulate Exclusion and Nonnative Grass Removal in a Remnant Hawaiian Dry Forest. *Pacific Science* 64(4): 533-544.

Tomich, P.Q. 1986. *Mammals in Hawai‘i*. Second edition. Bishop Museum Press. Honolulu, HI. 375 pp.

Trujillo, E.E., Kadooka, C., Tanimoto, V., Bergfeld, S., Shishido, G. and Kawakami, G. 2001. Effective biomass reduction of the invasive weed species banana poka by *Septoria* leaf spot. *Plant Disease* 85: 357-361.

Tunison, J.T. and C.P. Stone. 1992. Special ecological areas: an approach to alien plant control in Hawai‘i Volcanoes National Park. Pp. 781-798 In C.P. Stone, C.W. Smith, and J.T. Tunison (eds.). *Alien Plant Invasions in Native Ecosystems of Hawai‘i: Management and Research*. University of Hawai‘i Cooperative National Park Resources Studies Unit, University of Hawai‘i Press, Honolulu.

United States Department of Agriculture Forest Service (USFS). 2007. Establishment Record for the Hawai‘i Experimental Tropical Forest within Hawai‘i County, Hawai‘i  
Available at: <http://www.fs.fed.us/psw/ef/hawaii/documents/HETFEstablishmentRecord.pdf>

USFS. 2011. Final Environmental Assessment HETF Laupāhoehoe Construction Project.  
Available at: [http://www.hetf.us/page/projects\\_plans/pdf/HETF\\_Final\\_EA%20\\_08312011.pdf](http://www.hetf.us/page/projects_plans/pdf/HETF_Final_EA%20_08312011.pdf)

United States Department of the Interior Geological Survey (USGS). 2005. Biocomplexity of introduced avian diseases in Hawai‘i: Threats to biodiversity of native forest ecosystems. Prepared by B.L. Woodworth, C. T. Atkinson, M. D. Samuel, D. A. LaPointe, P. C. Banko, and J. A. Ahumada. USGS Fact Sheet 2005-3139.  
Available at: <http://biology.usgs.gov/pierc/Biocomplexity/Biocomplexity.pdf>.





USGS. 2006a. Feral cats: Too long a threat to Hawaiian wildlife. Prepared by S.C. Hess and P.C. Banko. USGS Fact Sheet 2006-3006. Available at: [http://biology.usgs.gov/pierc/Fact\\_Sheets/Feral\\_cats.pdf](http://biology.usgs.gov/pierc/Fact_Sheets/Feral_cats.pdf).

USGS. 2006b. Hawai'i forest bird interagency database project: Collecting, understanding, and sharing population data on Hawaiian forest birds. Prepared by T.K. Pratt, B.L. Woodworth, R.J. Camp, P.M. Gorresen. USGS Fact Sheet 2006-3013. Available at: [http://biology.usgs.gov/pierc/Native\\_Birds/Forest\\_birds.pdf](http://biology.usgs.gov/pierc/Native_Birds/Forest_birds.pdf).

USGS. 2006c. Feral pigs, introduced mosquitoes, and the decline of Hawai'i's native birds. Prepared by D.A. LaPointe. USGS Fact Sheet 2006-3029. Available at: [http://biology.usgs.gov/pierc/Fact\\_Sheets/Pigs\\_and\\_mosquitoes.pdf](http://biology.usgs.gov/pierc/Fact_Sheets/Pigs_and_mosquitoes.pdf).

U.S. Fish and Wildlife Service (USFWS). 1978. Hawaiian Waterbirds Recovery Plan. USFWS, Portland, Oregon.

USFWS. 1984. Hawaiian Hawk Recovery Plan. Prepared under contract with C. R. Griffin. USFWS, Portland, Oregon.

USFWS. 1996. Big Island Plant Cluster Recovery Plan. USFWS, Portland, OR. 202+ pp. Available at: [http://ecos.fws.gov/docs/recovery\\_plans/1996/960926a.pdf](http://ecos.fws.gov/docs/recovery_plans/1996/960926a.pdf).

USFWS. 1998a. Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster. USFWS, Portland, OR. 115 pp. Available at: [http://ecos.fws.gov/docs/recovery\\_plans/1998/980511a.pdf](http://ecos.fws.gov/docs/recovery_plans/1998/980511a.pdf).

USFWS. 1998b. Recovery Plan for the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). USFWS, Portland, OR. 59 pp. Available at: [http://ecos.fws.gov/docs/recovery\\_plans/1998/980511b.pdf](http://ecos.fws.gov/docs/recovery_plans/1998/980511b.pdf).

USFWS. 2003. Final designation and nondesignation of critical habitat for 46 plant species from the island of Hawai'i, HI. Federal Register Final Rule (68 FR 39623 39672). Available at: [http://ecos.fws.gov/docs/federal\\_register/fr4117.pdf](http://ecos.fws.gov/docs/federal_register/fr4117.pdf)

USFWS. 2006. Revised Recovery Plan for Hawaiian Forest Birds. Region 1, Portland, OR. 622 pp. Available at: [http://ecos.fws.gov/docs/recovery\\_plan/060922a.pdf](http://ecos.fws.gov/docs/recovery_plan/060922a.pdf)

Wagner, W. L., Herbst, D. R., and Sohmer, S.H. 1999. Manual of the flowering plants of Hawai'i. University of Hawai'i Press, Bishop Museum, Honolulu.

Warner, Richard E., 1956 – 1969. Ecological investigation on the Hawaiian pig (1959); Ecology of the Wild Pig (1963, 1963); and Feral Game Mammal Survey (1969). State of Hawai'i, Division of Fish and Game, Project # W-r-R10; Project # W-5-R13; Project # W-5-R14; and Project # W-5-R-20.



## Appendix A – Other Available Resources

The following resources related to Laupāhoehoe Forest are available on-line at:

<http://dlnr.hawaii.gov/ecosystems/nars/reserves/hawaii-island/laupahoehoe/>

- 1) *Hilo Palikū - Hilo of the Upright Cliffs: A Study of Cultural-Historical Resources of Lands in the Laupāhoehoe Forest Section, Ahupua‘a of the Waipunalei-Mauluanui Region, North Hilo District, Island of Hawai‘i* (Maly and Maly 2006)
- 2) Laupāhoehoe Plant Species List



## Appendix B – Biosecurity Protocols



# HETF BIOSECURITY



### What is Biosecurity and why is it important?

Biosecurity is a set of precautions that aim to prevent the introduction and spread of harmful organisms. These may be pests, pathogens or invasive species. Biosecurity measures are the practical steps designed to minimize the risk of introducing or spreading pests and diseases. Control of invasive plants and animals is a high priority for all resource managers in Hawai'i. A large amount of personnel time and resources are expended each year to battle invasive species. Biosecurity is important because invasive species have significant negative impacts to resources - including native species, ecosystem function (e.g. nutrient cycling), ecosystem services (e.g. ground-water recharge, prevention of erosion, reef sedimentation, etc.), ecosystem structure (distribution and abundance of species), etc. New plants and animals arrive in the islands on a continual basis and natural resource managers must focus on preventing their spread into natural areas. Visitors, volunteers, contractors, researchers and staff are potential vectors of invasive species. The origin of these pests can be the mainland, another island in the Hawaiian archipelago or even a weedy or urban area of the same island.

Described below are likely routes of invasive species introduction and procedures that should be followed to minimize or eliminate introduction and spread of invasive plants and animals in the Hawai'i Experimental Tropical Forest.

### Required HETF Biosecurity Measures:

**1. Inspect field gear and equipment BEFORE going into the field.** Three categories of pests that merit attention are weeds/seeds, insects (especially ants and cockroaches), and slugs. Clods of dirt or mud can hide these hitchhikers. If materials have been in storage, be aware that arthropods can lay eggs within equipment. It is necessary to inspect and clean all: footwear (treads, laces, boot tongues); socks; pant legs; pockets, jackets, raingear (pockets and cuffs); food-stuffs; tools; packs (folds, pockets, Velcro); tents; hammocks; tarps; helicopter sling nets; wood and building materials; fencing materials; bottoms of plastic buckets; tool bags; and other containers or equipment.

Soil, cinder and potted plants are also major invasive species transporters. Ensure soil and cinder are sterile and free of insects. Potted plants should be visibly weed-free, pest-free, and pathogen-free, anything suspicious should not be taken into the field.

Preferably a different set of field gear should be used for each field site. If this is not possible, gear should be thoroughly cleaned before going into the field. All gear (personal or field) must be free of any plant, animal, or earthen materials. Appropriate methods for cleaning include: water and hose, brush, clean rag, knife edge, bleach rinse and/or insecticide. Cleaning should be done away from the forest in a designated area with a nearby receptacle for disposal. Laundering of washable items should be done after each trip. This is particularly important when you have come from working on different islands or different parts of the island, as each area may have its own assemblage of pests that must be prevented from spreading to new locations. If items cannot be cleaned, they should not be taken into the forest.

**2. Prepare a checklist of items to be inspected before any extended field operations or camping trips.** Note all materials that will accompany staff during these operations. On prep day, an assigned person should inspect those supplies, concentrating on those most susceptible in aiding accidental introductions. Items having the potential for carrying unwanted species: helicopter sling nets, wood, building materials, fencing material, plastic buckets, cardboard boxes (roaches and ants!), open food and water containers, tool bags, backpacks, raingear and tents. Methods for cleaning articles range from using brushes, tweezers, bleached rags, or insecticides. Have these items on hand. If contaminated supplies are found, they must be disposed of away from the HETF.

**3. Avoid carrying weed seeds from an infested part of the forest to the pristine areas.** If routes of transit go through invasive weed belts, be conscious of the potential for spread. A safeguard could be having a brush on hand to clean shoe soles at the boundary of such a site. This is especially a concern when performing priority weed work where there is a large seed bank. When working in a different area, be very careful to avoid spreading pests by inspecting and cleaning gear before and after each excursion into the field. It is important to use completely different gear on each island or area.

**4. Keep field vehicles clean.** Clean field gear can easily be compromised by using a dirty truck. The inside of field vehicles should be vacuumed and pickup truck beds swept out regularly, especially if used off-road. When cleaning vehicles it is important to pay particular attention to the inside lip of bidders, seats, floors, dashboards, door jambs, tires (especially treads) and the undercarriage. All mud should be hosed off to avoid transporting weed seeds.

*Continued on next page*



L-R: Faya (*Morella faya*), Miconia (*Miconia calvescens*), Smoke bush (*Buddleja madagascariensis*), Cotoneaster (*Cotoneaster pannosus*) and Pampas grass (*Cortaderia jubata*). ALL are invasive.  
Photo credits: Forest and Kim Starr





5. **Pack out your trash and unused foodstuffs.** Something as harmless as an apple core or banana peel could result in dire consequences out in the field. Discarded foods can become food for invasive insects, like ants; seeded fruits (apples, pear, avocado, peach, etc.) could germinate, as certain seeds have a strong potential to naturalize. Many foods carry unseen insects, fungus, bacteria and parasites that could affect native flora and fauna, Hawai'i has many closely related species that could be negatively affected by leaving behind foodstuffs.

6. **Become acquainted with invasive species in Hawai'i** and their varying status regarding particular localities. Learn which of these species is localized to your area and which to be on the alert for that are established in other areas. Take inventory of weeds that occur along trails and byways, and pay attention to any unusual changes or additions to these. There is plenty of literature on the identification of weedy plants that will provide current status throughout the various islands. Start with [www.hear.org](http://www.hear.org).

7. **Educate visitors to these protocols.** This includes other researchers, visitors, or volunteer groups. A very high probability exists that much of these visitors' gear (primarily packs and footwear) has been to other areas in Hawai'i that have infestations of alien species, and they could act as dispersal agents. People who share our appreciation of Hawai'i's native forests will not be insulted by these procedures if related firmly yet politely, but rather will be impressed with their conscientious implementation.

## New Invasive Species Detection

Sightings of new invasive species within the HETF or existing high risk species seen in previously un-infested areas should be reported to the:

**Hawai'i Experimental Tropical Forest**  
**(808) 443-5931**  
**[hawaii\\_experimental\\_tropical\\_forest@fs.fed.us](mailto:hawaii_experimental_tropical_forest@fs.fed.us)**

Please provide the following information in your report: 1) Your name and contact information, 2) date you observed the species, 3) species name and/or detailed description, 4) approximate location (latitude/longitude, UTM, or other approximate estimation) of the organism, and 5) a rough estimate of the overall size of the area infested (if stationary).

There are additional invasive species of serious concern to land managers that are present in adjoining areas but have not yet been detected in HETF Units. It is a high priority to prevent the establishment of these species, which include but are not limited to:



Fire Thorn (*Pyracantha angustifolia*)

### Iaupāhoehoe

- Miconia (*Miconia calvescens*)
- Faya (*Morella faya*)
- Gorse (*Ulex europaeus*)
- Firethorn (*Pyracantha angustifolia*)
- Cotoneaster (*Cotoneaster pannosus*)
- New Zealand flax (*Phormium tenax*)
- Indonesian cinnamon (*Cinnamomum burmanii*)
- Red Robin (*Photinia davidiana*)
- Ants (especially Little Red Fire Ants)

### Pu'u Wa'awa'a

- Cotoneaster (*Cotoneaster pannosus*)
- Pampas Grass (*Cortaderia jubata* and *selloana*)
- Pereskia (*Pereskia aculeata*)
- Rubbervine (*Cryptostegia madagascariensis*)
- Smokebush (*Buddleja madagascariensis*)
- Wax Myrtle (*Morella cerifera*)
- Barbados Gooseberry (*Pereskia aculeata*)
- Jerusalem Thorn (*Parkinsonia aculeata*)
- Axis Deer (*Axis axis*)
- Ants (especially Little Red Fire Ants)

## KNOWN AND POTENTIAL RISKS

FOR INFORMATION ON CURRENT PEST SPECIES THAT SHOULD BE REPORTED IF SEEN VISIT:

<http://www.reportapest.org/pestlist.htm>



L-R: Gorse (*Ulex europaeus*), Pereskia (*Pereskia aculeata*), Axis Deer (*Axis axis*), Rubbervine (*Cryptostegia madagascariensis*) and Jerusalem Thorn (*Parkinsonia aculeata*). ALL are invasive. Plant photo credits: Forest and Kim Starr. Axis deer photo credit: [daemonsandanalyses.tumblr.com](https://www.tumblr.com/daemonsandanalyses)

Other invasive species may be added to the priority invasive species list if monitoring shows their range and abundance increasing in native ecosystems targeted for management.





## Appendix C - List of Research Projects to Date

Studies are grouped by total project years (one, two, or 3 and greater), then by project start date, and last name.

Project Description	Name	Affiliation	Project Start Date	Project End Date	Total Years of Project
Comparative nutritive values of traditional and exotic foraging substrates for upper elevation forest birds.	Kapono, M.	UH-Hilo	2007	2008	1
An assessment of tropical ecosystem dynamics in response to climate variability using long-term satellite data records.	Park, S.	UH-Hilo	2007	2008	1
Sprouting vs. seeding in Hawaiian wet, mesic, and dry forests.	Busby, P.	Stanford University	2008	2009	1
Objective quantification of plumage coloration of a Hawaiian honeycreeper ( <i>Hemignathus virens</i> ) along environmental gradations of biogeography: does variation exist between sub-populations?	Gaudioso, J.	UH-Hilo; USGS-PIERC	2008	2008	1
Study of the molecular evolution of arthropods - phylogenetic study.	O'Grady, P.	UC-Berkeley	2008	2009	1
Study of alien snails, survey of native snails	Yeung, N	UH-Manoa	2008	2009	1
Examining the impacts of strawberry guava on Native biodiversity in Hawaiian forest	Giardina, C.	USDA Forest Service	2009	2010	1
Remote sensing across multiple spatial scales for use with calibration of satellite sensors.	Goodenough, D.G.	Canadian Forest Service Natural Resources	2009	2010	1
Soil Survey		USDA-NRCS	2009	2010	1
DNA sequencing of endemic Hawaiian Drosophila.	Price, D.	UH-Hilo	2012	2013	1
Climatic influences on Lycopsid and fern leaf physiognomy	Benca, J.	UC-Berkeley	2013	2014	1
Community assembly & diversification of Hawaiian Arthropods	Gillespie, R.	UC-Berkeley	2013	2014	1
Experimental cultivation of simple rare ferns in common garden conditions.	Husby, C.	Montgomery Botanical Center	2013	2014	1
Epiphytes as an indicator of climate change in Hawaii	Kettwich, S.	UH-Hilo	2013	2014	1
Assessment of mosquito-borne avian disease risk in non-breeding habitat for foraging iiwi adjacent to Hakalau Forest NWR	LaPointe, D.	USGS-PIERC	2013	2014	1
Assessing the <i>Scotorythra paludicola</i> outbreak on koa: population abundance, rates of parasitism and patterns of spread	Peck, R.	UH-Hilo	2013	2014	1
UH Hilo Geography and Environmental Studies Senior Seminar	Price, J.	UH-Hilo	2013	2014	1



Project Description	Name	Affiliation	Project Start Date	Project End Date	Total Years of Project
An assessment of Hawaiian tropical ecosystem dynamics in response to climate variability using long-term satellite data records.	Miura, T.	UH-Manoa	2007	2009	2
Passive study of vocalizations of Hawaiian hoary bat for evaluation of conservation status.	Bonaccorso, F.	USGS-PIERC	2008	2010	2
Developing a DNA barcoding method to be used as a system of species identification	Magnacca, K.	UH-Hilo	2009	2011	2
Do expected evolutionary trade-offs in enzyme activities manifest at the level of microbial community function?	Bradford, M	Yale University	2010	2012	2
Inventory of Hawaii's Forests	Hughes, F.	USDA-USFS	2011	2013	2
Understanding the genetic variation in <i>Acacia koa</i> across environmental gradients	Michler, C.	USDA-USFS; Purdue University	2012	2014	2
Quantifying the effects of ungulate and vegetation on the hydrology of Hawaiian tropical forests	MacKenzie, R.	USDA-USFS	2012	2014	2
Long-term monitoring of forest and climate inventory	Cordell, S.	USDA-USFS	2007	ongoing	3+
Forest architecture, Carbon dynamics, and climate change interactions: linking field and remote sensing along temporal and spatial gradients.	Broadbent, E.	Stanford University; Carnegie Institute of Washington	2008	2012	3+
Investigating productivity of koa forests on different substrates and climate zones. Long-term plots.	Friday, J.B.	UH-Manoa-CTAHR	2008	2012	3+
Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics.	Vitousek, P.	Stanford University	2008	ongoing	3+
Assessing Forest Structure, community composition, diversity, carbon mass, and biomass on a landscape scale in the HETF	Hughes, F.	USDA-USFS	2009	2015	3+
Experimental Test of the impacts of rising temp on C input, allocation, and loss in model forests.	Litton, C.	UH-Manoa	2009	ongoing	3+
Hawaiian Hoary Bat habitat occupancy, reproduction and diet	Bonaccorso, F.	USGS-PIERC	2010	2014	3+
Adaptive Radiation in Hawaiian Spiders	Gillespie, R.	UC-Berkeley	2011	2014	3+
Forest Disease Monitoring for Rust Disease affecting Ohia Lehua	Yeh, A.	Contractor for DLNR/DOFAW Forest Health	2011	ongoing	3+
Impacts of strawberry guava management across a density gradient	Johnson, T.	USDA-USFS	2013	2028	3+



